Horizon 2020 Societal challenge 5
Climate action, environment, resource
Efficiency and raw materials

SIM4NEXUS
D2.2
Nexus-relevant policies in the transboundary, national and regional case studies
Background Report

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INTERNAL REVIEWER	All case study partners arranged this for their own background report.

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VERSION	INITIALS/NAME	DATE	COMMENTS-DESCRIPTION OF ACTIONS
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Acronyms

Table 1 Acronyms used in the report

Acronym	Description
AZ	Azerbaijan
GR	Greece
LV	Latvia
NL	Netherlands
SE	Sweden
AND	Andalusia
SAR	Sardinia
SWE	South-West England
DE-CZ-SK	Transboundary Germany-Czech Republic-Slovakia
DE-FR	Transboundary Germany-France (Upper Rhine basin)
AD	Anaerobic digestion
AIEA	Latvian Auctioning Instrument of Emission Allowances
APREAN	Andalusian Association of Promoters and Producers of Renewable Energy
CAP	European Common Agricultural Policy
CITE	*Crédit d'impôt transition énergétique,* the energy transition tax credit
COAG	Andalusian Agricultural Professional Organisations
CSO	Community Supported Organizations
DWI	English Independent Water Inspectorate
ECN	Energy Research Centre of The Netherlands
EEOS	Latvian Energy Efficiency Obligation Schemes
EFAs	Ecological Focus Areas
ENAS	Sardinian regional water authority
FENACORE	Andalusian irrigation water users associations at national level
FERAGUA	Andalusian irrigation water users associations at regional level

GAEC	Good Agricultural and Environmental Conditions
GHGs	Green-house gases
IFAPA	Andalusian Institute of Agricultural and Fisheries Research and Training
NPFA	Non-Productive Functions of Agriculture
NGOs	Non-Governmental Organisations
LEMs	Localised energy networks
PBL	Netherlands Environmental Assessment Agency
RWS	Dutch national water and infrastructure agency Rijkswaterstaat
RES	Renewable energy sources
RHI	The UK Renewable Heat Incentive
RQs	Research questions
SDGs	Sustainable Development Goals
SME	Small Medium Enterprise
SRCE	Regional Schemes for Ecological Coherence
STOWA	Research office of Dutch Union of Water Authorities
SWW	South West Water in South-west England
UvW	Dutch Union of Water Authorities
UNFCCC	United Nation Framework Convention on Climate Change
WLEFC nexus	Water-Land-Energy-Food and Agriculture-Climate nexus
WUR	Wageningen University

1 Introduction

This background report to 'SIM4NEXUS D2.2 Nexus-relevant policies in the transboundary, national and regional case studies' (Munaretto et al., 2018) provides the policy assessments conducted in all the transboundary, national and regional case studies of the SIM4NEXUS project. In accordance with the grant agreement, the background reports of the cases provide:

1) an overview of nexus-relevant policies relevant to the case study);
2) an analysis of how global and European policy goals and targets are translated to lower governance levels and how policies are implemented);
3) an analysis of synergies, conflicts and related trade-offs between policies in the implementation phase;
4) an overview of solutions found to address trade-offs and exploit synergies from an institutional and governance perspective.

A common guidance for the policy analyses of the case studies was developed. Each case study used the same analytical framework and report template (Munaretto & Witmer, 2017b). The case study analysis was tied to that conducted at global and European scale, reported in Munaretto & Witmer (2017a). The case study analysis consisted of:

- mapping of relevant policy areas related to the WLEFC nexus, depending on the main research questions of the case;
- mapping of stakeholders and of power and interest structures;
- mapping of policies in the relevant policy areas;
- mapping of policy goals and instruments in the relevant policy areas;
- assessment of coherence between objectives of different nexus sectors and relevant instruments (horizontal coherence);
- assessment of coherence between policies at different scales (vertical coherence), except Sardinia and Slovakia;
- assessment of formal and informal arrangements and practices in place for coordination, addressing trade-offs and exploiting synergies between policies of different sectors, except Slovakia;

The case study reports are listed in Table 2 . The interested reader can find the detailed policy analyses in the case study reports in Chapter 2.

The policy analysis in the case studies was conducted by the case study partners, who are responsible for the content of their reports. The case study reports constituted the background information for the syntheses and analyses presented in the Main report (Munaretto et al., 2018).

Table 2 Overview Case study reports

Case study	SIM4NEXUS partner	Authors	Reviewed
Azerbaijan (AZ)	KTH, Baku State University (external consultant)	Anar Nuriyev, Georgios Avgerinopoulos	yes
Greece (GR)	University of Athens University of Thessaly	Chrysaida-Aliki Papadopoulou, Maria P. Papadopoulou, Chrysi Laspidou	yes
Latvia (LV)	BEF	Daina Indriksone, Ingrida Bremere	yes
Netherlands (NL)	WUR, PBL	Trond Selnes, Vincent Linderhof, Roos Marinissen	yes
Sweden (SE)	UU	Claudia Teutschbein, Malgorzata Blicharska	yes
Andalusia (AND)	UPM	Bente Castro, Pilar Martinez, Maria Blanco, Javier Castaño	yes
Sardinia (SAR)	UNISS	Simone Mereu, Fabio Madau, Daniele Pulino, Vania Statzu, Gavril Kyriakakys, Elisabetta Strazzera, Loudes Morillas, José Costa-Saura, Antonio Trabucco	Only block1
South-West England (SWE)	SWW	Julie Smith, Nicola Hole, Carolyn Petersen, Matthew Griffey, Catherine Mitchell, Ben Ward, Lottie McKnight	yes
Transboundary DE-CZ-SK	PIK ENKI P&W	**Czech part:** Petra Hesslerová, Jan Pokorný, Lenka Kröpfelová, Marek Baxa **German part:** Chris Hodel, Tobias Conradt **Slovak part:** Michal Kravčík, Martin Kováč, Michal Gažovič, Jaroslav Karahuta	CZ yes DE only block1 SK only block1
Transboundary DE-FR	ACT	Pierre Strosser, Alexandra Rossi, Anaïs Hanus, Camille Chanard, Camille Parrod, Gitta Köllner, Maïté Fournier, Maya Taselaar, Ornella Puschiasis, Thomas Désaunay, Verena Mattheiß	Yes

2 References

Munaretto, S., & Witmer, M.C.H. (2017a). *D2.1 Water-Land-Energy-Food-Climate Nexus: Policies and Policy Coherence at European and International Scale*. The Hague: SIM4NEXUS; PBL.

Munaretto, S., & Witmer, M.C.H. (2017b). *SIM4NEXUS Deliverable Template*. The Hague: SIM4NEXUS; PBL.

Munaretto, S., Negacz K., Witmer M.C.H. (2018). SIM4NEXUS D2.2. Nexus-relevant policies in the transboundary, national and regional case studies. Main report.

3 Case study reports

- Azerbaijan (AZ)
- Greece (GR)
- Latvia (LV)
- Netherlands (NL)
- Sweden (SE)
- Andalusia (AND)
- Sardinia (SAR)
- South-West England (SWE)
- Transboundary DE-CZ-SK
- Transboundary DE-FR

Azerbaijan case study
Policy analysis

AUTHORS: Anar Nuriyev, Georgios Avgerinopoulos

28 – May –2018

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Executive summary

The objective of this report is the mapping of the nexus-related policy space in Azerbaijan. The report focuses on policy priorities, goals and means concerning the nexus components: water, energy, agriculture and food, forestry and climate. A number of policy papers were collected (policy inventory stage) concerning water, energy, agriculture and food, forestry and climate in order to explore the socio-economic framework within which the respective policies are designed and implemented. Socio-economic indicators, graphs and statistical data are used as supporting material. Of exceptional importance is the involvement of several public and private organizations (stakeholders), representatives of the nexus-related sectors. Stakeholders enriched this study with their knowledge, existing experience and expertise on the policy issues investigated. We also explored their influence / power on decision making, their interests on the nexus-related policies and their formal and informal role during the policy design process. Finally, the content of the respective nexus-related policy papers was analyzed and the policy objectives and means for each nexus component are presented in this report.

1 Introduction

Problem definition

Transition to a low carbon economy can be a significantly challenging task. Besides economic aspects, social engagement, political actions and physical resource management need to be considered, leading to intricacies and trade-offs. The unique characteristics of the Azeri case study such as geography, history, geopolitics need to be taken into account as well. Azerbaijan is by definition a transition economy[1] which aspires to open up to a more market oriented pattern. Following the collapse of the Soviet Union in the early 1990s, the country started focusing on the hydrocarbon industry (oil and natural gas) which led to massive economic growth from 2005 onwards[2]. Although fuel exports constitute the cornerstone of Azerbaijan's economy accounting for more than 90% of its exports[3], agriculture is the largest single employer providing jobs to 36.8% of the active population as of 2014[4].

The Republic of Azerbaijan (Azerbaijan) is located in the southern Caucasus region bordered by the Russian Federation and Iran to the North, Iran to the South, the Caspian Sea to the East and Georgia to the West. Although Azerbaijan is technically an Asian country, its relations with the European Union have been gaining momentum. The EU is the major trade partner of Azerbaijan while the latter is also part of several EU initiatives namely the European Neighborhood Policy (ENP), Eastern Partnership and the Council of Europe[5]. The cooperation between the two parties spans from trade to energy security. Consequently, Azerbaijan is linked to Europe in various aspects and therefore, analyzing certain aspects of the country in conjunction with drivers stemming from EU decisions should be pursued.

Research question

This case study aims at answering the following research question: "What is the optimal way for Azerbaijan's transition to a low carbon economy while minimizing the stresses on the energy, water, climate, land use and food sector?". To answer that question each of the aforementioned sectors will be analyzed, interlinkages will be identified, and solutions will be proposed. This will be carried out following the guidelines and implementing the framework developed under the scope of the SIM4NEXUS project[6]. The current report aims at shedding light on the main policies governing each of the above (as well as other relevant) sectors and mapping out the main stakeholders involved.

Nexus and other relevant sectors

Below follows a list of the sectors which will be analyzed in this study. This list is tentative as it is possible that other sectors will be deemed important after delving deeper in the study and interacting with stakeholders. It is also worth noting that the main nexus challenges from a physical point of view will be part of the analysis in SIM4NEXUS Deliverable "D5.2 Nexus challenges in case-studies".

- Energy: spanning from resources to final consumption of all energy forms in every sub-sector
- Water: covering both natural resources and human made infrastructure
- Agriculture: this also includes livestock
- Forestry: with a strong focus on reforestation
- Climate: mainly from a climate change perspective

[1] http://www.economicsonline.co.uk/Competitive_markets/Transition_economies.html
[2] https://tradingeconomics.com/azerbaijan/gdp
[3] http://stat.wto.org/CountryProfile/WSDBCountryPFView.aspx?Language=E&Country=AZ
[4] http://data.un.org/CountryProfile.aspx?crName=azerbaijan
[5] https://eeas.europa.eu/headquarters/headquarters-homepage/4013/eu-azerbaijan-relations_en
[6] https://www.sim4nexus.eu/

- Environment: focusing on minimizing pollution

2 Mapping of the policy sectors

2.1. Water

The main actors involved in water resources management in the Republic of Azerbaijan include:

- Ministry of Ecology and Natural Resources (MENR)
- Ministry of Emergency Situations (MES),
- Ministry of Health (MH)
- "Azersu" Joint Stock Company (Azersu JSC)
- "Amelioration & Water Management" JSC (AWM JSC)
- Water Users Associations (WUA)
- State Company for Alternative and Renewable Energy Sources (SCARES)
- Tariff Board (TB)

The Ministry of Ecology and Natural Resources (MENR) is the key state agency responsible for formulating and implementing the environmental policy; developing environmental protection measures; screening of development activities for potential adverse environmental impact; monitoring of the quality of air, soil, precipitation, surface and groundwater, biodiversity, forests, radioactivity; monitoring the implementation of environmental legislation and imposing sanctions; and administering a pollution permit system. The MENR provides forecasts of natural and human-induced environmental processes, including climate change.

The MENR is the designated national authority for participation in the Clean Development Mechanism (CDM). The MENR manages a database on the state of the environment.

The MENR executes the state water policy, aimed at the conservation and sustainable use of water resources – surface water and groundwater, and the prevention of their pollution. The MENR carries out water resources inventories, and manages the monitoring stations network for hydrometric, hydro-geological and hydro-chemical observations.

The MENR prepares water balances, evaluates groundwater resources and yields, and deals with issues on rational use and the regeneration of water resources. It establishes and approves standards of maximum allowable discharges of wastewater and controls them through regional offices.

The MENR includes several water-related departments and services:

The Ecology and Nature Protection Policy Division (MENR-ENPPD) defines the main directions of the policy on conservation and protection of water resources from pollution. It coordinates the monitoring and implementation of environmental legal acts, and enforces compliance of planned activities affecting water resources with existing legislation.

The Environmental Protection Department (MENR-EPD) of the MENR is responsible for verifying compliance of wastewater discharges and law enforcement - fines and claims. MENR-EPD takes water samples downstream and upstream of wastewater discharges as part of compliance verification procedures.

The National Environmental Monitoring Department (MENR-NEMD) of the MENR ensures the monitoring of surface water quality, currently using 44 monitoring stations - 27 in rivers, 4 in reservoirs (Aghstafa, Jeyranbatan, Mingechevir and, Shamkir), and 11 in lakes (7 lakes on Absheron peninsula: Beyuk-shor, Lake Krasnoe, Yasamal-1, Masazyr, Kurdekhany, Byulbyulya, Khodzhakhassan; and 4 lakes in other regions) and 1 in the port of Baku. The total number of parameters included in the programs for monitoring inland surface water quality by different organizations is: MENR-NEMD - 48; the Center of Hygiene and Epidemiology (MH-SHE) - 41 (including 7 microbiological parameters); and MENR-EPD - 38.

The National Geological Exploration Service (MENR-NGES) is responsible for groundwater monitoring, as well as the regulation and control of groundwater abstraction, including reviewing of Water Use Permit requests for groundwater. Quality standards for groundwater are currently not in place. The MENR-NGES) maintains a groundwater cadaster with groundwater quality information from over 2,500 boreholes in the country.

The Department of National Hydrometeorology (MENR-DNH) is responsible for monitoring surface water reserves and flows, and executes also groundwater quantity monitoring. It is also the focal point for climate change, including the Communications to the UNFCCC, and other climate change-related international obligations, including greenhouse gases inventory. There are 11 regional subdivisions of the MENR-DHM, responsible for 106 stations executing hydrological observations.

The Caspian Complex Ecological Monitoring Administration (MENR-CCEMA) is responsible for monitoring the environmental status of the Caspian Sea and for monitoring the implementation of the 2007 Presidential Decree No. 224: On Certain Measures for Protection of the Caspian Sea from Pollution.

The Department for Reproduction and Protection of Bio-resources in Water Reservoirs (MENR-DRPBWR) is responsible for scientific research, monitoring, control and surveillance of the fisheries in the Caspian Sea, and improving reproduction in several fish species.

The State Expertise Administration (MENR-SEA) issues permits for waste water discharges, including payment of environmental fees, in accordance with the Law on Environmental Protection (1999). Permissible volumes of wastewater discharged into water resources or their watersheds, description of outflows, as well as permissible limits of discharges of hazardous substances in wastewater are included in wastewater discharge permits. Fees rate vary from region to region depending on cost of services, but currently no volumetric fees applied to wastewater discharge to the environment. The MENR-DEE also responsible for issuing groundwater use permits, in cooperation with the MENR-NGES.

The State Information- Archive Fund (SIAF) on environmental protection and the use of natural resources is managed by the MENR, the hydro-meteorological and geological databases, together with the environmental monitoring bulletins and monthly and annual reports of the main departments and regional environmental committees of the MENR provide the basis for the database. Many data sets and much information stored in the SIAD are not in electronic form and are not easily accessible to users, including the general public.

The Ministry of Emergency Situations (MES) is the lead organization for all aspects of managing emergency situations in Azerbaijan. It coordinates activities for protection of the population from natural and man-made disasters, including fire; for elimination of consequences of disasters; and implementation of the state policy in the field of civil defense, rescue and restoration works.

The State Agency on Water Resources (MES-SAWR) of the MES was recently assigned with new guidelines, activities and responsibilities, as described in the Charter approved on November 22, 2011. Their main tasks include:

- Undertake measures for the protection of water reservoirs of national importance.
- Carry out monitoring of water resources and entities, hydro-technical facilities and water supply systems, in cooperation with other stakeholders.
- Undertake measures to improve water resources management in the country, involving relevant authorities.
- Provide integrated management of water entities (facilities), efficient operation of hydro-technical facilities, stock-taking of water supply systems listed on the MES-SAWR asset register.
- Participate in protecting water entities, hydro-technical facilities and water supply systems in emergency situations, in mitigating the consequences from emergencies, in cooperation with other structural units of the Ministry and relevant public institutions.
- Ban the exploitation of technical facilities, equipment, enterprises and other entities that harmfully impact on water resources, provide recommendations on limiting and suspension of exploitation.
- Participate in developing and implementing measures aimed at preventing the harmful impact of flash floods, ground and surface waters, participate in addressing impacts.
- Develop recommendations to rehabilitate water industry entities damaged or destroyed as a result of a natural disaster or accident.
- Develop recommendations for measures on the integrated use of water resources, elaborate water resources protection schemes, describe activities for the water industry, and identify future demands for water resources in the country.

The Ministry of Health (MH)

The Centre for Hygiene and Epidemiology (MH-CHE) of the MH is responsible for setting drinking water standards and monitoring the quality of surface waters used for drinking water supply and for recreational purposes. The MH-CME is a consulting party in the assessment process on issuing WUPs for surface & groundwater use as well as wastewater discharge. There are locally based divisions of the Ministry that monitor and control water quality.

The Ministry of Economy (ME) coordinates the implementation of the State Program for the Socioeconomic Development of the Regions of Azerbaijan for 2014-2018. The ME finances the development and improvement of the energy, water and sanitation infrastructure in the country.
The Tariff Board (ME-TB) under the ME is responsible for the approval of all tariff and fees, except those relates to taxes and custom payments. The TB is chaired by the Minister of Economic Development. Tariffs and fees are set at meetings of the TB, which are organized after receiving proposals from relevant authorities. Control over the regulations for calculation and payment of fees (including the transfer of calculated fees to the state budget) and actual water use volumes is exercised by the Cabinet of Ministers and Ministry of Taxes. Current tariffs and fees only partially account for the actual economic value of providing water of appropriate quality to customers. No provisions are included in regulations to adjust automatically (e.g. once per year) the level of the water resource fees for inflation.

The "Azersu" Joint Stock Company (Azersu JSC) is a mix public and private organization in charge of implementing the state policy and strategy in the field of water supply – drinking water - and sanitation services to consumers in a centralized manner, including community water supply, water treatment, transportation and sales of water. The agency is funded mostly from governmental budget. Their primary responsibilities include: (a) integrated use of water resources, assessing needs in water resources, (b) developing forecasts and norms of water use, (c) forecasting the distribution of water between different sectors of economy, (d) In cooperation with the Tariff Council, determine water use fees. Azersu is responsible for the construction, operation & maintenance of intake structures, reservoirs, pumping stations, water pipelines and sewage collectors. Azersu collects wastewater collection and treatment fees.

The "Amelioration & Water Management" (AWM JSC) is a mixed public and private state-controlled JSC responsible for providing water to economic sectors, by means of assessing needs for water and developing forecasts and norms of water use. More specifically, the AWM JSC provides bulk water supplies to irrigation systems and oversees the development and management of irrigation and drainage systems throughout the country. The agency is funded mostly from governmental budget. Overall functions and responsibilities include:

- Distribution of water to industries and the agricultural irrigation sector.
- Design and construct new state-owned irrigation and drainage systems, and reconstruct existing systems.
- Ensure state control in water use and protection, among others by maintaining a register on water use and conservation.
- Supervise activities of water users associations.
- Mitigate salinity problems on irrigated lands.
- Arrange measures to combat flooding and flood water.
- Prepare overall schemes for the integrated use of surface water use and their protection, together with other relevant state bodies, including determining water use fees.
- Ensure the use of transboundary water objects, inter-state joint use of land reclamation and irrigation systems.

The AWM JSC has established **District Irrigation Departments (DIDs),** the main responsibility of which is to plan and implement bulk water supplies to Water Users Associations (WUAs) at the farm level. There are 49 DIDs in Azerbaijan, one in each regional district, as local representative of AWM JSC.

The AWM JSC is also the key responsible organization for issuing **Water Use Permits** for surface water use, where needed coordinating the decision making with the MENR-DEE – on the need for obtaining an EIA - and the MH-CHE – on the need to comply with water quality state standards, depending on the purpose of water use.

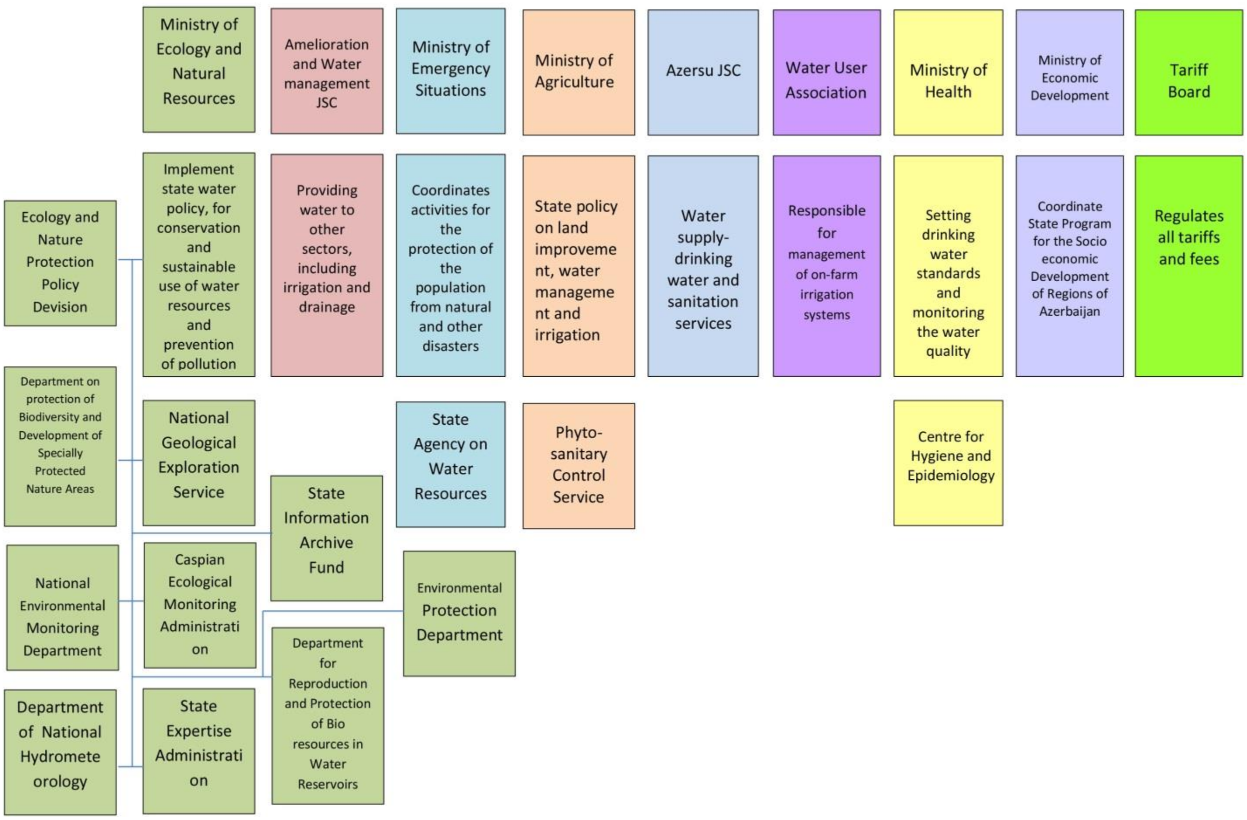
Water Users Associations (WUA) are voluntary community farmer associations responsible for management of on-farm irrigation systems. After irrigation and drainage system improvement, WUAs enter into 20-year management transfer agreements with contracts for provision of bulk water supply. In accordance with the Law on Melioration and Irrigation (LAI), a WUA has the right to set its own WUA Irrigation Service Fee (WUA-ISF) to cover all costs of management at the WUA level. By January 2010, about 550 WUAs covering an area of 1,320,497 ha had re-registered under the LAI.

The State Agency for Alternative and Renewable Energy Sources (SAARES) is a state-owned company providing public services in the field of alternative and renewable energy sources, as well as identifying of sources of renewable energy resources, and carrying out other works related to the development of this field. The company plans and executes small irrigation channels and Hydro power plants in mountain rivers.

Ministry of Agriculture (MA)

The Phytosanitary Control Service (MA-PCS) was established under the MA in 2006, dealing among other things with obsolete pesticides, which still pose a major environmental problem in Azerbaijan.

Figure 1 Mapping of the water sector in Azerbaijan



2.2. Energy

The main actors involved in energy sector in the Republic of Azerbaijan include:

- Ministry of Energy of the Republic of Azerbaijan
- State Energy Supervision Department
- State Agency for Alternative and Renewable Energy Sources (SCARES).
- Ministry of Ecology and Natural Resources (MENR)
- Ministry of Economy of the Republic of Azerbaijan (ME)
- The State Statistical Committee of the Republic of Azerbaijan (SSCRA)
- Azerbaijan National Science Academy (ANAS)
- SOCAR (Azerbaijan Oil Company)
- Azerenergy JSC
- Azersishiq JSC

Ministry of Energy of the Republic of Azerbaijan

The ministry regulates the activities in the production and energy production complex. These activities include upstream and downstream activities, exploration and development of fields, operations of oil and gas refineries, power and heat generation, its supply and distribution through the networks, and so forth. Main functions of the ministry are preparation and execution of state and regional energy programs; forecasting of production of various energy products; participation in international cooperation agreements in certain areas of energy sector; supervision of activities enforcing energy sector norms and laws; creation of friendly conditions for external and domestic investments in the sector; issuing of licenses; ensuring the sufficient supply of energy products in domestic markets; research and development in the sphere of energy; application of international standards and expertise within the country; preparation of activities directed at decreasing the potential losses during production, transportation, distribution and exploitation of energy resources; preparation of programs ensuring energy security of Azerbaijan Republic; ecological security assurance, etc.

State Energy Supervision Department

The State Energy Supervision Department is the state energy surveillance body and the main objective is to control production, transmission, distribution, sailing and consumption of electricity and thermal energy; designing, construction, reconstruction and repair of constructions.

State Agency for Alternative and Renewable Energy Sources (SAARES)

The Agency has the mandate of the principal regulatory institution in the sphere of alternative and renewable energy.

Main responsibilities:

- Participation in the development and preparation of public policies for creating the infrastructure of renewable energy, and ensure the accomplishment of this policy;
- Participation in the preparation and creation of the normative documents regulating the Renewable Energy sector.
- Putting forth suggestions on the use of renewable energy sources, designing, building, operation of facilities and mechanisms of regulating the activity related to the production of the necessary equipment for the purposes listed;
- Preparation of proposals for measures to encourage the activity (design, construction, maintenance and production) and to meet demand for Renewable Energy;
- Monitoring activities in the Renewable Energy sector;

Ministry of Ecology and Natural Resources (MENR)

It is the key governing body in charge of climate change, emission accounting and regulation on natural resources use.

National climate Change Center is a public organization under MENR, which is developing national GHG inventory, National Communication and other analysis on national/sectorial GHG abatement potential and costs.

Ministry of Economy of the Republic of Azerbaijan (ME)

It coordinates the implementation of the State Program for the Socioeconomic Development of the Regions of Azerbaijan. The ME finances the development and improvement of the energy, water and sanitation infrastructure in the country.

The State Statistical Committee of the Republic of Azerbaijan (SSCRA)
Department of Energy and Environment Statistics: provision of conduction of official statistics in the energy and environmental statistical field; - Provision of timely collection of the statistical information and adjustment of them to the social-economic processes in the country; - Development and delivery of the indicators characterizing social-economic development of the regions; - Provision of the development of the methodologies regarding the energy and environment statistics and international benchmarking of the statistical information.

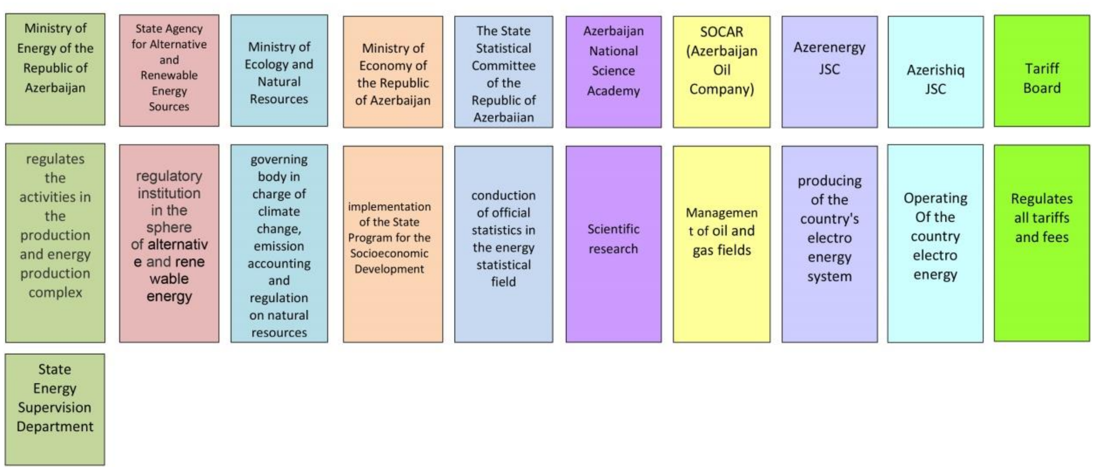
Azerbaijan National Science Academy (ANAS)
Institute of Geography named after Academic Hasan Aliyev scientific research. In the field of energy, the institute conducts assessments of renewable energies mainly wind and solar energy.

SOCAR (Azerbaijan Oil Company)
The State Oil Company of the Azerbaijan Republic (SOCAR) is involved in exploring oil and gas fields, producing, processing, and transporting oil, gas, and gas condensate, marketing petroleum and petrochemical products in domestic and international markets, and supplying natural gas to industry and the public in Azerbaijan.

Azerenergy JSC
This organization ensures the operation of the country's electro energy system, responsible for electric power generation and transmission, centralized power plants, substations, systemic high voltage transmission lines and their dispatcher control conducts.

Azerishiq JSC
This organization is responsible for selling of energy to population. Azerishiq buys total energy from the Azerenergy who produces it and sells in local level to electricity users.

Figure 2 Mapping of the energy sector in Azerbaijan



2.3. Agriculture

The main actors involved in agricultural sector in the Republic of Azerbaijan include:

- Ministry of Agriculture of the Republic of Azerbaijan
    - Agro-leasing Joint Stock Company (JSC)
    - State Phytosanitary Control Service
    - State Veterinary Control Service
    - State Grain Fund
    - State Seed Fund
- Ministry of Ecology and Natural Resources (MENR)
- The “Amelioration & Water Management” (AWM JSC)
- Ministry of Economy of the Republic of Azerbaijan (ME)
- Ministry of Health (MH)
- Azerbaijan National Science Academy (ANAS)
- The State Statistical Committee of the Republic of Azerbaijan

Ministry of Agriculture of the Republic of Azerbaijan
Ministry of Agriculture is the central executive body implementing regulatory, legal and economic control of production and processing of agricultural products in the Republic of Azerbaijan, provision of services to producers, veterinary, plant protection and quarantine, agrarian sector.

The ministry regulates the rational use of arable land and the functioning and implementation of state policy for the development of rural infrastructure and social sectors. It also develops and implement the state policy in the field of land reclamation and water management, and irrigation. It realizes the unified scientific-technical policy in the field of agriculture with research priorities that include: increasing agricultural productivity, improve agricultural products processing, ensure effective use of biological diversity, maximize plant growing and cattle production.

It also participates in the field of food security of the country. Here it participates on the implementation of state policy together with relevant government agencies, and in the preparation and implementation of the national and regional programs on the agriculture and rural social problems. It also controls veterinary services, production of safe and quality food products from veterinary point of view and takes action to protect people and animal from common diseases, and it makes a registration of veterinary medicines. It arranges the work of breeding, planting and seeding, in particular testing for the protection of selection achievements, and controls of the seeding within the limits of its authority.

Finally, it takes measures for rendering agri-technical, agrochemical and other necessary services to producers and processors of agricultural products, provide other necessary services, to implement actions to provide them with equipment, machinery, equipment, spare parts, to make analysis of demands on goods, to give proposals together with the relevant authorities to meet those demands, to arrange technical service sectors.

The Ministry of Agriculture has several depart which are responsible for different fields:
State Phytosanitary Control Service
State Veterinary Control Service
State Grain Fund
State Seed Fund

Agro-leasing Joint Stock Company (JSC): Involvement of new technologies and modern equipment is of crucial importance for the development of the agricultural sector and food production. However, the involvement of new technologies, purchase of modern agricultural techniques that require significant resources, so to make changes in this area would not be possible without the support of the government. Given this, the President of Azerbaijan had ordered in 2004 on the establishment of joint-stock company Agroleasing. Agroleasing JSC was assigned to import fertilizers, pesticides, equipment, seedings, wheat seeds, pedigreed animals to the country and delivery to producers, and also other functions have been delegated.
Agroleasing JSC leases to natural and legal persons agricultural techniques and technical equipment purchased on the state budget, under conditions of paying of 20 percent of the value in advance and the remainder at a term of up to 10 years (depending on amount) and selling by leasing. So far, 9.452 different brands of agricultural equipment were purchased on Agroleasing line.

The "Amelioration & Water Management" (AWM JSC) provides bulk water supplies to irrigation systems and oversees the development and management of irrigation and drainage systems throughout the country. Design and construct new state-owned irrigation and drainage systems, and reconstruct existing systems.

Azerbaijan Hydro technique and Amelioration Scientific Production Union: Under the Union Mughan Absheron and Shirvan experimental stations, experimental and manufacturing enterprise operates. The main activity of the Union is carrying out scientific research about the direction of solving existing problems on melioration and water management, at the same time developed of the engineering-melioration and hydrotechnical measures and introduction for production. Main directions of scientific researches are follows:

- Methods of regulation of water-salt regime of soil and development of tools for arid zones of the Republic;
- Creation of new reclamation facilities to provide efficient use of land and water resources;
- Efficient management of water-salt regime of soils;
- Development and implementation of efficient land reclamation technology;
- Development of progressive methods of exploitation of Hydro-ameliorative systems and water economy complexes;
- Intensive use and the development of scientific bases of melioration lands;
- The calculation methods of water consumption, cultivation techniques and technology development of agricultural plants in different natural, economic conditions;
- Improvement of irrigation techniques and normalization of water use.

Company of operation of water supply systems for winter pastures
Company of operation of water supply systems for winter pastures provides water for wintering cattle in 1.025.000 hectares of winter pastures of the republic. At the same time dealing with repair and restoration of hydro-technical installations, pipelines, exploitation of pumping stations and sub-artesian wells. Within the Joint Stock Company seven operation of water supply systems for winter pastures operates.

Ministry of Ecology and Natural Resources (MENR)
It prepares forecast for dangerous natural disasters and drought and flood forecast. Controlling pressures on the natural resources.

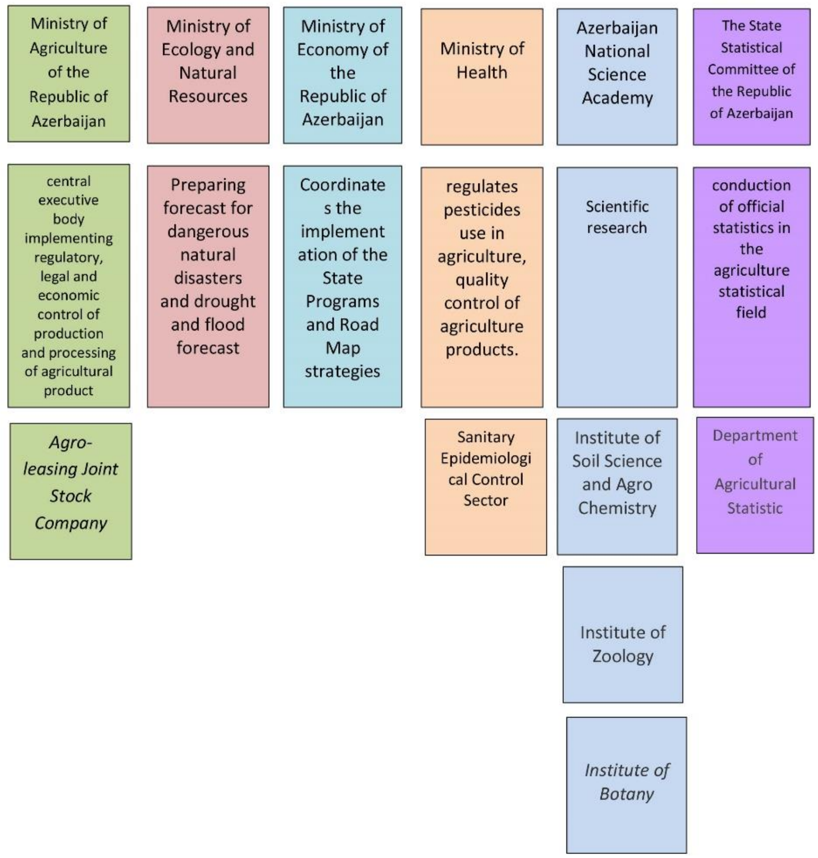
Ministry of Economy of the Republic of Azerbaijan (MERA)
It coordinates the implementation of the State Programs and Road Map strategies also for agriculture.

Ministry of Health (MH)
Sanitary Epidemiological Control Sector – it regulates pesticides use in agriculture, quality control of agriculture products.

Azerbaijan National Science Academy (ANAS)
Institute of Soil Science and Agro Chemistry – It conducts research on: genesis of soils, degradation of soils, anthropogenic impact of human activity on irrigated lands, scientific analyzing of land reforms, restoration of humus and research on humus.
Institute of Zoology - The study of the animal kingdom of Azerbaijan; the investigation of the current situation of various groups of the animal kingdom; defining the role of animals in various biocenoses; the study of dynamics of insects', numbers and their spreading patterns; preparation of scientific and practical bases of biological protection of agricultural crops; regulation of the number of pests in biological methods; the study of biodiversity and ecological peculiarities of invertebrate animals living in water and soil biotopes; increasing of endangered and rare species of fish in the conditions of aquaculture; Use of methods of molecular biological research and space research, information technologies in the study of animal kingdom of Azerbaijan.
Institute of Botany –molecular – genetic and physical-chemical base of biological processes on agriculture fields.

The State Statistical Committee of the Republic of Azerbaijan (SSCRA)
Department of Agricultural Statistics: main responsibilities are to provide implementation of official statistics on national accounts, finance and bank statistics; to provide timely collection of statistical data and compliance of those with the social-economic processes in the country; to prepare indicators characterizing social-economic development of regions and present to the relevant institutions.

Figure 3 Mapping of the agriculture sector in Azerbaijan



2.4. Forestry

The main actors involved in Forestry sector in the Republic of Azerbaijan include:

- Ministry of Ecology and Natural Resources (MENR):
  Department on Forest Development (MENR-DFD)
  The Department on Protection of Biodiversity and Development of Specially Protected Nature Areas (MENR-DPBDSPNA)
  "Azerbaijan Greenery and Landscape System" Public Corporation
- The State Statistical Committee of the Republic of Azerbaijan (SSCRA)
- The "Amelioration & Water Management" (AWM JSC)

Forest amelioration company

- Azerbaijan National Science Academy (ANAS)

Institute of Soil Science and Agro Chemistry
Institute of Botany

- SOCAR (Azerbaijan Oil Company)
  Environmental Department
- Baku city executive power
  Greening center

The Department on Forest Development (MENR-DFD) is a body which implements monitoring of forest protection in areas included in the state forest fund, executes forests restoration and forestation work, grows planting materials, supplies seeds of forest trees and bushes, carries out state records and cadaster

of forest fund lands, and implements the national legislation on forests. Forest Development Department has sectors with specific responsibilities:
Forest service, state registration and cadastral sector
Forestry Conservation and Protection Sector
Reforestation and afforestation sector
Forestry and seeding sector
Forestry Legislation Control Sector
Pest Control and Disease Center
Scientific-Research Forestry Institute
Regional Forestry Institutions
Forest Protection and Restoration Institutions
Regional Measuring Institutions

The Department on Protection of Biodiversity and Development of Specially Protected Nature Areas (MENR-DPBDSPNA) is a body responsible for monitoring in Protected Areas and Objects; monitoring of hunting and hunting farms on compliance to hunting rules; the inventory and conservation of biological diversity towards sustainable development; the restoration and increase (including artificially) of biological resources and preservation of their genetic fund; the sustainable use of the specially protected state hunting fund in Azerbaijan; the execution of activities in the field of environmental awareness; the organization and development of eco-tourism; as well as the implementation of relevant legislation.

"Azerbaijan Greenery and Landscape System" Public Corporation "- Azerbaijan Greenery and Landscape System" Public Corporation was established under the Ministry of Ecology and Natural Resources with the purpose of implementation of services in the greenery sphere, as well as conduction of other works on establishment, cultivation, rehabilitation, extension of greeneries, and development of appropriate infrastructures in accordance with the decree "on improvement measures of management of greeneries establishment in the Republic of Azerbaijan of the President of the country dated June 13, 2008, with the purpose of perfection of management system providing durable development of greenery establishment, rehabilitation, and tillage sphere in the soils of non-forest foundation, as well as in the guarding strips of highways in the Republic of Azerbaijan.

The State Statistical Committee of the Republic of Azerbaijan -Department of Agricultural Statistics – organizing statistics on forestry, and providing database on forestry for each region.

SOCAR (Azerbaijan Oil Company)- The Environmental Department was established in accordance with the Decree of the President of the Republic of Azerbaijan of September 14, 2006 "Concerning the Improvement of the Structure of the State Oil Company of the Azerbaijan Republic". For the purposes of performing environmental work that meets international standards and conforms to applicable regulations and implementing comprehensive programs to improve the SOCAR system's environmental performance, resolving environmental safety problems arising in the process of producing and processing oil and gas, assessing the company's environmental impact, and solving other problems.
The "Amelioration & Water Management" (AWM JSC)
Forest amelioration company - Main Functions of Forest amelioration company is discharge of salty groundwater into the second and first tier collector on ameliorate irrigated areas, as well as implementation of protective forest strips along melioration and irrigation facilities.
Baku city executive power - Greening Farming Association – This department was established on 2005 under Baku City Executive Power. Main responsibility of this association is greening and providing services to existing greens in Baku and Absheron Peninsula.

Figure 4 Mapping of the forestry sector in Azerbaijan

2.5. Climate

The main actors involved in climate industry in the Republic of Azerbaijan include:

- Ministry of Ecology and Natural Resources (MENR):

National Hydrometeorological Department
Climate Change and Ozone Center
Hydrometeorological Forecasting Bureau
The Scientific-Research Institute for Hydrometeorology

- The State Statistical Committee of the Republic of Azerbaijan (SSCRA)
- Azerbaijan National Science Academy (ANAS)

Institute of Geography
Department of Climate and Agro-climatology

- Azerbaijan Airlines (AZAL)

Meteorological service

The Department of National Hydrometeorology (MENR-DNH). It is the focal point for climate change, including the Communications to the UNFCCC, and other climate change-related international obligations, including greenhouse gases inventory.

National Hydrometeorological Department Hydrometeorological Forecasting Bureau - The main role of the Hydro-meteorological Forecasting Bureau (HFB) on the territory of the country, including Azerbaijan Republic sea region of the Caspian sea, is studying and forecasting of the hydro-meteorological phenomena and processes, including high-rise layers of atmosphere. The bureau prepares daily and for the next two days weather forecasts for 7 regions of the country, as well as hydrological and monthly forecasts.
HFB provides all government departments (such as right –guarding, defensive and transport services, Caspian sea oil fleet, oil, power and water sectors, construction and agriculture branches etc.) with hydro-meteorological information, warnings about the dangerous atmospheric phenomena's, meteorological and hydrological forecasts and climate descriptions.
HFB informs population of the country by daily forecast and warnings via Mass media. Also, Bureau prepares special purpose forecast for the different organizations with all required details.

The Climate Change and Ozone Center (MENR-CCOC) was established to provide support to implementing commitments to the UNFCCC Convention, and to facilitate coordination and support to planning and implementation of climate change-related activities.

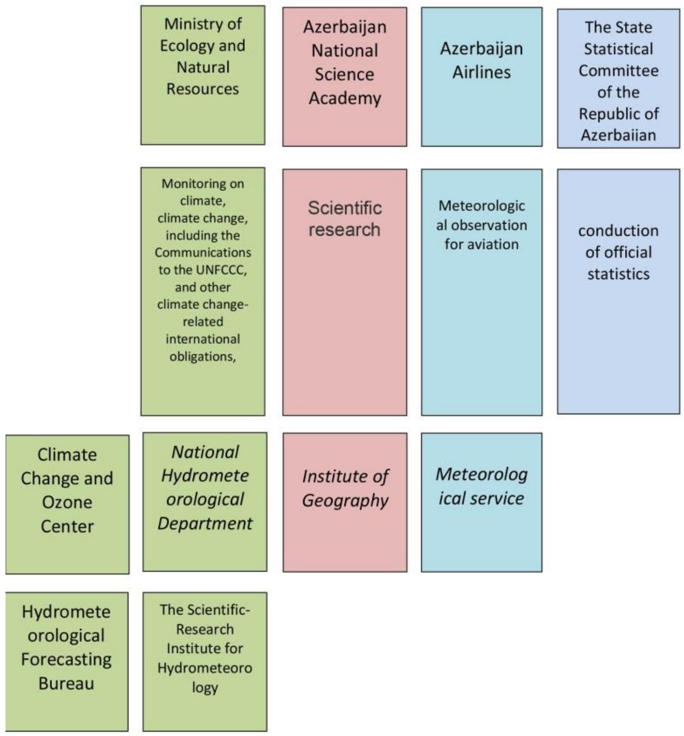
The Scientific-Research Institute for Hydrometeorology - The activity of the institute under The Ministry for Ecology and Natural Resources has been developed on the following four directions: Scientific-research works; Scientific-methodical works; scientific publications; High qualified cadre's preparation.

The State Statistical Committee of the Republic of Azerbaijan- collection climate dates from MENR and providing statistical information on Climate.

Azerbaijan National Science Academy (ANAS) -*Institute of Geography*-Department of Climate and Agro-climatology – Scientific research and preparing Climate maps.

Azerbaijan Airlines (AZAL) - *Meteorological service* – Provides meteorological information for aviation.

Figure 5 Mapping of the climate sector in Azerbaijan


Ministry of Ecology and Natural Resources
Azerbaijan National Science Academy
Azerbaijan Airlines
The State Statistical Committee of the Republic of Azerbaijan
Monitoring on climate, climate change, including the Communications to the UNFCCC, and other climate change-related international obligations,
Scientific research
Meteorological observation for aviation
conduction of official statistics
Climate Change and Ozone Center
National Hydrometeorological Department
Institute of Geography
Meteorological service
Hydrometeorological Forecasting Bureau
The Scientific-Research Institute for Hydrometeorology

3 Socio-economic context

According to State Statistical Committee of the Republic of Azerbaijan, the population of Azerbaijan for the year 2017 was 9,8 million residents. In comparison to the year 2007 (8,666 million residents) it has increased by 11.7%. According the International Futures (IFs) forecasting system by the 2030 population of Azerbaijan will be 10,71 million and while by the year 2060 it is estimated to 11,20 million residents.

Figure 6 Population forecast for Azerbaijan

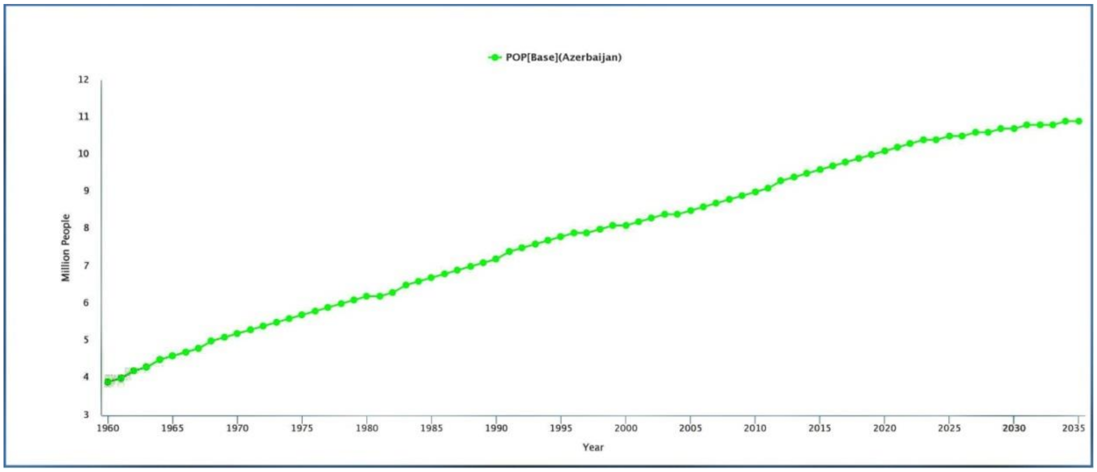


Table 1 Territories, number and density of population by towns and regions of the Republic of Azerbaijan

Towns and regions	Territory, thsd sq. km[1)]	Population, thsd person		Population density for 01.01.2017 (per 1sq. km, person)
		on the base of population census 2009	at the beginning of the 2017	
Republic of Azerbaijan	86,6	8922,4	9810,0	113
Baku city	2,14	2045,8	2245,8	1049
Absheron economic region	3,73	514,0	563,1	151
Ganja-Gazakh economic region	12,30	1172,6	1265,2	103
Sheki-Zagatala economic region	8,84	566,0	611,9	69
Lankaran economic	6,07	824,0	917,8	151
Guba-Khachmaz economic region	6,96	488,7	538,8	77
Aran economic region	21,15	1796,4	1985,2	94
Yukhari Garabagh economic region	7,33	610,2	669,8	91
Kalbajar-Lachin economic region	6,42	224,8	251,4	39

Dakhlik Shirvan economic region	6,13	281,6	311,9	51
Nakhchivan Autonomous Republic	5,50	398,3	449,1	82

1) Including areas of islands in the Caspian sea.

The Gross Domestic Product per capita in Azerbaijan was last recorded at 15.994 US dollars in 2016, when adjusted by purchasing power parity (PPP). The GDP per Capita, in Azerbaijan, when adjusted by Purchasing Power Parity is equivalent to 90 percent of the world's average. GDP per capita PPP in Azerbaijan averaged 9.338 USD from 1990 until 2016, reaching an all time high of 16.715,10 USD in 2014 and a record low of 3.319,80 USD in 1995.

Figure 7 GDP per capita PPP Azerbaijan

Unemployment Rate in Azerbaijan increased to 5,10 percent in 2016 from 5 percent in 2015. Unemployment Rate in Azerbaijan averaged 6,37 percent from 1991 until 2016, reaching an all time high of 11,80 percent in 2000 and a record low of 4,50 percent in 1996.

Figure 8 Unemployment rate of Azerbaijan

3.1. Water

Water resources of the Azerbaijan Republic, their use and security are characterized by the figures in Table.

Table 2 Water resources and water abstraction of the Azerbaijan Republic.

Type of water resources		Water resources (km^3)	Water abstraction (km^3)
Surface water resources:	Local	10.6	12.3
	Transboundary	20.3	
Groundwater resources		4.40	1.70
Total		35.3	14.0

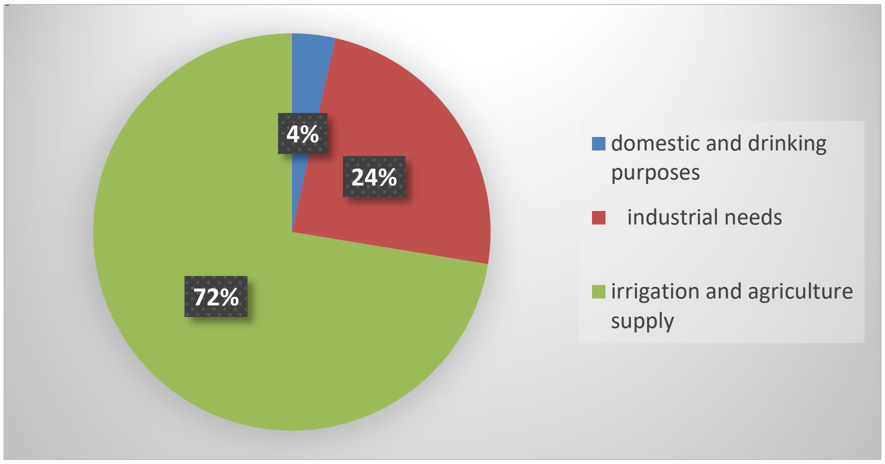
In general, although an average local river water resource is approximately 10.6 km^3, in recent times, on average approx. 12.5 km^3 is abstracted annually. It is important that approx. 70% of the river resources (approx. 20.3 km^3) originates in neighboring countries, and is transported to the country by transboundary rivers. Moreover, those water flows into Azerbaijan is highly polluted.

In general, the Azerbaijan Republic is considered a country with limited water resources. The amount of water per capita is approx. 3253 m3 /year. If we take into account only local water resources, the figure is equal to approx. 1084 m3 /year. As a result of the regional impacts of climate change and global warming, there is a reduction of water resources in local Azerbaijani rivers. At the same time, increases in the repetition of floods and of the duration of drought periods are occurring.

Table 3 Main indicators characterizing protection of water resources and their rational use (million m3)

Water abstraction from natural water resources - total	12504
per capita, m^3	1297
Water consumption - total	8824
of which:	
• domestic and drinking purposes	308
• industrial needs	2108
of which drinking water	43
• irrigation and agriculture supply	6342
Volume of recycled and consequently used water	2346
in percent to total water consumption for industrial needs	53
Water losses during transportation	3680
Discharge of sewage waters	5673
of which untreated waste water	319

Figure 9 Water use in different sectors of Azerbaijan



3.2. Energy

The most important measure in the energy balance of Azerbaijan is the total consumption of 17.62 billion kWh per year. Per capita this is an average of 1,785 kWh.
Azerbaijan could provide itself completely with self-produced energy. The total production of all energy producing facilities is 25 bn kWh. Thats 140% of the countries own usage. Despite this Azerbaijan trades its energy with foreign countries. Along with pure consumptions the production, imports and exports play an important role.

Table 4 Energy Balance of Azerbaijan

	Total	Azerbaijan per capita	Compared to Europe per capita
Own consumption	17000.62 m kWh	1,784.71 kWh	5,836.10 kWh
Energy production	24000.69 m kWh	2,500.82 kWh	6,337.78 kWh
Energy imports	107.50 m kWh	10.89 kWh	595.80 kWh
Energy exports	265.00 m kWh	26.84 kWh	624.30 kWh

Table 5 Carbon footprint of Azerbaijan

	Total	Azerbaijan per capita	Compared to Europe per capita
CO_2 emissions	35.00 m t	3.55 t	8.02 t

The given production capacities have a theoretical value, which could only be obtainable under ideal conditions. They are measuring the generatable amount of energy, that would be reached under permanent and full use of all capacities of all power plants. In practice this isn't possible, because e.g. solar collectors are less efficient unter clouds. Also wind- and water-power plants are not always operating under full load. All these values are only useful in relation to other energy sources or countries.

Table 6 Energy source of Azerbaijan

Energy source	Azerbaijan Total	Azerbaijan percentage	Europe percentage	Azerbaijan per capita	Europe per capita
Fossil fuels	55000.10 m kWh	85,0 %	50,7 %	5,581.05 kWh	8,160.07 kWh
Nuclear power	0.00 kWh	0,0 %	9,0 %	0.00 kWh	1,440.23 kWh
Water power	9000.66 m kWh	14,9 %	26,2 %	978.33 kWh	4,220.47 kWh
Renewable energy	0.00 kWh	0,0 %	11,4 %	0.00 kWh	1,829.55 kWh
Other energy sources	64.82 m kWh	0,1 %	2,7 %	6.57 kWh	431.21 kWh
Total production capacity	64000.82 m kWh	100,0 %	100,0 %	6,565.94 kWh	16,081.53 kWh

Table 7 Power generation in Azerbaijan

Years	Power generation million kWt hour	from its:					
		generation in heat station	generation in hidro station	production by non power enterprises	production by generator	wind energy	solar (photovoltaic) energy
1913	110,8	...	...	...	...	-	-
1920	122,0	...	...	...	...	-	-
1950	2 924	2894	29,5	...	...	-	-
1990	23 152	21 399	1 658	95,6	...	-	-
2000	18 699	17 069	1 534	83,1	13,0	-	-
2005	22 872	19 344	3 009	430,5	88,0	-	-
2010	18 710	15 003	3 446	259,7	-	0,5	-
2015	24 688	20 905	1 637	2 137	-	4,6	4,6
2016	24 952,9	20 699,0	1 959,3	2 236,5	-	22,8	35,3

Table 8 Plant power generation

Years	Plant power, MW	from its:	
		power of heat stations	power of hydro stations
1913	39,8	39,8	-
1950	401,6	401,6	-
1990	5 051	4 263	787,7
2000	4 912	3 990	921,9
2005	5 157	4 187	970,1
2010	6 396	5 401	995
2015	7 793	6 690	1 103
2016	7 869	6 764	1 105

Figure 10 Primary production of energy , in percent

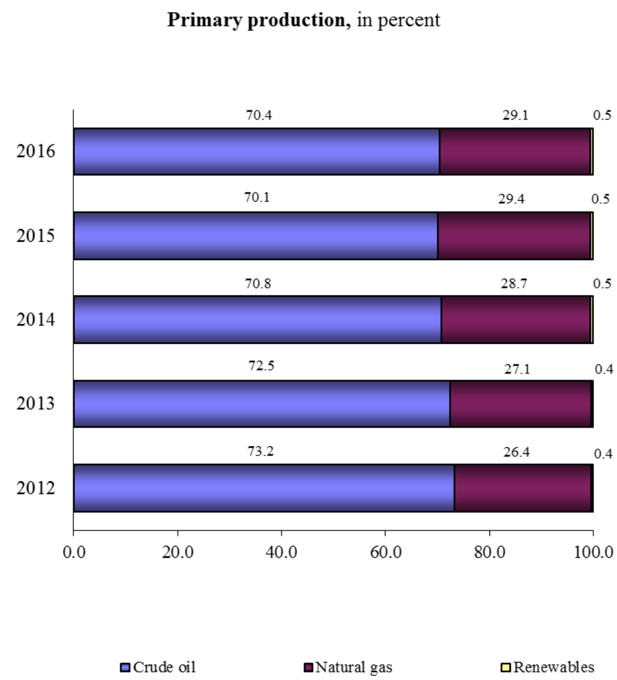


Figure 11 Final consumption of energy products

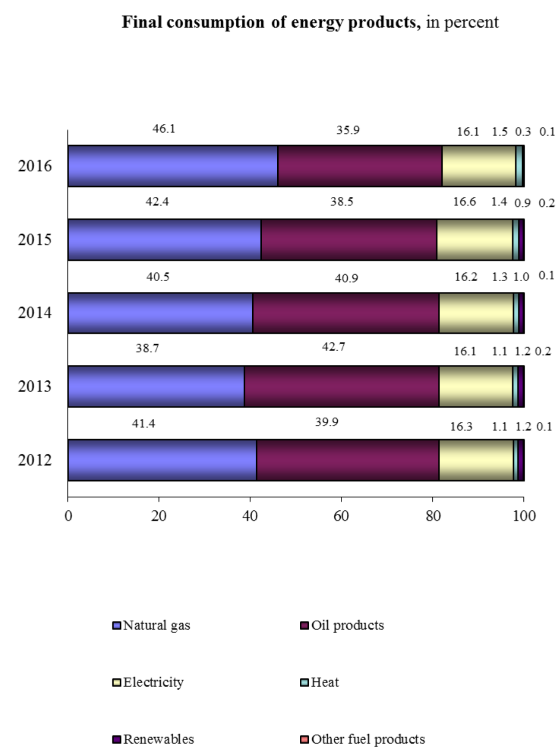


Figure 12 Final energy consumption by types of economy in percent

Final energy consumption by active types of economy, in percent

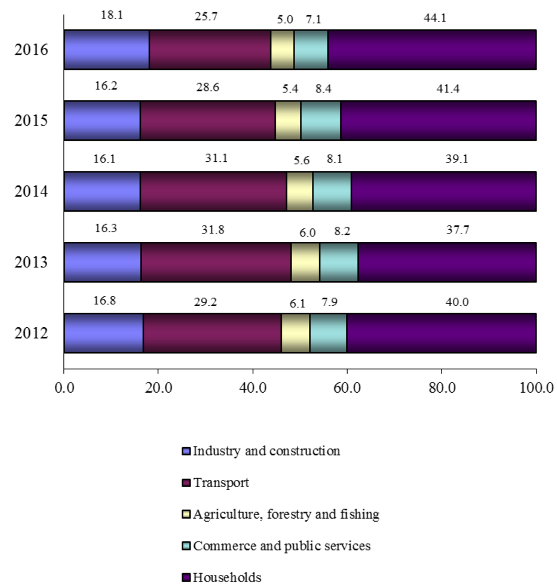
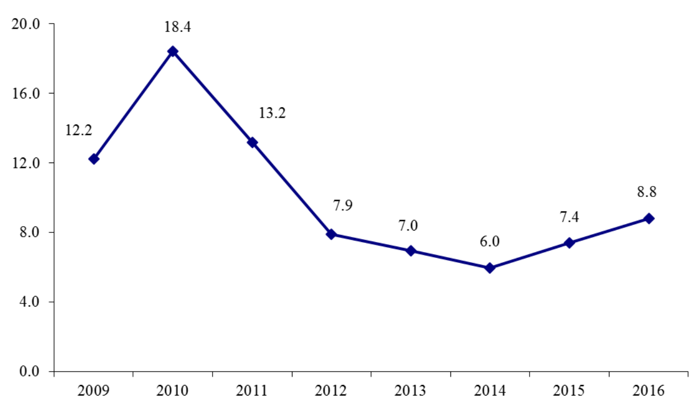


Figure 13 Share of electricity generated from renewable sources in total production of electricity

Share of electricity generated from renewable sources in total production of electricity, in percent



3.3. Agriculture

The Major Caucasus, Minor Caucasus and Talish mountain ranges are rich in natural resources, covered with forests and meadows. The Kur-Araz lowland surrounded by these mountain ranges is the main area that provides the population with agricultural products. In addition, there are four more plains: Gusar sloping plain on the northern slope of Major Caucasus, Samur-Davachi lowland, Nakhchivan plain along the Araz river, Absheron peninsula and Lankaran lowland in the foothills of Talish mountains. Details of the land resources of Azerbaijan are given below in Table 1.

Table 9 The land resources of Azerbaijan

Indicators	Land resources, ha	Share in percent
Total area	*8,641,506*	*100.0*
Cultivable lands	4,588,703	53.1
Lands that could be irrigated	3,200,000	37.0
Arable land	1,622,129	18.8
-out of which irrigated lands	1,097,169	12.7
Area under perennial crops	207,257	2.4
-out of which irrigated lands	150,071	1.7
**Total irrigated lands*	*1,437,694*	*16.6*
Land per head(total)	1.08	-
-Including per head arable land	0.20	-
Eroded land of total land resources	3,610,100	41.8
Including- water erosion	2,972,400	34.4
-wind erosion	367,800	4.2
-Irrigation erosion	269,000	3.1
Irrigated lands subjected to salinization	611,800	7.1
Including -weak salinization	426,869	4.9
-Moderate salinization	129,997	1.5
-Severe and very severe salinization	54,934	0.64
Arable land destroyed by contamination	25,000	0.29
Including: By oil and gas production By building industry By construction and waste disposal By erosion and waterlogging	11,000 5,340 1,800 6,000	0.13 0.06 0.02 0.07

* Total irrigated lands also include irrigated meadows, pastures, rested lands and households.

Agriculture is Azerbaijan's largest employer, with roughly 40 percent of the working population making some part of their living in agriculture. The government has targeted agriculture as one of the priority areas of diversification of Azerbaijan's economy. However, there are significant barriers to growth in the sector, which comprises only 6 percent of GDP.

Post-Soviet land reforms that parceled small land plots (one to three hectares) out to individual farmers created a structural impediment to larger-scale agriculture, which constrains the market from the equipment or methods used in larger-scale agribusiness. Lack of adequate record keeping, and titling of land are also impediments to even small-scale consolidation of agricultural plots. Furthermore, the degradation of Soviet-era irrigation systems has led to the salinization of large areas of farmland, which will require big investments to repair and may provide a niche market for partnering with the government on restoring arable land. Access to finance is a persistent challenge for the owners of small and medium-sized land plots. A lack of agricultural experts and specialists also poses significant challenges to development in agriculture. The Azerbaijan State Agricultural University, located in Ganja, is the only university that specializes in agriculture. Despite government subsidies to farmers, food imports from Georgia are a significant part of this market sector. In 2015, there were 2703.9 thousand cattle, including 1301.4 thousand cows and buffaloes, 8743.4 thousand sheep and goats, 6.3 thousand pig in the country.

Despite these obstacles, there is potential for further development in the food processing industry. Azerbaijan produces a wide variety of crops, with excellent climatic conditions and an extended growing season. Fruits (apples, cherries, grapes, olives, lemons, persimmons, melons, watermelons, raspberries, strawberries, currants, plums, peaches, pears, quince, and pomegranates), vegetables (potatoes, carrots, beets, cabbage, tomatoes, cucumbers, onions and greens), grains (wheat, maize, barley), tea leaves, and nuts are high quality, have minimal unit production costs, and have strong brand recognition in post-Soviet markets.

Table 10 Irrigated lands, end of the year* (1000 ha)

Years	Total area	of which		
		utilised agricultural area	of which	
			arable land	permanent crops
1970	1129,9	1128,0	863,5	190,7
1990	1422,8	1418,5	1095,0	234,1
2000	1426,0	1423,0	1176,5	173,6
2005	1432,8	1429,7	1203,4	156,6
2010	1424,6	1421,4	1200,1	157,7
2015	1434,5	1431,0	1210,4	163,8
2016	1438,8	1435,4	1210,5	168,1

Table 11 Gross Domestic Product by sectors of economy, at factor cost

Years	Total	including					
		industry	agriculture, forestry and fishing	construction	transport and comminication	net taxes	other sectors
million manats (1 Euro = 2 manats)							
2000	4718,1	1699,0	758,9	308,0	567,1	291,2	1093,9
2005	12522,5	6201,9	1137,9	1126,8	917,2	946,5	2192,2
2010	42465,0	21942,2	2344,6	3439,7	3160,3	2876,5	8701,7
2015	54380,0	17912,4	3359,4	6499,5	4329,6	4859,0	17420,1
2016*	60393,6	22446,8	3369,5	6394,2	5162,7	4591,2	18429,2

per cent							
2000	100	36,0	16,1	6,5	12,0	6,2	23,2
2005	100	49,5	9,1	9,0	7,3	7,6	17,5
2010	100	51,7	5,5	8,1	7,4	6,8	20,5
2015	100	32,9	6,2	12,0	8,0	8,9	32,0
2016*	100	37,2	5,6	10,6	8,6	7,6	30,4

Table 12 Plant growing sown area, all categories of economy 1000 ha

	2000	2005	2010	2015	2016
Total sown areas	1041,5	1327,9	1583,9	1585,4	1628,3
Cereal and leguminous	648,2	802,3	968,0	952,1	997,5
Industrial crops	118,2	132,0	52,6	38,7	73,6
Potatoes, market-garden crops and vegetables	136,1	179,7	178,8	166,0	163,1
Forage crops	139,0	213,9	384,5	428,6	394,1

Table 13 Number of animals and poultry, 1 January, (1000)

Years	Cattle	Buffaloes	Total	Sheep	Goats	Sheep and goats	Pigs	Poultry	Horses	Donkeys	Camels	Mules
1916	...	...	1397,0	2143,0	251,0	2394,0	31,0	...	...	...	...	...
1940	1060,8	321,2	1382,0	1955,2	591,7	2546,9	98,9	...	...	...	...	...
1950	991,1	271,2	1262,3	2537,6	566,7	3104,3	55,5	2692,4	...	...	...	...
1960	1068,8	300,7	1369,5	4539,3	311,4	4850,7	144,0	7210,0	131,2	78,5	1,3	1,0
1970	1156,5	403,8	1560,3	3783,6	177,0	3960,6	89,8	8623,8	82,4	49,9	0,4	0,8
1980	1452,7	316,1	1768,8	5117,1	189,3	5306,4	187,6	18552,3	49,7	38,2	0,2	0,5
1990	1615,4	300,1	1915,5	5315,2	198,4	5513,6	202,1	30343,2	39,2	31,4	0,2	0,3
2000	1664,4	297,0	1961,4	5279,6	494,2	5773,8	19,7	14711,1	60,9	35,6	0,2	0,1
2005	2007,2	308,6	2315,8	6887,4	601,4	7488,8	22,9	18253,3	71,0	44,5	0,2	0,1
2010	2299,7	282,7	2582,4	7723,9	607,3	8331,2	5,3	22041,6	74,1	46,0	0,2	0,1
2015	2445,2	252,3	2697,5	7987,3	658,1	8645,4	6,1	28851,7	75,4	40,0	0,3	0,1
2016	2466,0	242,3	2708,3	8025,6	651,5	8677,1	5,2	27559,4	73,7	35,8	0,2	0,1
2017	2484,3	214,2	2698,5	7966,5	648,3	8614,8	4,4	28009,5	71,6	34,1	0,2	0,1

3.4. Forestry

The total forested area in Azerbaijan is 1,021.0 hectares and covers approximately 11.8% of the country's territory. 95% of forests are situated in the mountains areas, 5% in the low-lying areas.
49% of forest reserves are located in the Greater Caucasus, 34% in the Lesser Caucasus, 15% in the Talish, and 2% in the Aran zones. Forests in Azerbaijan are included in the "non-tropical", natural forests type. The types of trees in the forests are mostly mixed, and are shown in the figure below.

Currently 261,000 hectares of forest area have been occupied by Armenia. Forests in Azerbaijan are state-owned. The state is responsible for protecting it.

One of the main challenges we have faced during the preparation of the inventory for the sector are:
- Uncertainties about the data on the forests; and Absence of an inventory of forests. The last time the forest inventory was conducted was in 1988.

Figure 14 Forest types of Azerbaijan

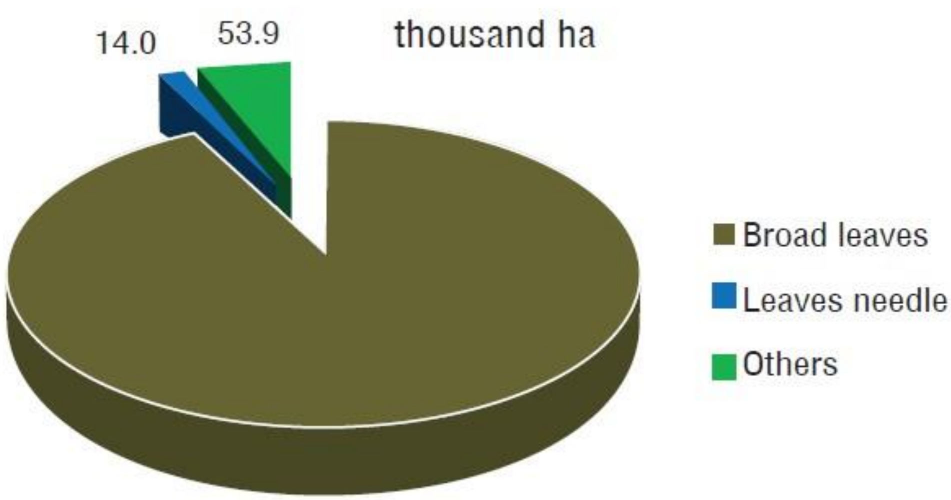


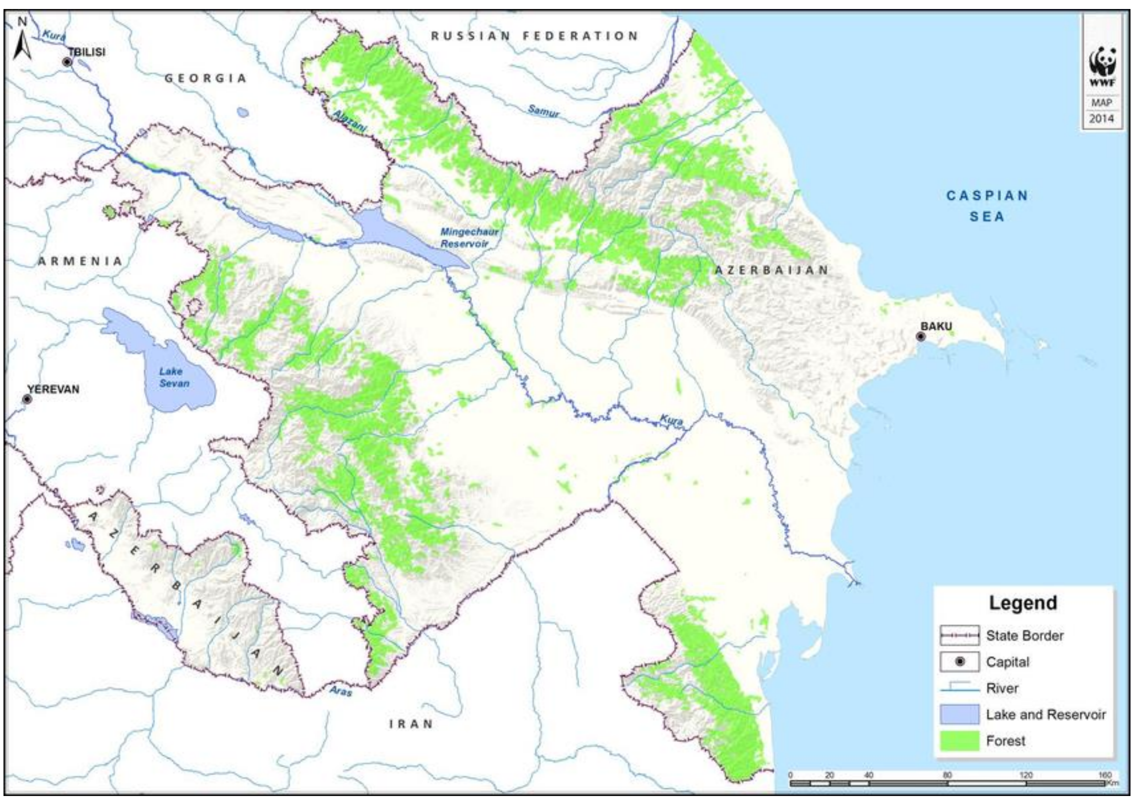
Table 14 Main indicators of forest funds

	2000	2005	2010	2015	2016
Total area of the country, thsd ha	8660	8660,0	8660,0	8660,0	8660,0
Total area of forest fund lands, thsd ha	1037,4	1037,8	1040,7	1040,3	1040,3
their share in country's area, percent	12,0	12,0	12,0	12,0	12,0
Dry lands from total area of the country, thsd ha	8260,4	8263,7	8265,5	8265,5	8267,0
Forested area, thsd ha	871,8	877,2	1008,3	1033,5	1036,3
their share in country's area, percent	10,6	10,6	12,2	12,5	12,5
Total tree resources, million cubic meter	133,0	139,0	144,2	151,8	153,4

Table 15 Reforestation in forests of state importance

	2000	2005	2010	2015	2016
Number of forestries, unit	32	38	41	41	41
Reforestation in forest fund lands - total, thsd. ha	5,3	9,7	10,6	10,1	10,2
including:					
sowing and planting of forests	2,0	3,9	3,5	2,6	2,7
provision of support to natural renovation of forests	3,3	5,9	7,2	7,5	7,5
Share of forest planting and sowing areas in total area where reforestation works were carried out, in percent	37,7	40,2	33,0	25,7	26,5
Planting of manmade forests in ravines, gorges and other useless agricultural lands, ha	265,0	65,0	434,0	197,0	86,5
Raising of young trees in forest fund lands and moving them into the category of forested areas and groves, thsd ha	3,3	3,8	6,7	9,7	9,6
including:					
through creation by method of forest planting and sowing	0,8	0,9	2,5	2,8	2,8

Figure 15 Forest cover of Azerbaijan



3.5. Climate

The climatic picture is complicated. Mountains occupy more than half of the country (58.0 percent); the rest is plains and flat lands (42.0 percent). Azerbaijan is surrounded by the Major Caucasus, Minor Caucasus and Talish mountain ranges. The Kur-Araz lowland is surrounded by these ranges. In different parts of the country, the climate varies from arid to humid "subtropical".
The lower mountains and foothills have sufficient moisture with the precipitation ranging between 500-800 mm. Heavy rains occur in the southwest where weather is under the influence of the Talish mountains and the Caspian Sea. Here, annual precipitation can be as high as 1,500 mm. In the Kur-Araz lowland and plains of Nakhchivan AR, annual precipitation ranges between 200-800 mm.

Mountains greatly affect the landscape of the Republic. The Major Caucasus prevents north winds, but Caucasus summer pasture and the Suram mountain chain in Georgia blocks the westerly air stream that brings wet weather. There is easy access of air only from the north-west, and from the east along the Urals, Siberia and from Central Asia. The impact of the Caspian sea on climate is very weak as the weather moves from west to east and wet weather coming from the sea may is stopped by mountains. The climatic peculiarities of both the Caucasus and Central Asia are met in the Azerbaijan.

Relief plays an important role in distribution of these peculiarities. Nine out of eleven world climate types occur in Azerbaijan. Absolute height ranges between 4,466 m above sea level and 26 m below sea level. The Caspian Sea and The Black Sea play a significant role in the climate of the region. Azerbaijan has a mild winter, average monthly temperatures only fall below zero in the mountains. In spring, a rise in temperature and length of the day is characteristic. This results in warmth of soil surface in early spring, especially in Kur-Araz lowland. Summers are hot and dry, with strong sunshine. In Absheron temperature ranges are between 23.4-25°C. Summer is cool in the mountains of Lankaran zone, but hot in the plains. The hottest zone is the Kur-Araz lowland where temperatures range between 24.8-26.5°C.

In Kur-Araz lowland and the Lankaran plain, average annual temperature is above 14°C. In the mountains at 2,500 m the temperature goes down to 4.5- 6.6° C, but at 3,000 m it goes down to 0°C. In plain areas and foothills the average January temperature rises above 0°C, but sometimes falls to -10°C. In the Lankaran plain it even falls to -8° to -10° C, in the Major and Minor Caucasus at 2,000 m average January temperature is -5° C, but at 3,000 m it is nearly -10°C. The hottest months are July-August. Average July temperature in Kur-Araz lowland with its foothills, in west Absheron and in the foothills of Nakchivan is 25-27.0°C. At times temperatures reach 40.0-43.0°C in these regions.

The duration of snow cover in the plains is limited, 10-15 days, at 1,400-1,500 m it is rather stable, but in high mountains it reaches to 50-100 days. Some precipitation falls as hail which seriously damages cotton, orchards, tobacco, vineyards and other valuable crops. In spring, hail destroys cereals. There are often storms in the mountains (35-45 days a year), but seldom on the plains: 5-10 days. The winds are very variable and complicated. In the Absheron peninsula the north and south winds dominate. Wind speeds are not high with the exception of the Absheron peninsula.
The amount of precipitation ranges between 500 and 800 mm in mountains and foothills which is considered sufficient moisture. Precipitation in the plains of Lankaran in the south-east of the Republic reaches 1,500 mm under the influence of the Talish mountains and Caspian sea. Precipitation in Absheron peninsula, in the Kur-Araz lowlands and the plains of Nakhchivan AR ranges between 200-300 mm. In the Minor Caucasus precipitation ranges between 600-900 mm, but in the moderate mountain part of Major Caucasus it is between 600-1,200 mm. In high parts of Major Caucasus and in the central plain of

Lankaran precipitation is 1,200 mm in a year. Precipitation usually falls in the cold season. Most precipitation is in winter in Lankaran-Astara regions and is 2-5 times more than that of other regions.

Distribution of spring precipitation varies widely. Most spring rainfall is on the southern slope of the Major Caucasus: 250-370 mm. In other areas spring rainfall varies widely. In Lankaran precipitation in spring is 2 times less than what falls in winter. Summer rainfall tails off here far from the sea. Distribution of spring rainfall in Kur-Araz lowland is very complicated. In Gazakh-Ganja and Upper Garabakh region the rain in summer is 2-3 times more than in winter. In summer on the southern slope of the Major Caucasus there is 2 times more rainfall than in winter. In Nakhchivan AR and on north-east slopes of Major Caucasus there is little difference between summer and winter precipitation. In summer the driest zone is the Absheron peninsula.
High autumn rainfall is observed in Astara and Lankaran regions. Distribution of autumn precipitation in Kur-Araz, Gazakh-Ganja, Upper Garabakh regions, in Nakhchivan AR and in the north-east slopes of Major Caucasus differ slightly from each other. Autumn precipitation is sufficient on the southern slopes of the Major Caucasus.
The amount of the precipitation decreased over all territory during 1991-2010. This decrease was about -4,2- (-19,8%) in winter, -2,3- (-28,8%) in spring, -1,4- (-23,9%) in summer, -0,4- (-3,3%) in autumn.

Table 16 Average monthly precipitation and temperature for the South Caucasus countries

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Av
Average Precipitation (1901-2006; mm)												
24.9	25.7	40.4	49.8	56.1	50.7	30.2	25.1	37.2	42.5	35.4	25.9	444.0
Average Temperature (1901-2006; °C)												
-1.0	0.1	4.3	10.7	16.1	21.2	24.3	23.9	19.3	12.6	6.3	0.8	11.5

Source: UNDP, 2011.

Anomaly of temperature during 1991-2010 years ranges between 0.2 – 1.5 0 C. The highest increase occurred in Lesser Caucasus region during spring season. Increase of temperature was observed mainly during summer season which was about 0.90 C in Absheron-Gobustan region, 1.10 C in Lesser Caucasus region, 0.80 C in Lankaran-Astara region and 0.90 C in Kura-Araz region. Increase of temperature in Nakhcivan region was observed in summer and autumn seasons (0.80 C). Annual anomaly of temperature was observed mainly in Ganja (1.10 C) and Dashkasan (1.20 C) stations of Lesser Caucasus.

4 Mapping of stakeholders

THE MINISTRY OF ECOLOGY AND NATURAL RESOURCES (MENR)		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, responsible for formulating and implementing the environmental policy; developing environmental protection measures; screening of development activities for potential adverse environmental impact; monitoring of the quality of air, soil, precipitation, surface and groundwater, biodiversity, forests, radioactivity; monitoring the implementation of environmental legislation and imposing sanctions; and administering a pollution permit system
Stakeholders' power and its source	Formal power	Design of policies for: environmental management, climate change adaptation, mitigation of climate change impacts, water resources management
	Informal power	Consultant in case where cross-sector policies are designed (e.g. policies on agriculture, policies energy activities)
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage with other public authorities and ministries.
Stakeholders' interests		- water policies (very strong interest) – official decision/policy maker (water security, water allocation, water quality, water pollution, etc.). - energy policies (moderate interest) - Agriculture policies (moderate interest)– limited issues concerning pressures put on natural resources by agriculture sector - Forestry (very strong interest)- Official decision/policy maker on issues regarding forest restoration and forestation work - Climate (very strong interest) - Official decision/policy maker on issues regarding climate change adaptation and mitigation strategies.

Ministry of Emergency Situations		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, managing emergency situations in Azerbaijan. It coordinates activities for protection of the population from natural and man-made disasters, including fire; for elimination of consequences of disasters; and implementation of the state policy in the field of civil defense, rescue and restoration works
Stakeholders' power and its source	Formal power	Design of policies for: civil defense, protection in water areas, safety measures in industry, mining and construction, prevention of emergency situations and consequence management
	Informal power	Consultant in case where cross-sector policies are designed (e.g. policies for the agricultural and food sector, policies concerning the forestry sector etc.).
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage with other public authorities and ministries
Stakeholders' interests		- water policies (very strong interest) – official decision/policy maker (water security, integrated water resources etc)

		- energy policies (moderate) – limited on issues related on hydropower energy production, and their security - Agriculture policies (weak interest)- limited to issues related natural and manmade disasters in agricultural sector - Forestry (weak interest) - limited to issues related forestry fires and protection - Climate (no interest)

The Ministry of Health		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, main functions of the ministry are organization and regulation of healthcare system in the country; preparation and implementation of state healthcare programs; regulation of sanitary-epidemiology stations in the country; prevention of dangerous diseases in the country etc.
Stakeholders' power and its source	Formal power	Design policies for drinking water standards and regulation of sanitary-epidemiology stations in the country
	Informal power	Consultant in case where cross-sector policies are designed (e.g. policies for the agricultural and food sector).
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage with other public authorities and ministries
Stakeholders' interests		- water policies (strong interest) – official decision/policy maker (setting drinking water standards and monitoring the quality of surface waters used for drinking water supply and for recreational purposes) - energy policies (weak interest) – limited on issues related on human health - Agriculture policies (strong interest)- official decision/policy maker (using of pesticides, food security) - Forestry (no interest) - Climate (moderate interest) – limited on issues related human health

Azersu JSC		
Dimensions	Sub-dimension	Description
Stakeholders' role		Responsible for arrangements for extraction of water from sources followed by treatment, transportation and sales. It also takes necessary actions for wastewater treatment. The Company engages in design, construction, operation and maintenance of intake structures, reservoirs, pumping stations, water pipelines and sewer collectors.
Stakeholders' power and its source	Formal power	Policy on water supply and waste water system
	Informal	Consultant (management level) – consultant on water management policies

	power	
	Source of power	Legal public authority, Knowledge – experience linkage water supply, waste water management
Stakeholders' interests		- water policies (strong interest) – implementing the state policy and strategy in the field of water supply – drinking water - and sanitation services - energy policies (weak interest) – designing pilot projects related energy production from sludge at WWTP - Agriculture policies (no interest) - Forestry (no interest) - Climate (no interest)

The "Amelioration & Water Management" (AWM JSC)		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, provides with water various sectors of the economy, arranges exploitation of state-owned land reclamation and irrigation systems, ensures state control in water use and protection, removal of saline waters from reclaimed lands, arranges measures to combat against the flood and flood waters, prepares main scheme of complex using of surface water recourses and protection, prepares together with relevant state bodies basin and territorial schemes, ensures the use of trans-boundary water objects, inter-state joint use of land reclamation and irrigation systems, and acts as customer for the construction of irrigation and water objects.
Stakeholders' power and its source	Formal power	Design of policies for: water resources management, reclamation and irrigation
	Informal power	Consultant in case where cross-sector policies are designed (national, regional and international level).
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage with other public authorities and ministries
Stakeholders' interests		- Water policies (Very strong interest): Availability of water resources, meeting the needs of the different sectors - energy policies (weak interest) – designing pilot projects related energy production from sludge at WWTP - Agriculture policies (very strong interest) - Policies regulating the development of the agricultural sector - Forestry (moderate interest) - implementation of protective forest strips along melioration and irrigation facilities - Climate (weak interest)

Water users Association		
Dimensions	Sub-dimension	Description
Stakeholders' role		voluntary community farmer associations responsible for management of on-farm irrigation systems

Stakeholders' power and its source	Formal power	No formal power mandated by law
	Informal power	Consultant to the AWM JSC as an expert – cooperation with farmers
	Source of power	Knowledge-expertise-experience – Linkages to stakeholders (farmers)
Stakeholders' interests		- Water policies (strong): Availability of water resources, meeting the needs of the agricultural users - energy policies (no interest) - Agriculture policies (strong) - Policies regulating the development of the agricultural sector - Forestry (no interest) - Climate (no interest)

The State Agency for Alternative and Renewable Energy Sources		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, providing public services in the field of alternative and renewable energy sources.
Stakeholders' power and its source	Formal power	Design of policies for creating the infrastructure of renewable energy, and ensure the accomplishment of this policy
	Informal power	Consultant in case where cross-sector policies are designed (national, regional and international level).
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage with other public authorities and ministries.
Stakeholders' interests		- Water policies (moderate): Availability of water resources, meeting the needs of the small hydropower plants (HPP) - energy policies (very strong interest) – policy design for renewable energy, and ensure the accomplishment of this policy - Agriculture policies (moderate interest) - limited to issues concerning biogases, biomass for energy production - Forestry (weak interest) - Climate (strong interest) – issues concerning carbon emission

Ministry of Energy of the Republic of Azerbaijan		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, responsible for regulating the activities in the production and energy production complex. These activities include upstream and downstream activities, exploration and development of fields, operations of oil and gas refineries, power and heat generation, its supply and distribution through the networks, and so forth
Stakeholders' power and its source	Formal power	Design of energy policies at national level and related regional energy programs; research and development in the sphere of energy, preparation of programs ensuring energy security of Azerbaijan Republic

	Informal power	Consultant in case where cross-sector policies are designed (national, regional and international level).
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage with other public authorities and ministries.
Stakeholders' interests		- Water policies (moderate): Availability of water resources, meeting the needs of the HPP - energy policies (very strong interest) – policy design for energy sector - Agriculture policies (moderate interest) - biomass for energy production - Forestry (moderate interest) – limited to issues concerning biogases, biomass for energy production - Climate (moderate) issues concerning carbon emission

The State Statistical Committee of the Republic of Azerbaijan (SSCRA)		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, conduction of official statistics in the energy, agriculture and environmental statistical field, collection of the statistical information and adjustment of them to the social-economic processes in the country
Stakeholders' power and its source	Formal power	No formal power mandated by law
	Informal power	Consultant in case where cross-sector policies are designed (national, regional and international level).
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage with other public authorities and ministries.
Stakeholders' interests		- Water policies (weak interest) - Statistics on water resources management. - energy policies (weak interest): Statistics on energy resources - Agriculture policies (weak interest): Statistics on agriculture. - Forestry (weak interest): Statistics on forestry. - Climate (weak interest): Statistics on climate data's.

SOCAR (Azerbaijan Oil Company)		
Dimensions	Sub-dimension	Description
Stakeholders' role		The State Oil Company is involved in exploring oil and gas fields, production, processing, and transport of oil, gas, and gas condensate, supplying natural gas to industry and the public in Azerbaijan
Stakeholders' power and its source	Formal power	No formal power mandated by law
	Informal power	Consultant in case where cross-sector policies are designed (national, regional and international level).
	Source of	Available knowledge-expertise-experience, linkage with other public

	power	authorities and ministries.
Stakeholders' interests		- water policies (no interest) - energy policies (very strong interest) – availability of energy resources - Agriculture policies (no interest) - Forestry (weak interest) – involved to cleaning of polluted soils, and new forestry lands - Climate (strong interest) - issues concerning carbon emission reduction

Azerenergy JSC		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, responsible for operation of the country's electro energy system, responsible for electric power generation and transmission, centralized power plants, sub-stations
Stakeholders' power and its source	Formal power	No formal power mandated by law
	Informal power	Consultant in case where cross-sector policies are designed, consultant to Ministry of Energy
	Source of power	Available knowledge-expertise-experience, linkage with other public authorities and ministries.
Stakeholders' interests		- water policies (moderate interest) – In relation to the water for energy production - energy policies (very strong interest) – operation of electro-energy - Agriculture policies (no interest; they only distribute energy) - Forestry (no interest; they only distribute energy) - Climate (moderate) issues concerning carbon emission

Azerishiq JSC		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, responsible for selling energy to population
Stakeholders' power and its source	Formal power	No formal power mandated by law
	Informal power	Consultant in case where cross-sector policies are designed, consultant to Ministry of Energy
	Source of power	Available knowledge-expertise-experience, linkage with other public authorities and ministries.
Stakeholders' interests		- water policies (no interest) - energy policies (very strong interest) – selling of electro energy - Agriculture policies (no interest) - Forestry (no interest) - Climate (no interest)

Ministry of Agriculture of the Republic of Azerbaijan

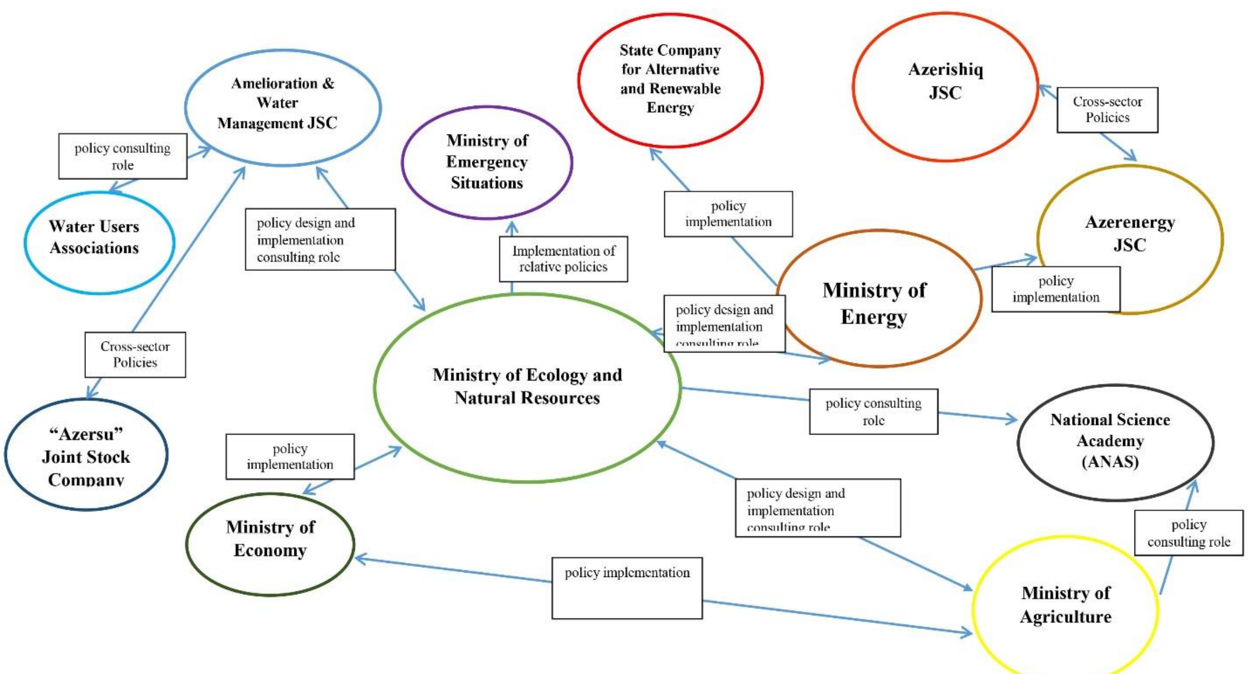
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, ensures public policy on the rational use of arable lands and the working out and implementing of state policy in the development of rural infrastructure and social sectors. It develops and implement the state policy in the field of land reclamation and water management and irrigation, realizes the unified scientific-technical policy in the field of agriculture, for increasing agricultural productivity, agricultural products processing, effective use of biological diversity, plant growing and cattle
Stakeholders' power and its source	Formal power	Design of policy on the arable lands and development of rural infrastructure
	Informal power	Consultant in case where cross-sector policies are designed (e.g. policies for the food security, policies concerning water for irrigation etc.)
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage with other public authorities and ministries.
Stakeholders' interests		- water policies (very strong interest) – Availability of water resources for irrigation - energy policies (moderate) – limited to issues concerning biogases, biomass for energy production - Agriculture policies (very strong interest) – design of policies related agriculture and food security - Forestry (moderate) – limited to issues concerning land use - Climate (strong) –issues to climate change and mitigation measures related food security, reduction of carbon emission

Azerbaijan National Science Academy		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder, state scientific organization responsible for developing science for policy making
Stakeholders' power and its source	Formal power	No formal power mandated by law
	Informal power	Consultant in case where cross-sector policies are designed (e.g. policies for the food security, policies concerning water for irrigation etc.)
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage with other public authorities and ministries.
Stakeholders' interests		- water policies (moderate interest) – scientific research on water resources - energy policies (moderate interest) - scientific research on energy resources - Agriculture policies (moderate interest) – scientific research on agriculture resources - Forestry (moderate interest) – scientific research on forestry - Climate (moderate interest)- scientific research on climate

The Ministry of Economy		
Dimensions	Sub-dimension	Description

Stakeholders' role		Public stakeholder, develops the economic policy, economic and social forecasts, carries out development of different areas of economy, foreign economic and trade relations, investment activity, attraction of investments in the Republic of Azerbaijan
Stakeholders' power and its source	Formal power	Design of policy on cross section issues
	Informal power	Consultant in case where cross-sector policies are designed
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage with other public authorities and ministries.
Stakeholders' interests		- water policies (strong interest) – funding the development of water management activities - energy policies (strong interest) - funding of renewable energy sector - Agriculture policies (strong interest) – funding the development of agricultural activities, - Forestry strong interest) – funding the development of agricultural activities - Climate (strong interest) – funding the development of agricultural activities

Figure 16 Stakeholder map of Azerbaijan



Stakeholders' power/interest grids

In this section stakeholders' power / interest grids are presented. Such grids have been automatically generated in the stakeholder register (excel file) once we filled in the data concerning the level of influence and level of interest of each stakeholder with respect to the nexus-related policies. Influence reflects the power that each stakeholder has over decisions in the several nexus-policy sectors. Interest has to do with the level of interest that each stakeholder has over decisions in the several nexus-policy sectors. Stakeholders' influence and interests have been rated in a scale from 1 (weak influence / weak interest) to 4 (very strong influence / very strong interest). The influence and interest of each stakeholder was rated with respect to each nexus component. For the Azerbaijan case study, influence and interest concerning agricultural and forestry sector policies have also been rated. The results are graphically represented in Diagrams 1-5 each one corresponding to the respective nexus components investigated for the Azerbaijan case study.

Figure 17 Power / interest grid with respect to water

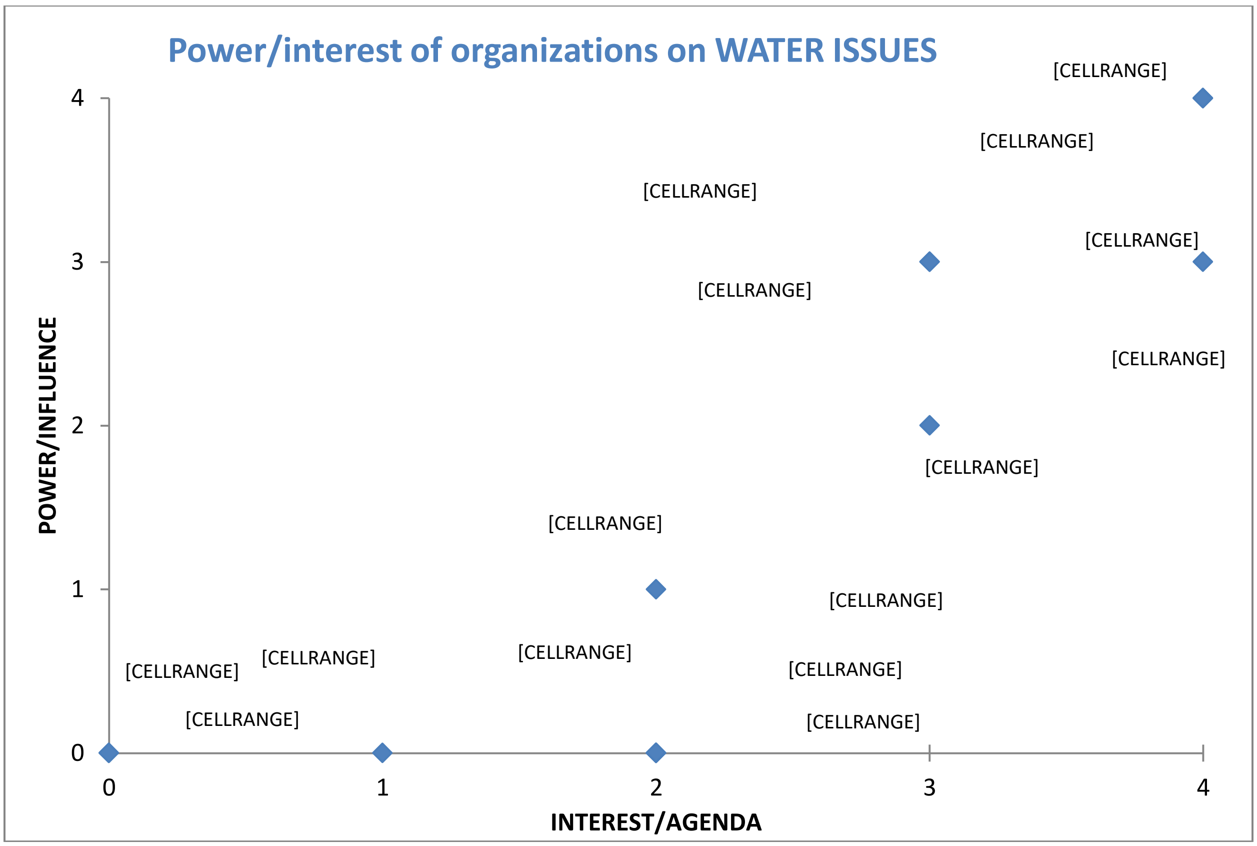


Figure 18 Power / interest grid with respect to energy

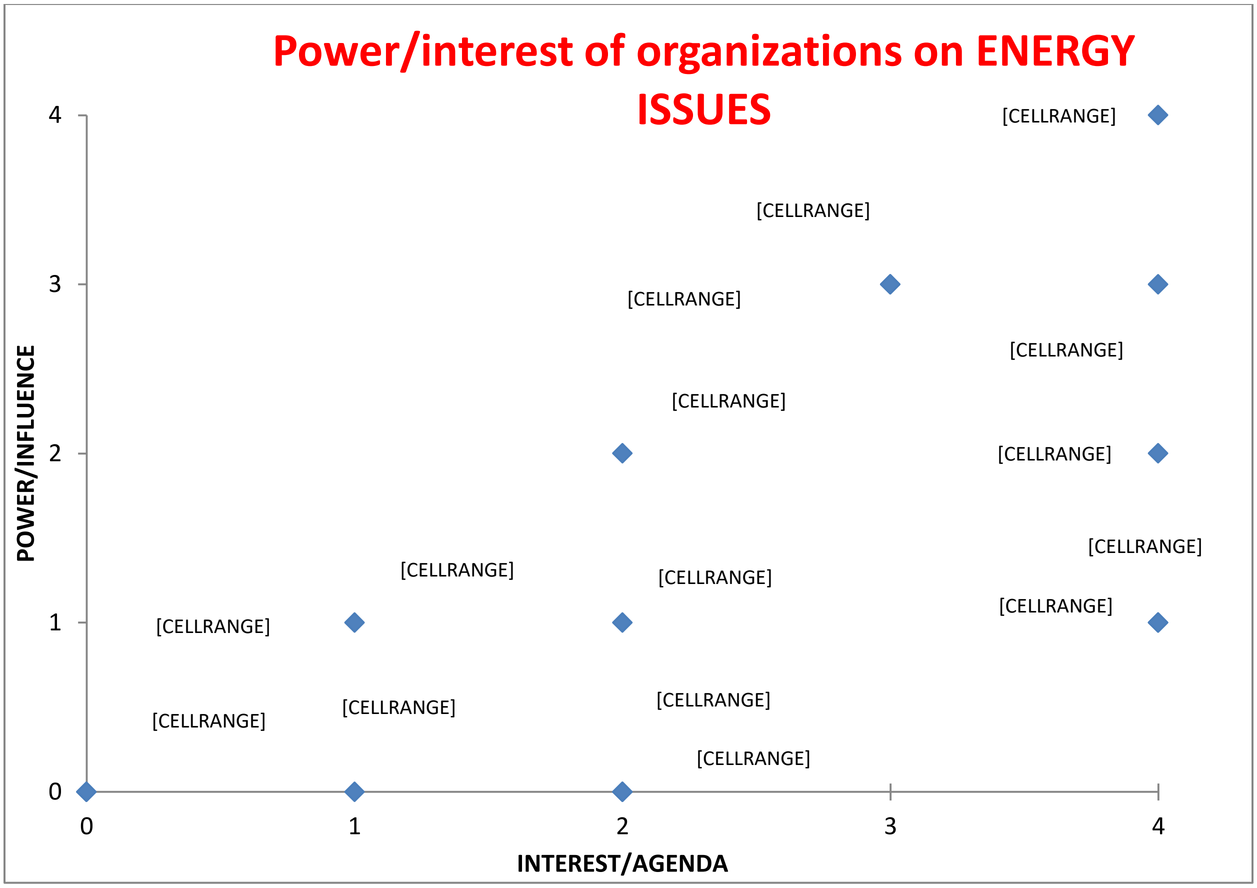


Figure 19 Power / interest grid with respect to agriculture

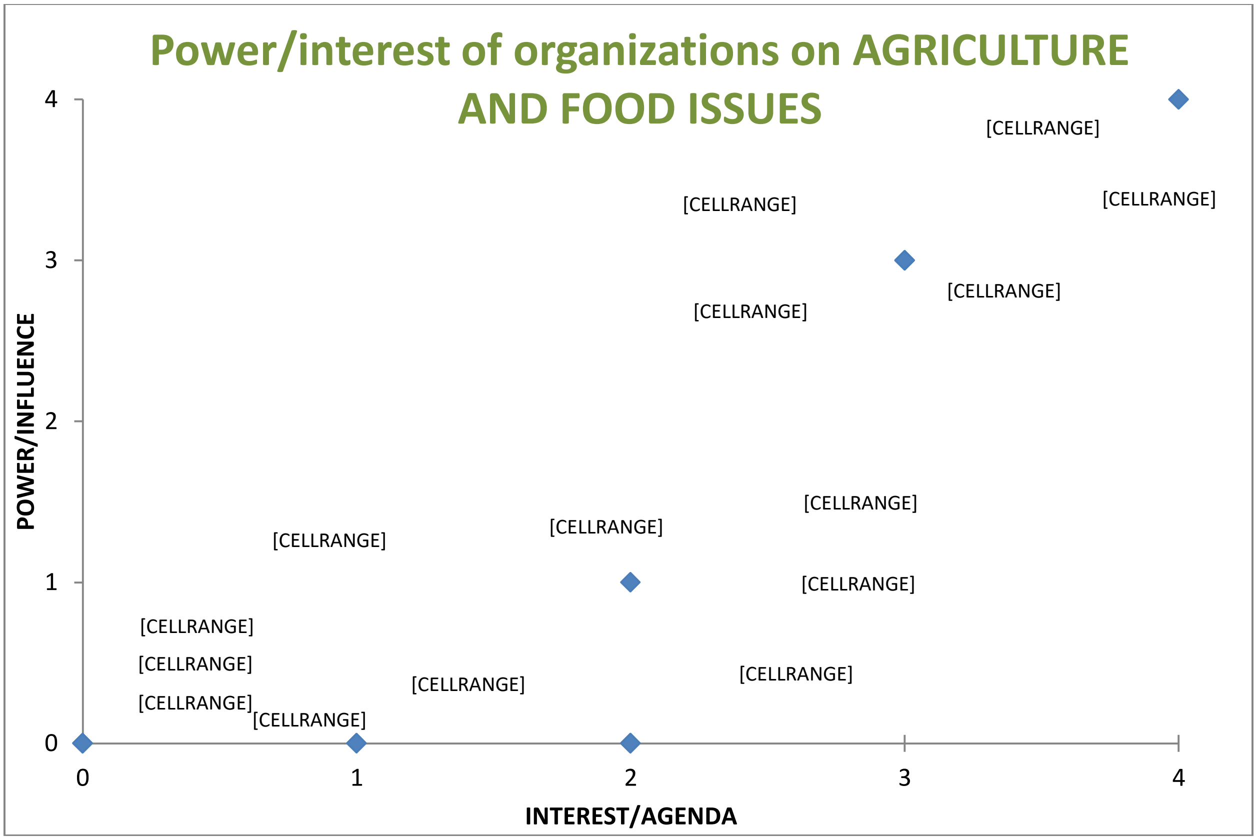


Figure 20 Power / interest grid with respect to forestry

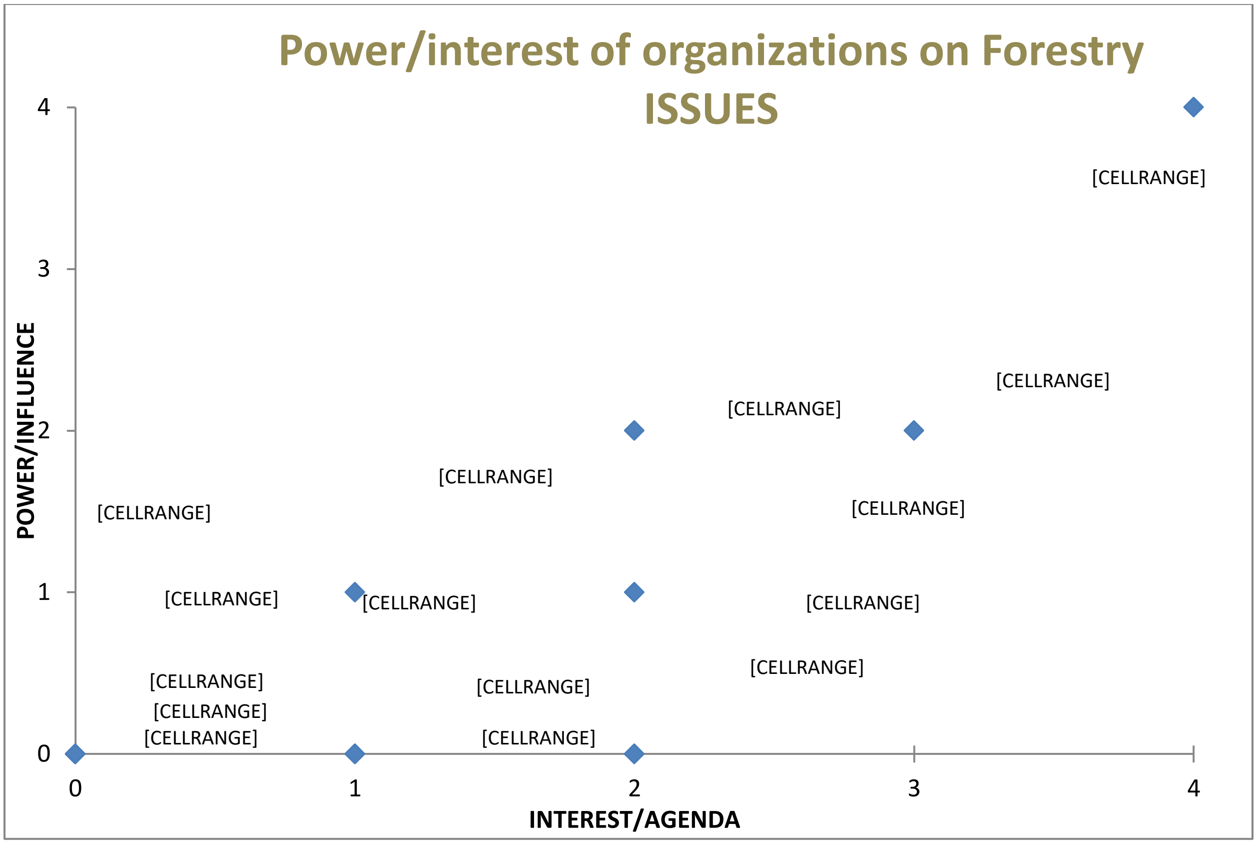
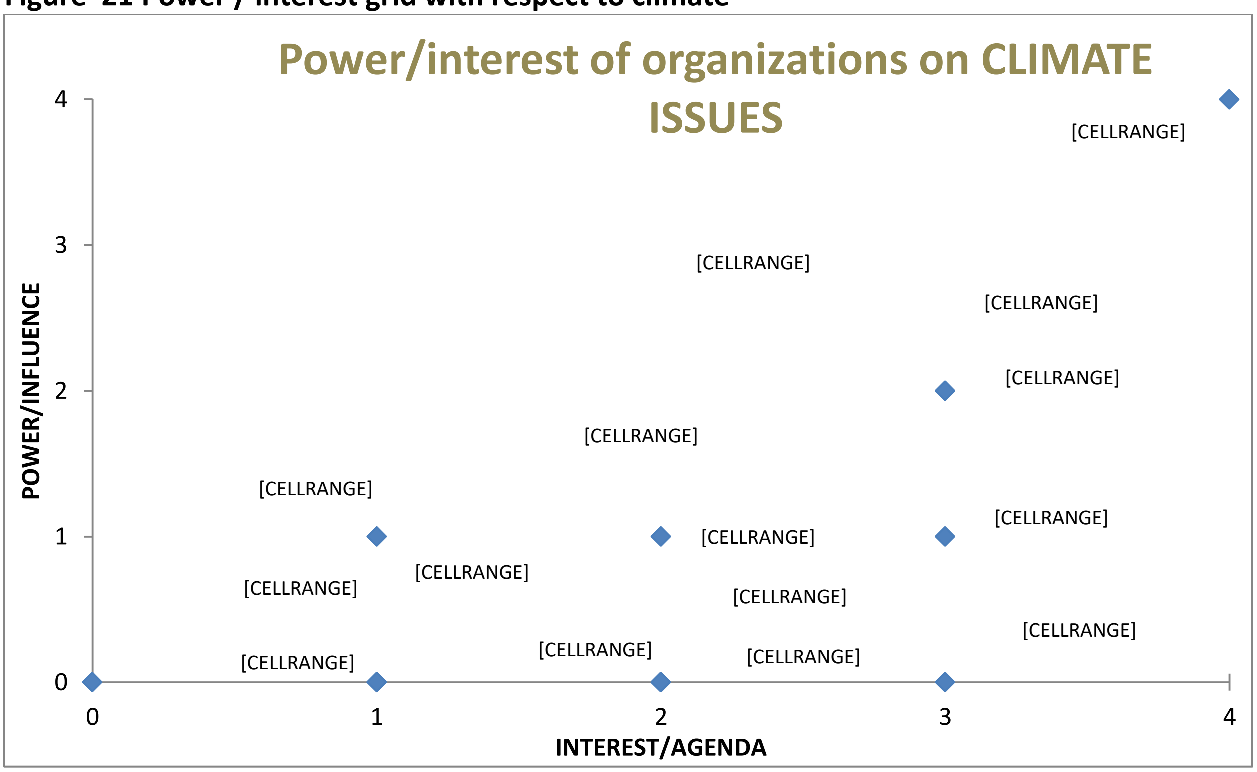


Figure 21 Power / interest grid with respect to climate



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5 Mapping of policy objectives and instruments

This chapter focuses on the identification of policy goals and policy means included in the policy documents (laws, ministerial decisions, national strategic plans, etc.) that were collected during the policy inventory phase. Policies reflect the preferences and choices of decision makers, determine what is allowed and what is prohibited as well as the terms and conditions within which several economic activities can be developed.

The policy areas investigated in the context of the present case study concern: the management of the available water and energy resources; the agricultural sector; the management of climate change impacts. Special emphasis is placed on the identification of policy priorities and future strategic actions for the sustainable management and rational use of natural resources. After the analysis of the policy content, a register containing the policy goals, namely the aims and expectations of decision makers and the policy means, namely measures and techniques adopted or planned to be adopted for the accomplishment / achievement of the respective policy goals, was created.

5.1. Water

5.1.1. Policy documents in the water sector

Water policy			
Type of document	Title of document	Short description of document content	Life span of policy
Law	The Law of Azerbaijan Republic on Water Supply and Sewage	The legislation on water supply and discharge of sewage consists of the present law, the Water code of the Azerbaijan Republic and other normative-legal acts. Also this law cover the rights connected to water use, Principles of rendering of services on water supply and discharge of sewage, Functions of the enterprises of water supply and sewerage	1999
Law	Water Code of the Republic of Azerbaijan	Internal waters of the Azerbaijan Republic, the sector of Caspian Sea (lake) belonging to the Azerbaijan Republic make national wealth of Azerbaijan people, are used and protected as a basis of ability to live of the population and provide existence of flora and fauna. The present Code regulates the legal relations connected to use and protection of water objects in the Azerbaijan Republic	1997 (Amended in 2017)
Law	Law on Melioration and Irrigation	This Law identifies the legal principles of activity in the field of land melioration and irrigation	1996 (amended in 2004)
law	Law on Hydrometeorology	This Law determines the legal basis of conducting observations, researches and works of active impact on atmospheric processes, developments, uses and protection of data by hydrometeorology and monitoring of the	1998

		environment in the Azerbaijan Republic.	
Law	Law on Water Management of Municipalities	This Law defines the legal basis for the relations between the municipalities and government executive bodies regarding the use and protection of the water structures located within the territory of municipalities of the Azerbaijan Republic.	2001 Amended in 2015
Law	Law of the Republic of Azerbaijan "On safety of hydro-technical installations"	This law regulates all issues related to the safety of hydro-technical installation including their design, construction, operation, reconstruction, restoration, conservation and dismantling; it also defines the duties of state authorities, plant owners and operators	2002
Law	Law on industrial and municipal wastes	The present Law establishes the state policy in the area of environment protection from industrial and domestic waste formed as a result of human activity in the form of substances and things, decrease of danger of influence of the given waste, maintenance of ecological balance in the nature, use of waste as secondary raw material, regulates the relations connected to waste, except for harmful gases, polluted waters and radioactive waste.	1998
Presidential decree	Decree endorsing "Strategic road maps for the national economy and main economic sectors".	The Decree aims to define the country`s development goals and priorities and ensure their implementation. The decree endorses Strategic Road Maps for the development of utilities including electricity and thermal energy, water and gas supply in the Republic of Azerbaijan.	2016-

5.1.2. Policy objectives in the water sector

Water policy		
Overarching objectives	Specific objectives	Reference documents
Services and functions on water supply and discharge of sewage	Supply of consumers with water of proper quality and in necessary quantity Creation of reliable system of treatment and discharge of sewage and wastes Development of the centralized systems of water supply and sewerage Supply of consumers with water meeting the norms of quality and corresponding state standards depending on the purposes Efficient use of water resources	The Law of Azerbaijan Republic on Water Supply and Sewage
Regulation of the legal relations connected to	Protection of water bodies Ensure sufficient amount of good quality water to all	Water Code of the Azerbaijan Republic

use and protection of water objects	uses Organization of management in the field of use and protection of water bodies	
Services and functions on melioration and irrigation	Establishment of favorable conditions for agriculture Establishment of state policy in the area of melioration and irrigation Provision of stability and increase of volumes of agricultural production via maintenance and improvement of productivity of lands Involvement into agriculture of low productivity non-agricultural lands Management of melioration and irrigation networks	Law on Melioration and Irrigation
Conducting observations, monitoring of the environment	Improvement of hydro-meteorological observations Develop hydrometeorological forecasts and warnings Study, analyze and forecast hydrometeorological events and processes Modernizing monitoring stations To provide operative collection, verification and analysis of hydro-meteorological data as well as dissemination of information to local, regional and international organizations in the manner prescribed by law	Law on Hydrometeorology
Use and protection of the water structures located within a territory of municipalities	Organization and Management of the Water Economy of Municipalities Efficient use of the Municipal Water Economy Structures	Law on Water Management of Municipalities
Ensuring safety of hydro-technical constructions	Effective use hydro technical constructions and organization of their protection Provision of necessary means to control technical condition	Law of the Republic of Azerbaijan "On safety of hydro-technical installations"
Qualitative improvement of environment	Proper use and rehabilitation of natural resources Regulating the ecological balance of environment	Law on Environmental Protection
Environmental protection from industrial and domestic waste	Protection of public health and ecological balance Promote recycle and re-use of waste	Law on industrial and municipal wastes
Safe environment for human beings	Improve water supply services and sewer system Provide cities and villages with water purifying installations Install new heating systems in cities	Decree endorsing "Strategic road maps for the national economy and main economic sectors".
Development water	Ensure access of all groups of population to safe	Decree endorsing

supply utilities	drinking water Ensure balance between economic needs and replenishment ability of water resources Ensure the right of present and future generation to use environmentally valuable water resources	"Strategic road maps for the national economy and main economic sectors".

5.1.3. Policy instruments in the water sector

Water policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Regulatory instruments in the field of water supply and sewerage	Granting of permission on use of water bodies Rules for recovery of the expenses of water supply services, discharge of sewage and discharge of wastes Neutralization of sewage and discharge thereof into the environment or water basins Measures for elimination and prevention of leaking out of sewage from sewer systems in the environment	The Law of Republic of Azerbaijan on Water Supply and Sewage
Regulatory, planning and financial instruments in the field of water quantity, quality and use	Harmonization of the administrative-territorial principle with the river basin principle Analytical description of the participation-consultation process Regulation of rights and duties of water-users Regulation of use of water objects for different purposes Separation of the functions of management in protection of water bodies from the functions of use of water objects and water economy functions Establishment of special measures against pollution by each region Economic regulation of actions on use and protection of water objects Resolution of disputes in the field of use and protection of water bodies Development of programmes and measures for monitoring of water resources status	Water Code of the Azerbaijan Republic
Regulatory, planning and financial instruments in the field of melioration and irrigation	Implementation of national programs in the area of melioration and irrigation Financing of melioration and irrigation activities and attraction of investments into the area of melioration and irrigation Implementation of uniform scientific and technical policy in the area of melioration and irrigation Establishment of limits for water intake from melioration and irrigation networks of regions and districts (cities) Certification and registration of melioration and irrigation networks	Law on Melioration and Irrigation

	Rights of ownership on melioration and irrigation networks Responsibility of executive power bodies and municipalities in the area of melioration and irrigation Procedure for implementation of melioration and irrigation activities Mechanisms for resolution of disputes in the area of melioration and irrigation Liability for violation of legislation on melioration and irrigation Control over compliance with legislation in the area of melioration and irrigation	
Regulatory and planning instruments	Programs and projects for the development of hydrometeorology Studies on hydro-meteorological regime and climate specifics of the territory of the Republic of Azerbaijan Keep records of surface waters, to solve issues arising from the State Water Cadastre Systematic observations on surface water bodies, agricultural crops, specially protected natural areas, forests, pastures, onshore and atmospheric radiation state Warnings on hazardous hydro-meteorological events (floods, strong winds, hurricanes, shores, avalanches, strong mines, droughts, etc.) as well as to disseminate the information to the state management bodies, and to aware the population about it Monitoring of hydro-meteorological processes in atmosphere, on land and water basins of Azerbaijan section of the Caspian Sea Investigate the impacts of regional climate change and other global hydro-meteorological problems on the country population and economy Recommendations for policy-makers on improvement of methodological instruction and guidelines in order to apply advanced methods in the field of hydro-meteorology Studies on global and regional climate change Implement a national climate program	Law on Hydrometeorology
Regulatory instruments for water use at	Rights and Duties of Municipalities to Regulate Water Relations Responsibilities for Violation of the Legislation on Water	Law on Water Management of Municipalities

municipality level	Management of Municipalities and Settlement of Disputes	
Regulatory, planning and financial instruments concerning the safety of hydro-technical installations	State Register of hydro-technical installations including information about: their intended use, technical properties, safety level and security classification of installation Requirements to ensure safety of hydro-technical installations Risk assessment of hydro-technical installations Certification of safety of installations Establishment of safety criteria Preventive measures to avert emergency situations at installations Financing measures to ensure installation safety Assessment of the responsibility for actions (or inaction) that can cause lowering safety levels from the established limit Responsibility for violation of the legislation on safety of hydro-technical installations and settlement of disputes Maintenance of the required technical professional degree of staff	Law of the Republic of Azerbaijan "On safety of hydro-technical installations"
Regulatory instruments for environmental protection	Rights and duties in environment protection and nature use Rules on ecological requirements for industry and other activities Education, research, statistics and information on ecology and environment protection The state ecological audit and its implementation Responsibilities against violation of legislation on environmental issues and dispute settling	Law on environmental protection
Regulatory instruments for industrial and municipal waste management	Principles of the state policy on waste use and disposal Estabishment of main requirements to waste control Economic regulation of waste disposal Measures for protection of public health and ecological balance of the environment Economic and other stimulating mechanisms with the purpose of introduction of waste in economic circulation Coordination of activity of the enterprises and organizations with the purpose of recycling of waste Infrastructure for re-use and disposal of waste	Law on industrial and municipal wastes
Planning instruments for water management	Identification of water resources used for drinking water supply Construction of new water treatment plants in regions	Decree endorsing "Strategic road maps for the national economy and main economic sectors".
Planning and financial instruments in the water sector	Assessment of areas where infrastructure is not available Increasing the use of meters for assessing water	Decree endorsing "Strategic road maps for the

	consumption Financial resources for water infrastructure Making a comprehensive assessment of the water network Measures for reducing water losses Taking measures to effectively use water resources Preparation of social programs on special consumer groups using water and sanitation services	national economy and main economic sectors".

5.2. Energy

5.2.1. Policy documents in the energy sector

Energy policy			
Type of document	Title of document	Short description of document content	Life span of policy
law	Law on the Utilization of Energy Resources	This Law determines legal, economic and social basis of state policy in the field of use of energy resources, and also the main directions of the mechanism of its implementation	1996
law	Law on Energy	This Law covers: types of activity in the field of energy; placement, construction and operation of installations for implementation of the specified types of activity; measures for protection and rational energy use, and also for prevention or weakening of negative environmental impact of activities in the field of power. This Law provides the legal basis of state regulation of oil, gas and electrical power industries	1998
law	Law on Electric Power and Heat Stations	This Law establishes the legal basis for designing, constructing, operating and using power plants, electrical and heat energy installations	1999
law	Law of Azerbaijan Republic "About Electrical Energy",	The law regulates issues connected with production and provision of electric energy	1998
Decree of the President	State Strategy on Use of Alternative and Renewable Energy Sources	Determination of main directions for 2012-2020 on electric and thermal power production by using alternative and renewable energy sources; Enforcement of legislative framework; Stimulating measures; Implementation of alternative and renewable energy sources in economic sectors.	2012-2020
Decree of the President	Strategic Road Map for the development of	Strategic road maps defining the country`s energy utilities development goals and priorities as well as ensure their implementation. The strategic road maps	2016-2035

	utilities (electricity and thermal energy, water and gas supply) in the Republic of Azerbaijan	covers 2016-2020 economic development strategy, long-term outlook up to 2025 and target vision after 2025.	

5.2.2. Policy objectives in the energy sector

Energy policy		
Overarching objectives	Specific objectives	Reference documents
Increase energy production from alternative and renewable energy sources	Create sustainable energy system in the country Create legal framework conditions for the usage of REC Determine key directions for the production of electricity ad thermal energy from renewables Establish conditions for the promotion of renewable energy (productions, transfer distribution and delivery) 20% of RES-E in total energy consumption in 2020 By 2020 20% of electricity consumption of Azerbaijan must be met by electricity generated from renewable energy sources In 2020 9,7% of total energy consumption must be met by renewable energy sources. Reach a cumulative renewable power capacity of 2GW by 2020 Promote the active participation of the private sector Raise awareness of energy consumers on renewables Accelerate the use of renewables	State Strategy on Use of Alternative and Renewable Energy Sources
Rational use of energy resources	Increase energy efficiency Increase energy saving Determination legal, economic and social basis of state policy in the field of use of energy resources Linking interests of energy resources producers, distributors and consumers Awareness raising on energy saving economic, environmental and social advantages	Law on the Utilization of Energy Resources 1996
Sustainable use of energy	Assesment of energy demand Rational and sustainable energy use Prevention of negative environmental impact of activities in the field of power	Law on Energy 1998
Ensure provision of electric energy and heat	Preparation of plans for developing electrical and heat energy Management and implementation of projects	Law on Electric Power and Heat Stations 1999

	Designing, construction, operation and use of the permanent installations (further - power plants) developing electrical and heat energy	
Provide full diversified and ecologically clean electricity	Reducing electrical energy losses Improving the quality of electricity transmission and distribution Increase productivity in consumption Increasing efficient use of power plants' capacities	Strategic Road Map for the development of utilities (electricity and thermal energy, water and gas supply) in the Republic of Azerbaijan

5.2.3. Policy instruments in the energy sector

Energy policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Regulatory, organizational and planning instruments	Rules on the relationships between state, legal entities and physical persons in the field of renewables Assesment of RES in Azerbaijan Create legal framework conditions for the usage of RES Identification of suitable areas for the renewable energy sources Connection of RES power plants to the national electricity distribution system / network Warranties of the origin of the produced electricity - Identification of organizations responsible for publishing and monitoring the relative electricity origin warranties Establishing a committee for the promotion of large-scale investment projects for RES and large scale investment projects Scientific and technical capacity building Flexible regulation of energy tariffs Enforcement of legislative framework	State Strategy on Use of Alternative and Renewable Energy Sources
Regulatory, planning, organizational and financial measures	Requirements on energy saving Definition and application of energy resources' utilization progressive norms Rate fixing and standardization in the sphere of energy saving and energy resources efficient utilization, power engineering standards and allowance observance Compulsory energy resources stock-taking utilized by enterprises and organizations Energy appraisal for newly constructed and rehabilitated facilities Economic sanctions in connection with the energy resources irrational utilization Intergovernmental cooperation on energy saving	Law on the Utilization of Energy Resources 1996

	Creation and utilization of new energy saving technologies	
Planning instruments on energy utilities	Prediction of the country's electricity needs Determination of Investment Funding Sources Evaluation of alternative and renewable energy potential Public consultations Consideration of privatization opportunities of power plants Installation of meters for reduction of losses Informing the public about the casualties Prioritization of energy losses reduction projects Enforcement mechanisms to increase effectiveness Feasibility studies to identify priorities for energy sources	Strategic Road Map for the development of utilities (electricity and thermal energy, water and gas supply) in the Republic of Azerbaijan

5.3. Agriculture

5.3.1. Policy documents in the agriculture sector

Agriculture policy			
Type of document	Title of document	Short description of document content	Life span of policy
Law	Law No. 344-IIQ "About stimulation of insurance in agricultural industry"	This Law establishes legal and economic basis of stimulation of proprietary insurance of producers of agricultural products, irrespective of pattern of ownership, governs the relations between participants of insurance	2002
law	Law of the Azerbaijan Republic of June 13, 2008 No. 650-IIIG "About environmentally friendly agricultural industry"	This Law governs the relations connected with production, conversion and turnover, environmentally friendly agriculture, and the provisions ensuring health and safety of the population, the earth, water, plants and animals	2008
	State program on developing of vine in Azerbaijan	This program aims to develop vine production and vine industry	2012-2020
Decree	“Strategic road maps for the national economy and main economic sectors” Strategic Road Map for the manufacture and processing of agricultural products in the Republic of Azerbaijan;	Road map aims to develop agriculture of Azerbaijan	2016

5.3.2. Policy objectives in agriculture sector

Agriculture policy		
Overarching objectives	Specific objectives	Reference documents
Support acquisition of insurance by producers of agricultural products	Increase the number of farmers involved in insurance schemes Provide legal and economic basis for insurance of producers of agricultural products	Law No. 344-IIQ "About stimulation of insurance in agricultural industry"
Support environmental friendly agriculture	Promote cultivation of agricultural plants and cultivation of farm animals without use of chemical and synthetic (artificial) substances Ensure health and safety of the population	Law of the Azerbaijan Republic of June 13, 2008 No. 650-IIIG "About environmentally friendly agricultural industry"
Development of vine production and vine industry in Azerbaijan	Strengthening scientific support and staffing potential in viticulture and vine production Improving the infrastructure of viticulture and vine production Provide state support measures in viticulture and wine-making	State program on developing of vine in Azerbaijan
Sustainability of food security	Improvement of existing legislation on the basis of advanced international experience Development of consulting and information services, (post 2025) measures Improving business environment in the sphere of agriculture Improving quality of professional education Promoting the growth of agricultural and processing industry products that are potentially able to replace import Formation of support infrastructure for agribusiness development Stimulation of the expansion of small and medium-sized fruit and vegetable processing enterprises in the regions	"Strategic road maps for the national economy and main economic sectors" Strategic Road Map for the manufacture and processing of agricultural products in the Republic of Azerbaijan

5.3.3. Policy instruments in agriculture sector

Agriculture policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Regulatory	Proprietary insurance in agricultural industry	Law No. 344-IIQ "About

instruments for insurance in agriculture	Establishment of types of property for insurance purposes	stimulation of insurance in agricultural industry"
Regulatory and financial instruments	Subsidies to farmers Provisions for production, conversion, turnover and certification of environmentally friendly agricultural Provisions for production, transportation, storage and use of agricultural products	Law of the Azerbaijan Republic of June 13, 2008 No. 650-IIIG "About environmentally friendly agricultural industry"
Regulatory instruments in the viticulture sector	Rules for the development of viticulture and vine production	State program on developing of vine in Azerbaijan
Regulatory and planning instruments in the agriculture sector	Simplifying access to financial resources: The Road Map comprises short-term (until 2020), medium-term (until 2025) and long-term measures simplifying the access to financial resources Establish an agricultural insurance fund: analysis of the potential impact of the fund's creation on insurance of producers Developing consulting and information services Conducting regular monitoring of risk assessment in terms of food supply and stability in the country Creation of data base on production of food products, import, stocks and trade flows Simplifying access to the markets for manufacturers; Developing market infrastructure Promoting the growth of cotton, tobacco and barley production Promoting the creation of large livestock complexes based on the intensive farm modelling Support for expansion of small and medium-sized meat and dairy processing facilities in the regions Support for development of beekeeping, fishing, including aquaculture Adoption of the Law on Agricultural Co-operation Identify the support mechanism for the development of public-private partnerships Formation of network Agropark (including agrarian industrial clusters) Establishment of industrial neighborhoods Formation of a farm partnership in agriculture and development of cooperation	"Strategic road maps for the national economy and main economic sectors" Strategic Road Map for the manufacture and processing of agricultural products in the Republic of Azerbaijan

5.4. Land (forestry)

5.4.1. Policy documents in the forestry sector

Forestry policy			
Type of document	Title of document	Short description of document content	Life span of policy
Law	Forest Law	The present Code establishes legal bases of regulation of forest relations, use, protection, preservation and reproduction of forests, increase of their ecological and resource potential on the territory of the Azerbaijan Republic.	1997-
Program	The National Forestry Program	The basic aims of the NFP are to promote sustainably meeting of the public expectations from the country's forests in a the long term, provide means to harmonize the forest management policies into the government policy instruments and rapid structural changes and, to identify the challenges and means for development of institutional and legal framework for national forest management.	2015-2030

5.4.2. Policy objectives in the forestry sector

Forestry policy		
Overarching objectives	Specific objectives	Reference documents
Sustainable management and use of forest resources	Protection, preservation and reproduction of forests and lands of forest fund, not covered with forest vegetation	Forest Code 1997
Sustainable management and use of forest resources	Preservation of ecological and protective functions of forests Reducing of negative impacts on forests Restoration of forest Increase public awareness on the vital bio-ecological functions and important social, cultural and economic benefits of forests for sustainable development Improvement and strengthened of institutional capacity, financial mechanisms and regulatory (legal) framework for sustainable forest management Management of forests in line with integrated multipurpose management plans, elaborated based on reliable information and modern methodologies for forest resource inventory, and assessment Sustainable management, improved use and trade of non-wood forest products' (NWFPs) Efficient use of wood from sanitary and improvement fellings Removal of human-induced harmful effects and damages on forest resources, with particular attention	The National Forestry Program 2015-2030

	on illegal logging, over-grazing, recreation and tourism pressures	

5.4.3. Policy instruments in the forestry sector

Forestry policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Planning and regulatory instruments	Linkage and complementarity of the forest policies with the other national, sectoral and regional development policies Creation of plantations of fast growing tree species Certification system for sustainable forest management Development of institutional and legal framework for national forest management Restoration of the degraded forests and afforestation of suitable open forest fund lands Regular monitoring and assessment of forest based on updated reliable information Support to scientific and applied research for the development and implementation of forestry programs	The National Forestry Program 2015-2030

5.5. Climate

5.5.1. Policy documents in the climate sector

Climate policy			
Type of document	Title of document	Short description of document content	Life span of policy
Decree	Azerbaijan 2020: Look to the Future	Decree highlights the possible impacts of climate change on the country's society and economy, and the importance of preparing necessary policy measures.	2012
Decree	Action Plan on improvement of ecological situation and efficient use of natural resources for 2015-2020	The Plan highlights the importance of developing, amongst others: (i) National Adaptation Plan (NAP), and (ii) nationally appropriate mitigation action (NAMA) that incorporates elements relating to Measurement, Reporting and Verification (MRV) systems.	2015-2020
Decree	State Strategy on Use of Alternative and Renewable Energy Sources	This strategy was prepared to promote development of a range of renewable energy sources in the countries.	2012-2020
Program	State Program for	This State Program is effectively the county's	2014-2018

	the Socioeconomic Development of the Regions of Azerbaijan	national sustainable development strategy, although its primary focus is poverty reduction.	
Law	Law on Protection of Atmospheric Air	The legal framework for establishment of regulations for air pollution and emissions and defines responsibilities of different agencies on elaboration of standards and thresholds for air pollution	2001
Law	Verification of the Kyoto Protocol in the UNFCCC	The document deals with sustainable management of emissions – Limitation and reduction of GHG emissions	2000

5.5.2. Policy objectives in the climate sector

Climate policy		
Overarching objectives	Specific objectives	Reference documents
Develop climate adaptation and mitigation measures for Azerbaijan	Preparation of National Adaptation Plan Preparation of mitigation action Develop Action Plan for air quality and climate changes	Action Plan on improvement of ecological situation and efficient use of natural resources for 2015-2020
Development of renewable energy sources	Assessment of renewable energy sources Improvement of using renewable energies	State Strategy on Use of Alternative and Renewable Energy Sources
Reduction of GHG emissions	Forecasting future GHG emissions Scenario describing the expected progress	State Program for the Socioeconomic Development of the Regions of Azerbaijan
Reduction of air pollution and emissions	Regulation in the area of protection of atmospheric air State registry of harmful influences on atmospheric air and sources thereof, economic regulation	Law on Protection of Atmospheric Air
Mitigation of climate change	Limitation and reduction of GHG emissions not monitored by the Montreal Protocol	Law Verification of the Kyoto Protocol in the United Nations Framework Convention on climate change
Reinforcement of country's resilience against climate change impacts	Systemization and improvement of decision making process (short-term and long-term decisions) with respect to climate change adaptation Establishment of a linkage between climate change	United Nations Framework Convention on Climate Change

	adaptation and sustainable development patterns through the design and implementation of regional/local plans of action Mapping out national strategic directions Establishment of a mechanism for monitoring, evaluation/assessment and update of the relative adaptation actions and policies Reinforcement of the society's adaptation ability – Increasing Improve citizen's awareness about climate change	

5.5.3. Policy instruments in the climate sector

Climate policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Regulatory and planning instruments for climate mitigation	Reduction of methane emissions Preparation of national programmes Use and promotion of green technologies Enhancement of knowledge, experience and information sharing and dissemination Promotions of scientific investigation and development in the field of RES	Law Verification of the Kyoto Protocol in the United Nations Framework Convention on climate change
Regulatory, planning, financial and organizational instruments for climate mitigation	Adoption of a methodological framework for emissions Maintenance or replacement of boilers used for central heating (households and tertiary sector) Lighting automation Solar collectors for water and space heating Roof-top solar systems Improvement of traffic lights Promotion of public transportation Forecasting energy consumption and GHG emissions Exploitation and promotion of natural gas for heating and cooling Energy saving by the industry sector Construction of wind parks and solar system areas Deregulation of the electricity market Regulation of land uses Use of biofuels Promotion of natural gas, solar systems and biomass in the industry sector Reduction of nitrogenous fertilizers Funding programmes concerning agricultural sector's adaptation to climate change	State Program for the Socioeconomic Development of the Regions of Azerbaijan

	Design of regional plans for the sustainable development of agricultural sector Acquisition of knowledge concerning climate change	

6 Conclusion

The current study has analysed a plethora of documents pertaining to policy making institutes and pieces of legislation. The overarching objective was to map out the main components of the nexus (of energy-water-land-food-climate) in Azerbaijan from a policy point of view. The mapping is expected to contribute to the definition of an in-depth (proposed) strategy, aiming at the transition of the economy of Azerbaijan to a low carbon pattern. This transition will require actions to be taken and analysis to be done on various domains (i.e. physical flows, policy framework, private sector and social mobility). It becomes clear that that policy plays a catalytic role, as it reveals prominent synergies and trade-offs between the different sectors.

A general conclusion that can be drawn from this study is that the state in Azerbaijan plays a significant role in infrastructure development and management (greater than for example in the EU). Moreover, in all sectors there is high number of institutes involved, with the relationship between those not being always clear. In an attempt to open up the economy and allow private actors to be more engaged, the country could potentially make certain sectors such as irrigation infrastructure or renewable energy less regulated and more open to private investments.

In terms of how a sector may influence or be influenced by another, the current study revealed the following. Energy and climate seem to have a great potential to work synergistically. On one hand, a key objective in the climate sector is to curb greenhouse gas emissions, while policy authorities in the energy sector pursue (to some extend) the decarbonization of the energy system through investments in renewable energy projects, renovated grid (featuring lower losses) and energy saving on the demand side. The aforementioned objectives seem to complement each other perfectly. Nevertheless, as the economy of the country grows and (consequently) the energy demand rises and given that the country is rich in low-cost hydrocarbon reserves which dominate the economy and the energy sector in particular, the decarbonization targets might become infeasible.

The main policy documents in the **energy sector** include the Presidential Decree on State Strategy on Use of Alternative and Renewable Energy Sources and the Strategic Road Map for the National Economy and main Economic Sectors. Key objectives set in these documents are: sustainable energy system, determine key directions for the production of electricity ad thermal energy from renewable; increase of energy efficiency; improvement of the quality of electricity transmission and distribution, create legal framework conditions for the usage of RES and identification of suitable areas for the renewable energy sources.

For the **climate sector** main policies are the Action Plan on improvement of the ecological situation and efficient use of natural resources and the Verification of the Kyoto Protocol in the UNFCCC United Nations Framework Convention on Climate Change. The main objectives in this sector are: the preparation of mitigation actions, development of Action Plan for air quality and climate changes, development of renewable energy sources, reduction of GHG emissions and mitigation of climate change. Main instruments for climate are reduction of methane emissions, using and promotion of green technologies, adoption of a methodological framework for emissions, forecasting energy consumption and GHG emissions, reduction of nitrogenous fertilizers, acquisition of knowledge concerning climate change.

Agriculture seems to affect and be affected by the water sector directly and the energy sector indirectly. More specifically, growing food production requires higher levels of water use. Also state programs to develop agriculture sector and food security, developing market infrastructure, promoting the growth of cotton, tobacco and barley production will increase demand. The latter though, should be restricted by the increased water tariffs and the expansion of meter installation. At the same time, investments in irrigation infrastructure could boost agriculture output. The impact of agriculture on water resources triggers a second-degree link with the energy sector as higher volumes of irrigated water require larger amounts of energy. The latter could be offset to some extend by the implementation of more efficient practices, but the final growth rate of water withdrawal would still be positive.

The main policy documents in the **water sector** are the Water Code of the Republic of Azerbaijan and the Law on Melioration and Irrigation. Also the Strategic Road Map for the National Economy and main Economic Sectors establishes long term targets. The strategic road maps covers 2016-2020 economic development strategy, long-term outlook up to 2025 and target vision after 2025. Key objectives in the water sector include protection of water bodies and efficient use of water resources. Key instruments are: the realization of waste water clean-up infrastructure for the reduction of wastewater discharge into water bodies; economic regulation of actions on use and protection of water objects; a comprehensive assessment of the water network infrastructure; measures for reducing water losses; measures to effectively use water resources; and preparation of social programs for special consumer groups using water and sanitation services.

A key policy document in the **agricultural sector** is the Strategic Road Map for the manufacture and processing of agricultural products in the Republic of Azerbaijan. The objectives are improving business environment in the sphere of agriculture, promoting the growth of agricultural and processing industry products that are potentially able to replace import, formation of support infrastructure for agribusiness development, stimulation of the expansion of small and medium-sized fruit and vegetable processing enterprises in the regions. The main instruments are: developing consulting and information services; conducting regular monitoring of risk assessment in terms of food supply and stability in the country; creation of a data base on production of food products, import, stocks and trade flows; simplifying access to the markets for manufacturers; developing market infrastructure; promoting the growth of cotton, tobacco and barley production; formation of an agro-park network; and establishment of industrial neighborhoods.

The main **forest policy** document are the Forest Code and the National Forestry Program. The objectives of these policies are protection, preservation and reproduction of forests and lands of forest fund, not covered with forest vegetation. The key instruments are creation of plantations of fast growing tree species, certification system for sustainable forest management, restoration of the degraded forests and afforestation of suitable open forest fund lands, increase public awareness on the vital bio-ecological functions and important social, cultural and economic benefits of forests for sustainable development, and removal of human-induced harmful effects and damages on forest resources.

The aforementioned questions as well as other that might come up, along with the main policy goals and instruments are expected to be addressed at the case study workshop (to be held in September 2018). The workshop will bring together representatives from all sectors in an attempt to identify conflicting issues, suggest solutions and strengthen synergies.

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Greek Case Study
Policy analysis

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Executive summary

The objective of this report is the mapping of the nexus-related policies in Greece. The report focuses on policy priorities, goals and instruments concerning the nexus components: water, food, land, energy and climate. Agriculture and tourism are also taken into consideration as the main contributors to the national GDP. In this context, all available policy papers were collected (policy inventory stage) concerning climate, agricultural, food, tourist and energy sectors, water resources and land use management in order to explore relative policy goals and instruments. Also, the socio-economic framework within which the respective policies are designed and implemented has been analyzed. Socio-economic indicators, graphs and statistical data are used as supporting material. Of exceptional importance is the involvement of several public and private organizations (stakeholders), representatives of the nexus-related sectors. Stakeholders enriched this analysis with their knowledge, existing experience and expertise on the policy issues investigated. Their influence / power on decision making, their interests on the nexus-related policies and their formal and informal role during the policy design process were also explored. The content of the respective nexus-related policy papers was analyzed and the policy objectives and instruments for each nexus component are presented in this report. Finally, an in-depth study concerning the assessment of policy coherence has been conducted. The main issues analyzed at this stage include: the interactions among the nexus critical objectives, the interactions among nexus critical instruments and nexus critical objectives, the vertical interactions among policies, the formal and informal arrangements adopted to address conflicts / negotiate trade-offs / exploit synergies in practice as well as relevant success stories and failures.

Glossary / Acronyms

NGO	NON GOVERNMENTAL ORGANIZATION
PPC	PUBLIC POWER CORPORATION S.A. – HELLAS
RES	RENEWABLE ENERY SOURCES
EU	EUROPEAN UNION
NUTS	NOMENCLATURE OF TERRITORIAL UNITS FOR STATISTICS
GDP	GROSS DOMESTIC PRODUCT
IRENA	INTERNATIONAL RENEWABLE ENERGY AGENCY
CRES	CENTER FOR RENEWABLE ENERGY SOURCES AND SAVINGS
DESFA	HELLENIC GAS TRANSMISSION SYSTEM OPERATOR S.A.
PV	PHOTOVOLTAIC
LTAA	LONG TERM ANNUAL AVERAGE
PDO	PRODUCTS OF DESIGNATED ORIGIN
PGI	PROTECTED GEOGRAPHICAL INDICATION

1 Introduction

Greece is located in the South-Eastern part of Europe (Southern part of the Balkan Peninsula) in the Mediterranean Sea. Its area is about 131,957 km^2 and its population has been estimated to 10.8 million residents. It consists of nine geographic regions in the mainland and four insular regions / complexes. The Aegean Sea lies to the East of the mainland, the Ionian Sea to the West and the Mediterranean Sea to the South. Greece has the longest coastline in the Mediterranean Basin, 16,300 km in length, and more than 5,000 islands (227 inhabited). The major economic sectors supporting national income are agriculture and tourism.

The natural environment of Greece is of exceptional importance as its biodiversity – flora and fauna- is very rich. More than 25% of its total area is registered as 'NATURE2000 area'. Moreover, there are 50,000 species, 25% of which are endemic and some rare (pinniped seals, sea turtles and brown bear). There are also 6,300 taxa (species and subspecies) of plants, 1,000 of which are endemic.

The available water resources have been classified in 14 hydrological districts while there are also 765 recorded streams (45 perennial, 4 transboundary) and 60 lakes (3 transboundary). Concerning groundwater, the total reservoir is about 10,3hm^3/y. Islands in the Aegean Sea are mainly supplied by groundwater resources while some small islands are supplied with water from tankers.

As for the energy sector, the total energy consumption was about 16 million TOE in 2012. Public Power Corporation (PPC) supplied 77.3% of electric demand while 61% of Greece's energy needs are covered by imports (mainly petroleum products 44% and natural gas 13%). A 39% is covered by lignite (77%) and RES (photovoltaics, small hydro-power plants and biomass) (22%). In 2015, the share of wind power for electricity production was about 9%. The food sector is strongly related to the agricultural production. Extensive plains, producing large amounts of agricultural products and food, are primarily located in the regions of Thessaly, Central Macedonia and Thrace. These regions constitute key economic regions as they are among the few arable regions in the country.

Finally, the tourist sector flourishes as Greece attracts a huge number of tourists especially between April and October.

Sustainable management and effective use of natural resources is regulated by the respective legislative framework (binding and non-binding) that defines what is allowed and what is prohibited. Also it defines the conditions under which several activities (e.g. agricultural activities, industrial activities, tourist activities, etc.) can be developed. In this report, emphasis is placed on the inventory and exploration of several policy papers concerning the nexus components and the analysis of their content. Stakeholders from public and private organizations, NGOs and academic/research institutes supported this effort by providing a further understanding of the respective policy content, clarifying misunderstandings and offering their knowledge and expertise. The nexus components investigated are: water, energy, climate, food and land as well as agricultural and tourist sectors. It should be mentioned that agriculture and tourism are prevailing economic sectors that put extra pressures to the nexus components in order to cover their needs. Key research questions of the analysis include: the identification of policy goals and policy means/instruments set in the relevant policy documents; the role of stakeholders (formal or informal) during the policy design and decision making process; the influence/power of stakeholders over policy decisions and also their interests with respect to the nexus-related policies; the assessment of coherence and interactions among policies and; the exploration of possible conflicts and synergies developed during the policy design and policy implementation phase. The socio-economic context within which the nexus-related components are developed and the relative policies are implemented has been also explored.

The main stakeholders involved so far are: the Ministry of Environment and Energy (Directorate for Climate Change and Atmosphere Quality), the Ministry of Tourism (General Directorate of Tourist Policy), The Ministry of Foreign Affairs (Directorate of International Energy Issues), the Ministry of Infrastructure, Transport and Networks (Special Office of Public Works, Construction and Maintenance of Hydraulic Infrastructures), Piraeus Bank, WWF Greece, etc. The main policy issues explored are: the sustainable management of water resources (surface water and groundwater), the management and regulation of land uses, the sustainable development of agricultural sector (including: certification of agricultural products, food quality and food safety), the management of conventional and renewable energy resources, the existing climate change adaptation and mitigation strategies, the sustainable development of the tourist sector by promoting the Greek "tourist product", the improvement of tourist services, etc.

Chapter 2 focuses on the description of the socio-economic context within which policy priorities are formulated and policy goals are implemented. In chapter 3, stakeholders' analysis stage is presented while chapter 4 includes the results from the policy analysis process (mapping of policy goals and instruments). Finally, chapter 5 places emphasis on the assessment of policy coherence, the formal and informal arrangements adopted so far to address conflicts, negotiate trade-offs and exploit synergies in practice as well as on success stories and failures regarding the policy design and policy implementation phase.

2 Socio-economic context

According to the most recent Eurostat data, the population of Greece for the year 2016 was 10,783,748 residents. In comparison to the year 2006 (11,004,716 residents) it has been declined by 2%. As projected by Eurostat, it is expected that by the year 2030 the Greek population will continue to decline (about 9,944,658 residents) while by the year 2050 it is estimated to 8,918,545 residents. Approximately 35% of the Greek population lives in the metropolitan area of Athens. The second largest urban center is Thessaloniki, located in the Central Macedonia Region (Northern Greece). The less populated NUTS 2 regions are the Islands of Northern Aegean and the Ionian Islands. The distribution of population in NUTS 2 level for the year 2016 is presented in Table 1.

Table 1: Population distribution in Greece (NUTS 2) for the year 2016

a/a	Greek Region (NUTS 2)	POPULATION	PERCENTAGE
1	Eastern Macedonia and Thrace	604,504	6%
2	Central Macedonia	1,883,339	17%
3	Western Macedonia	273,843	3%
4	Epirus	336,834	3%
5	Thessaly	729,442	7%
6	Ionian Islands	206,141	2%
7	Western Greece	668,258	6%
8	Central Greece	555,830	5%
9	Peloponnese	581,026	5%
10	Attica	3,781,274	35%
11	Islands of Northern Aegean	196,654	2%
12	Islands of Southern Aegean	334,791	3%
13	Crete	631,812	6%
Total		10,783,748	100%

Source: Eurostat

The GDP per capita (main GDP aggregate per capita), measured in euro per capita, for the year 2015 was 16.200 euro, 23.22% lower than the year 2007 due to the fiscal crisis that takes place in Greece during the last seven years. The annual decline of GDP per capita for the years 2007-2015 is presented in Table 2.

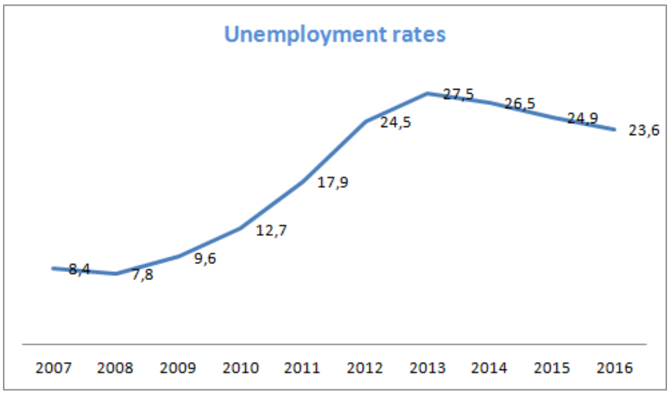
Table 2: GDP per capita among 2007-2015

Year	GDP per capita (euro per capita)
2007	21,100
2008	21,800
2009	21,400
2010	20,300
2011	18,600
2012	17,300
2013	16,500
2014	16,300
2015	16,200

Source: Eurostat

Unemployment is one of the major issues in Greece as it has experienced an extreme increase between 2007 and 2016. The rates of unemployment for this period are shown in Diagram 1 as percentages of the active population.

Diagram 1: Unemployment rate among 2007-2016



Source: Eurostat

The highest unemployment percentage was recorded in 2013 (27.5%). After 2010, the beginning of economical crisis, the unemployment rate has been exploded especially during 2013 and 2014. In 2016, the unemployment declined only by 1.3%. The employment rate, as percentage of the total population for the years 2007-2016, is presented in Table 3. In contrast to unemployment rate, employment was constantly declining, showing that a turnover is very difficult to happen unless economic crisis starts receding. The most difficult years, as in the case of unemployment, are 2013 and 2014. A small increase of 2.6% was achieved between 2014 and 2016.

Table 3: Employment rate among 2007-2016

Year	Employment
2007	60.9
2008	61.4
2009	60.8
2010	59.1
2011	55.1
2012	50.8
2013	48.8
2014	49.4
2015	50.8
2016	52.0

Source: Eurostat

2.1. Water **resources**

Concerning water resources and according to the available Eurostat data, the Long Term Annual Average (LTAA) of precipitation, actual evapotranspiration, internal flow, actual external inflow from neighboring territories and the renewable freshwater resources in million cubic meters for the years 2006-2014 are presented in Table 4.

Table 4: Water resources characteristics

Parameter	LTAA (million cubic meters)
Precipitation	115,000
Actual evapotranspiration	55,000
Internal flow	60,000
Actual external flow from neighboring territories	12,000
Renewable freshwater resources	72,000

Source: Eurostat

About 85% of the available water resources are used in the agricultural sector, 3% for industrial use and the rest 12% in municipal water supply (Agricultural University of Athens, 2017).

2.2. Energy

Energy production in Greece is supported by both conventional and renewable energy resources. According to the most updated Eurostat data, the energy consumption by sector in Greece for the year 2015 was (Table 5):

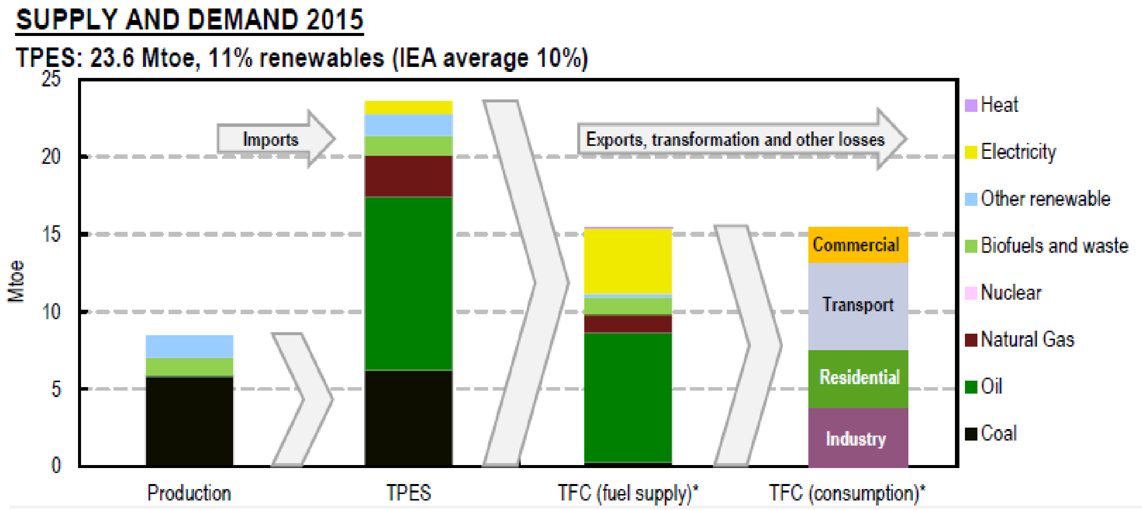
Table 5: Energy consumption by sector for the year 2015

Sector	Energy consumption (GWh)
Industry	12,668
Transport	388
Households/Services	37,731

Source: Eurostat

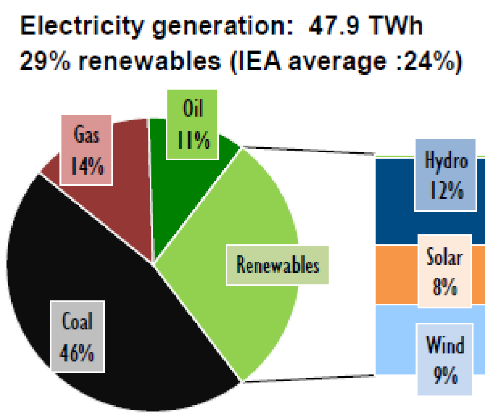
Households/services is the most energy consuming sector. For the same year, the International Energy Agency has provided data concerning energy supply and demand and; sharing of energy resources for electricity production. These data are graphically presented in Diagrams 2 and 3.

Diagram 2: Energy system transformation in Greece for the year 2015



Source: International Energy Agency

Diagram 3: Electricity generation by energy source in Greece for the year 2015



Source: International Energy Agency

The highest percentage of electricity is produced by coal as it exploits within the Greek territory. RES follow with a total sharing of 29%, percentage that is constantly developing in the Greek energy market.

2.3. Climate

Climate change has already affected and it will further affect regions of Greece in the future. National policy priorities for climate change adaptation and mitigation strategies are under structure. The Ministry of Environment and Energy has published a National Strategic Plan for Climate Change adaptation concerning the adaptation of Greek society and economic sectors to the new climatic conditions. In addition, regional plans (NUTS 2 level) are prepared exploring the specific impacts of climate change for each Greek NUTS 2 region and the corresponding necessary measures. These plans will be completed in 2018. In 2011, the Bank of Greece published an analytical study concerning climate change impacts in Greece until the year 2100. The results showed that the minimum winter temperature will be increased by

1.5^0 C during the period 2021-2050 (Bank of Greece, 2011). The average highest summer temperatures will be increased by 1.5^0 C – 2.5^0 C during the period 2021-2050 (Bank of Greece, 2011). The total annual rainfall will be declined while heavy and short-term storms will be increased (Bank of Greece, 2011). That means that flood risk will be also increased.

Climate change affects all the productive sectors. Agriculture and tourism are prevailing economic activities in Greece, affected by climate change, and decision makers place special emphasis on their future adaptation to climate change.

2.4. Agricultural sector

The agricultural sector contributes about 3.8% of the national GDP. According to Eurostat, the agricultural holdings in Greece for the year 2013 were approximately equal to 709,500 ha. In comparison to 2005, they had been reduced by 14.9%. In Table 6, agricultural holdings by crops for the year 2013 are shown:

Table 6: Agricultural holdings by crop for the year 2013

Crop type	Agricultural holding (1,000 ha)
Cereals	191.49
Pulses	13.82
Root crops	31.32
Industrial crops	70.89
Fresh vegetables, melons, strawberries	42.91
Flowers and ornamental plants	0.99
Fodder crops	75.55
Seeds, seedlings and other crops on arable land	2.37

Source: Eurostat

Also, the basic classification of agricultural land for the year 2015 is presented in Table 7. The most representative Greek agricultural products are grapes, olives and olive oil. In 2016 the production of grapes and olives was about 998,780 tones and 247,090 tones respectively (Eurostat).

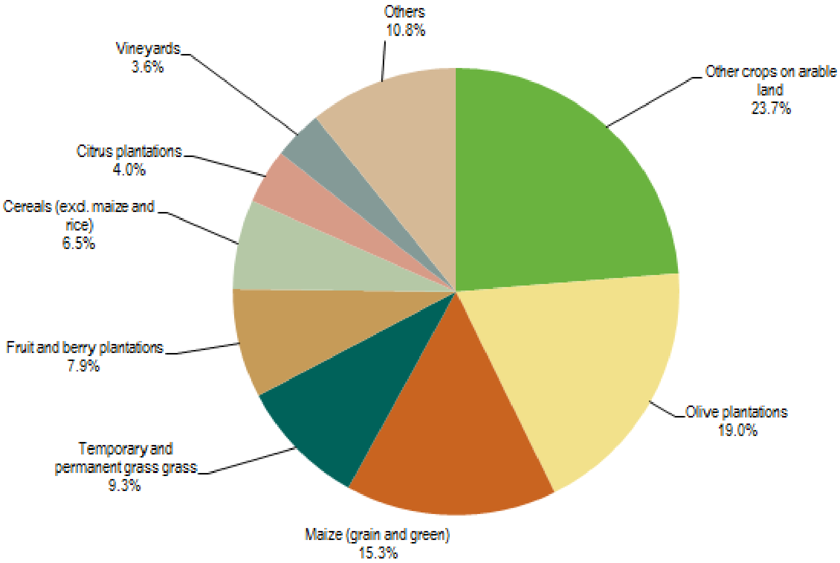
Table 7: Classification of the agricultural land for the year 2015

Agricultural land category	Area (thousand ha)
Arable land	2,892.98
Permanent grassland	930.05
Permanent crops	1,268.90
Kitchen gardens	0.00

Source: Eurostat

Agricultural sector is a water-consuming sector. The most water consuming crops are generally, crops on arable land, olive plantations and crops with maize. The irrigated agricultural land by type of crops for the year 2010 is presented in Diagram 4 (Eurostat).

Diagram 4: Irrigated area by type of crops for the year 2010



Source: Eurostat

As for the livestock sector, the livestock holdings covered in 2013 a total area equal to 256,400 ha (Table 8):

Table 8: Agricultural holdings by livestock activity for the year 2013

Livestock activity	Agricultural holding (1,000 ha)
Equidae	11.07
Cattle	15.94
Pigs	18.94
Dairy cows	6.06
Laying hens	167.40
Sheep	94.45
Goats	68.27

Source: Eurostat

Finally, the total labor force in the agricultural sector for the year 2013 was about 1,238.49 (1,000 full-time equivalent) and in comparison to the year 2005, it has been reduced by 18.9% (same trend with the agricultural holdings referred above). The crop output – million ECU/EUR, production value at basic price – has been estimated by Eurostat for the year 2016 at about 6,654.50.

2.5. Tourist sector

The tourist sector is the most important economic sector supporting national economy. The development of tourist activities has a long tradition due to the multiple historic natural and cultural resources of Greece. It contributes about 18.5% to the national GDP (Eurobank, 2016). It also supports employment, especially during the tourist season between April and October. According to the data provided by Eurostat, the nights spent at tourist accommodation establishments by both residents and non-residents between April 2016 and October 2016 are shown in Table 9.

Table 9: Nights spent at tourist accommodation establishments by residents and non-residents between April 2016 and October 2016

Month	Nights spent
April 2016	2,572,681
May 2016	9,467,417
June 2016	14,523,781
July 2016	20,944,966
August 2016	23,484,844
September 2016	14,894,159
October 2016	6,811,377

Source: Eurostat

As expected, July and August are the months with the highest tourist flows, preferred by the majority of tourists for their holidays. In Diagram 5 some indicative annual data for the tourist sector is presented, covering a time period among 2004-2015. It concerns the arrivals of residents and non-residents at tourist accommodation establishments.

Diagram 5: Annual arrivals of residents and non-residents at tourist accommodation establishments (years 2004-2015)

Source: Eurostat

The tourist flows have been significantly increased from the year 2004 until the year 2015. This diagram reflects the future trends of the tourist sector as it is expected to experience further development. In 2015 the highest number of tourist arrivals occurred, showing a 5.5% increase with respect to 2014.

2.6. Land uses

This section focuses on a brief presentation of the main land uses as registered by Eurostat for the year 2012. The prevailing land uses in Greece are cropland, woodland and broadleaved woodland. Coastal water bodies and root crops are the land uses with the lowest land cover percentages. Land use categories are presented in Table 10 as percentages of the total national territory.

Table 10: Land use categories for the year 2012

Land use category	Percentage
Artificial land	3.5
Cropland	23.1
Woodland	30.2
Grassland	13.5
Bare land	2.2
Water	1.4
Wetland	0.5
Built-up areas	1.0
Artificial non built-up areas	2.5
Cereals	7.8
Root crops	0.2
Non permanent industrial crops	2.9
Dry pulses, vegetables and flowers	0.5
Fodder crops (mainly leguminous)	1.2
Fruit trees and berries	1.9
Other permanent crops	8.5
Broadleaved woodland	18.2
Coniferous woodland	8.2
Mixed woodland	3.8
Inland water bodies	0.7
Inland running water	0.5
Coastal water bodies	0.2
Inland wetlands	0.5
Coastal wetlands	0.0

Source: Eurostat

2.7. Conclusions

In this chapter, some indicative statistical data concerning population trends, national GDP, the nexus components as well as the agricultural and tourist sectors were presented. Also data mainly derived from Eurostat, is used in order to describe the socio-economic context within which the nexus-related policies are designed and implemented. Special emphasis was placed on collecting and presenting the most recent available data. There were no particular difficulties during the data collection process. The most “old” data are those concerning the irrigated agricultural land, as their time reference is the year 2010, and the distribution of land uses which is referred to 2012. Unfortunately, there are no national data referring to a more recent time scale.

Conclusively, Greek population is expected to face an important decline during the next years while, employment and national GDP will start improving as the economical crisis starts receding. The energy sector follows the general principles having been determined by the European Union and it has been totally reconciled with the respective European policy priorities. The national goals set for the year 2020 in combination of the European Energy Policy are (Ministry of Environment and Energy):

- 20% reduction of GHG emissions in relation to the respective 1990 emissions levels
- 20% penetration of RES in the gross final energy consumption
- 20% saving of primary energy

The agricultural sector continues to occupy a prevailing position in the Greek economy while its future development is strongly based on the priorities defined by the Common Agricultural Policy (CAP).

Climate change will affect the majority of the productive sectors and as a result, mitigation strategies and adaptation measures are designed. Such strategies are mainly focusing on water resources management, adaptation of agricultural and tourist sectors as well as the sustainable management of energy resources.

Finally, of particular importance is the promotion and further development of the tourist sector. Emphasis is placed on the sustainable tourist development, extension of the tourist season, the tourist specialization and training as well as the improvement of the offered tourist product and services.

3 Mapping of stakeholders

Stakeholders' engagement is very important in almost any case where policy decisions are received. Stakeholders can affect either positive or negative a policy process and its implementation. According to the power or means of action that any stakeholder possesses, he/she can boost or block policies that promote or contradict his/her interests. Moreover, stakeholders' activities are strongly affected by the policy framework that sets the conditions within which an action may take place.

This chapter focuses on stakeholders' analysis for the Greek national case study. Representatives of several public organizations, businesses, NGOs and academic/research institutes have been invited and involved in the policy analysis process in order to offer their knowledge, experience and expertise with respect to the nexus-related policies. Stakeholders' involvement provided a better understanding of the decision-making, policy design and policy implementation process, in order to clarify policy priorities and interactions and also to eliminate any misunderstandings. The choice of participants was based on the nexus components investigated in this case study. It should be mentioned that as the project develops, more stakeholders will be engaged and the relevant information will be constantly updated.

In the following sections, stakeholders' formal and informal role; their power/influence on the policy issues investigated in the Greek case study and; their interests in issues concerning water, energy, land use, agriculture and food, climate and tourism, are analyzed. A stakeholders' map has also been prepared. This map represents, graphically, the role of each stakeholder and the existing interactions among them. Finally, the stakeholders' power/interest grids are presented.

3.1. Stakeholder analysis

Until now, eighteen interviews (1-5 persons) have been conducted with stakeholders already engaged in the project. Among these stakeholders are: The Ministry of Environment and Energy (Directorate for Climate Change and Atmosphere Quality), the Ministry of Foreign Affairs (Directorate of International Energy Issues), the Ministry of Tourism (General Directorate of Tourist Policy), the Ministry of Infrastructure, Transport and Networks (Special Office of Public Works, Construction and Maintenance of Hydraulic Infrastructures), the National Cadastre and Mapping Agency S.A., the Hellenic Public Power Corporation S.A. (PPC), the Athens Labor Unions Organization, the Greek Ombudsman, research / education institutes (National Technical University of Athens, University of Thessaly, National Documentation Centre), Piraeus Bank, WWF-Greece, Greenpeace Greece, the Hellenic Association for Cogeneration of Heat and Power, the Hellenic Association of Photovoltaic Energy Producers and agri-businesses (agricultural multi-shareholders company "Monopati-Monakrivo", company "Mills of Crete"). Stakeholders enriched this analysis with useful information about issues concerning: policy design, strategic policy priorities, interactions among decision makers, policy implementation in a practical level, policy coherence and existing conflicts/synergies as well as their interests as to the nexus-related policies. Relevant information about each of participants is presented concerning: their formal and informal role during the policy making process, the source of their power as well as their interests with respect to the nexus-related policy sectors.

Ministry of Environment and Energy (YPEKA)		
Dimensions	Sub-dimension	Description
Stakeholder's role		Public stakeholder, responsible for environmental management and the confrontation of environmental problems. Among its responsibilities are: the promotion of "Green Development", the sustainable management of natural resources, the quality of citizens' life, the adaptation to climate change impacts and the design of climate change mitigation strategies, the management of energy and water resources and the spatial organization of the productive sectors (http://www.ypeka.gr/).
Stakeholder's power and its source	Formal power	Design of policies for: climate change adaptation, mitigation of climate change impacts, water resources management, energy sector and land use sector (e.g. regulation of land uses).
	Informal power	Consultant in case where cross-sector policies are designed (e.g. policies for the agricultural and food sector, policies concerning the tourist sector and the available land for the development of tourist activities, etc.).
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage to other public authorities and ministries.
Stakeholder's interests		– Water policies (very strong interest): Official decision/policy maker (water allocation, water quality, water pollution, etc.). – Energy policies (very strong interest): Official decision/policy maker (energy production, RES management, RES energy production, national energy goals, etc.). – Agriculture and food policies (moderate interest): Limited on issues concerning pressures put on the natural resources by the agricultural and food sector. – Land use policies (very strong interest): Official decision/policy maker on issues concerning land uses regulation. – Climate policies (very strong interest): Official decision/policy maker on issues regarding climate change adaptation and mitigation strategies. – Tourist policies (weak interest): Limited on issues concerning pressures put on the natural resources by the tourist sector.

Ministry of Foreign Affairs (Directorate of International Energy Issues)		
Dimensions	Sub-dimension	Description
Stakeholder's role		Public stakeholder, responsible for: foreign policy, international cooperation initiatives (e.g. energy initiatives), implementation of international conventions and international legislation, economic and business cooperations (http://www.mfa.gr/).
Stakeholder's power and its source	Formal power	Design of policies for international energy issues – Political diplomacy (energy and climate issues, etc.) – Bipartite cooperations of Greece concerning the energy sector – Promotion of synergies in the energy sector - Regional actions (EU)- International actions (EU energy policies in relation to global energy policies - Emphasis on policy synergies - Focal point of IRENA - Promotion of coordinations among ministries with similar interests - Political diplomacy on issues concerning energy and climate - Generation of the necessary conditions for the

		extroversion of CRES, DESFA, Hellenic Petroleum).
	Informal power	Consultant in case where cross-sector policies are designed (national, regional and international level).
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage to other public authorities and ministries.
Stakeholder's interests		– Water policies (weak interest): Limited to issues concerning international affairs. – Energy policies (very strong interest): Policy design and promotion on international synergies. – Agriculture and food policies (weak interest): Limited to issues concerning international affairs. – Land use policies (weak interest): Limited to issues concerning international affairs. – Climate policies (moderate interest): In relation to the energy sector. – Tourist policies (weak interest): Limited to issues concerning international affairs.

Ministry of Tourism (General Directorate of Tourist Policy)		
Dimensions	Sub-dimension	Description
Stakeholder's role		Public stakeholder, responsible for: design of tourist policies, promotion of the Greek "tourist product", organization of an educational tourist framework / tourist training, tourist infrastructures and tourist investments (http://www.mintour.gov.gr/).
Stakeholder's power and its source	Formal power	Design of tourist policies - Institution of laws concerning the tourist sector.
	Informal power	Lobbyist / Consultant in case where cross-sector policies are designed - Monitoring policy coherence - Policy conflict management.
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage to other public authorities and ministries.
Stakeholder's interests		– Water policies (very strong interest): Availability of water resources, meeting the needs of the tourist sector. – Energy policies (very strong interest): Availability of energy resources, meeting the needs of the tourist sector - Conflicts with the energy sector for the exploitation of geothermal springs. – Agriculture and food policies (very strong interest): Competitive land uses, agricultural vs. tourist activities - Food availability, meeting the needs of the tourist sector. – Land use policies (very strong interest): Land availability for the development of tourist activities - Land use regulatory framework. – Climate policies (very strong interest): Adaptation of the tourist sector to climate change impacts - The tourist sector is very sensitive with respect to environmental impacts. – Tourist policies (very strong interest): Design of relevant policies and future strategic directions.

Ministry of Infrastructure, Transport and Networks (Special Office of Public Works, Construction and Maintenance of Hydraulic Infrastructures)		
Dimensions	Sub-dimension	Description
Stakeholder's role		Public stakeholder, responsible for: design of national policies and implementation of European and International policies having to do with transportation networks, telecom services and hydraulics (e.g. construction of dams) (http://www.yme.gr/).
Stakeholder's power and its source	Formal power	Design of policies having to do with the construction and maintenance of hydraulic infrastructures, design of the program of public investments.
	Informal power	Consultant in case where cross-sector policies are designed.
	Source of power	Legal public authority, available knowledge-expertise-experience, linkage to other public authorities and ministries.
Stakeholder's interests		– Water policies (very strong interest): Water availability and water uses, construction of hydraulic infrastructures. – Energy policies (moderate interest): Exploitation of water resources for energy production (hydroelectric power plants). – Agriculture and food policies (moderate interest): Exploitation of water resources by the agricultural sector for irrigation purposes. – Land use policies (weak interest): Land availability for the construction of hydraulic infrastructures. – Climate policies (no interest). – Tourist policies (weak interest): Exploitation of water resources by the tourist sector.

National Cadastre and Mapping Agency S.A.		
Dimensions	Sub-dimension	Description
Stakeholder's role		Legal entity of private law. Responsible for: the study, the development and operation of the Hellenic cadastre (http://www.ktimatologio.gr/Pages/Default.aspx).
Stakeholder's power and its source	Formal power	No formal power mandated by law.
	Informal power	Supportive role during the design of land use policies, consultancy and supply of geo-data and geo-information.
	Source of power	Available knowledge-expertise-experience, linkage to other public authorities and ministries.
Stakeholder's interests		– Water policies (no interest). – Energy policies (no interest). – Agriculture and food policies (no interest). – Land use policies (very strong interest): Operational service for the development of Hellenic cadastre – Production of relative geo-data and geo-information. – Climate policies (no interest). – Tourist policies (no interest).

Hellenic Public Power Corporation S.A. (PPC)		
Dimensions	Sub-dimension	Description

Stakeholder's role		Public stakeholder – The biggest power producer and electricity supply company in Greece – Assets in lignite mines, power generation, transmission and distribution – Active in the RES sector (PPC Renewables S.A.) (https://www.dei.gr/el).
Stakeholder's power and its source	Formal power	Participant during the design of energy policies in the national, EU and global level – Consultation on energy and environmental issues – Policy intervention – Advising.
	Informal power	Consultant in case where cross-sector policies are designed.
	Source of power	The largest public power corporation in Greece, available knowledge-expertise-experience, linkage with other public authorities and ministries, highly reputed opinion leaders.
Stakeholder's interests		– Water policies (very strong interest): Availability of water resources, meeting the needs of the energy sector - Hydropower. – Energy policies (very strong interest): Investments related to the energy sector for electricity production and supply – Participation during policy design processes - Consultancy. – Agriculture and food policies (low interest). – Land use policies (very strong interest): Land availability – Policies regulating land use for the development of activities concerning the energy sector (production and supply) - Investments. – Climate policies (very strong interest): Climate change adaptation policies in relation to the energy sector – Climate change mitigation strategies in relation to the energy sector. – Tourist policies (low interest).

Athens Labor Unions Organization (EKA)		
Dimensions	Sub-dimension	Description
Stakeholder's role		Regional trade union organization whose aims are: to merge the labor unions in Athens for the protection of economic, professional, labor and social security; to coordinate the activities of labor unions; to improve the working conditions; to extend and improve labor legislation, etc. (http://www.eka.org.gr/).
Stakeholder's power and its source	Formal power	Establishment of proposals focusing on environmental impacts on employees and laborers. Indicative issues of special interest are: climate change impacts, quality of the atmosphere within the urban environment, waste management, water management, land uses, energy and transportation.
	Informal power	Consultant during the design of policies that concern employees (e.g. working conditions) – Representative of laborers and employees – Training employees' and laborers' representatives on: political economy, environmental issues, legislation, negotiation, etc.
	Source of power	Labor union that defends the rights of employees – Available knowledge-expertise-experience – Linkage to key stakeholders (decision makers, politicians).
Stakeholder's interests		– Water policies (very strong interest): Impacts of water policies on employees (working conditions). – Energy policies (very strong interest): Impacts of energy policies on employees (working conditions). – Agriculture and food policies (very strong interest): Impacts of agricultural and food sector policies on employees. – Land use policies (very strong interest): Impacts of land use

		policies on employees (working conditions). – Climate policies (very strong interest): Impacts of policies concerning climate and atmosphere quality on employees – Climate change impacts on employees (working conditions). – Tourist policies (very strong interest): Impacts of policies concerning the tourist sector on employees (working conditions).

The Greek Ombudsman		
Dimensions	Sub-dimension	Description
Stakeholder's role		Independent authority. Mediates between public administration and citizens in order to help citizens in exercising their rights effectively. It also makes recommendations and proposals to the public administration (https://www.synigoros.gr/).
Stakeholder's power and its source	Formal power	Policy assessment and policy evaluation on the basis of citizens' references. Policy assessment concerns the level of policy implementation and policy design "on the field" – Interlocutor of legislative and executive authorities.
	Informal power	Consultant on issues mainly concerning policy implementation.
	Source of power	Authority focusing on policy implementation and the assessment of implemented policies – Available knowledge-expertise-experience – Linkage to key stakeholders (decision makers, politicians).
Stakeholder's interests		– Water policies (very strong interest): Implementation / assessment of water policies and relative impacts on citizens. – Energy policies (very strong interest): Implementation / assessment of energy policies and relative impacts on citizens. – Agriculture and food policies (very strong interest): Implementation / assessment of agricultural and food policies and relative impacts on citizens. – Land use policies (very strong interest): Implementation / assessment of land use policies and relative impacts on citizens. – Climate policies (very strong interest): Implementation / assessment of climate policies and relative impacts on citizens. – Tourist policies (very strong interest): Implementation / assessment of tourist policies and relative impacts on citizens.

School of Mechanical Engineering (National Technical University of Athens)		
Dimensions	Sub-dimension	Description
Stakeholder's role		Public university / research and innovation organization (http://www.mech.ntua.gr/gr/).
Stakeholder's power and its source	Formal power	Consultant of the HORIZON2020 energy programme committee (energy policy design).
	Informal power	Consultant of the HORIZON2020 energy programme committee (energy policy design).
	Source of power	Academic organization – Available knowledge-expertise-experience – Linkage to key stakeholders (research institutes, scientific organizations, businesses).
Stakeholder's interests		– Water policies (no interest). – Energy policies (very strong interest): Energy strategic

		planning, energy saving. – Agriculture and food policies (no interest). – Land use policies (no interest). – Climate policies (very strong interest): Climate issues in relation to energy planning and energy saving. – Tourist policies (no interest).

School of Planning and Regional Development (University of Thessaly)		
Dimensions	Sub-dimension	Description
Stakeholder's role		Public university / research and innovation organization (http://www.prd.uth.gr/en/).
Stakeholder's power and its source	Formal power	No formal power mandated by law.
	Informal power	Consultant on issues having to do with land use management, regional planning and the respective policies.
	Source of power	Academic organization – Available knowledge-expertise-experience – Linkage to key stakeholders (research institutes, governmental authorities).
Stakeholder's interests		– Water policies (weak interest). – Energy policies (moderate interest): Management/availability of land for the development of energy infrastructures. – Agriculture and food policies (strong interest): Regulation of land uses for the development of agricultural activities, protection of agricultural land. – Land use policies (very strong interest): Regulation of land uses, elimination of land use conflicts, balanced distribution of economic activities – Climate policies (moderate interest): Impacts of climate change and climate policies on land uses. – Tourist policies (strong interest): Regulation of land uses for the development of tourist activities.

National Documentation Centre (National HORIZON2020 Contact Point on Energy Issues)		
Dimensions	Sub-dimension	Description
Stakeholder's role		Public research organization. Supports research and technology – Collection, documentation, dissemination and preservation of quality digital content and data produced by the Greek scientific, research and cultural communities (http://www.ekt.gr/).
Stakeholder's power and its source	Formal power	No formal role mandated by law.
	Informal power	Feedback to the General Secretariat of Research and Technology for policies concerning the energy sector.
	Source of power	Public research organization – Available knowledge-expertise-experience – Linkages to key stakeholders (research institutes, academic organizations).
Stakeholder's interests		– Water policies (no interest). – Energy policies (very strong interest): Energy policies from the perspective of research and technology. – Agriculture and food policies (no interest). – Land use policies (no interest).

		– Climate policies (no interest). – Tourist policies (no interest).

Piraeus Bank		
Dimensions	Sub-dimension	Description
Stakeholder's role		Private financial organization, one of the leading banks in Greece. It leads a group of companies covering all types of financial activities in Greece. Special emphasis is placed on the areas of medium-sized and small enterprises, agricultural banking, leasing, investment banking, etc. (http://www.piraeusbank.gr/el/idiwtes).
Stakeholder's power and its source	Formal power	No formal power mandated by law.
	Informal power	Consultant (management level) - Funding the agricultural sector - Implementation of policies in the funding level – Design of strategies in the framework of private initiatives concerning products and services relative to the nexus components - Funding the renewable energy sector, energy saving, sustainability.
	Source of power	One of the leading Greek banks – Corporation with big turnover and high number of employees – Knowledge-experience-expertise – High level businessmen – Investment corporation – Highly reputed opinion leaders.
Stakeholder's interests		– Water policies (very strong interest): Sustainable water resources management, available water resources for the development of agricultural activities. – Energy policies (very strong interest): Funding of renewable energy sector, energy issues related to the agricultural sector, green banking. – Agriculture and food policies (very strong interest): Funding the development of agricultural activities, agricultural entrepreneurship. – Land use policies (very strong interest): Availability of land for the development of green banking activities and the development of agricultural sector (agricultural entrepreneurship). – Climate policies (very strong interest): Adaptation of the bank product mix and service model to climate change impacts. – Tourist policies (very strong interest): Development and funding of tourist activities.

WWF-Greece		
Dimensions	Sub-dimension	Description
Stakeholder's role		NGO. Protection, preservation and sustainable management of natural environment and natural resources. Identification of the country's comparative advantages and promotion of long-term solutions for a sustainable future (http://www.wwf.gr/).
Stakeholder's power and its source	Formal power	No formal power mandated by law.
	Informal power	Lobbyist. Exerts pressure during the policy design and policy implementation processes – Submission of proposals concerning biodiversity, climate change, common agricultural policy, water

		policy, land uses ,etc.
	Source of power	One of the leading Greek NGOs – Knowledge-experience-expertise.
Stakeholder's interests		– Water policies (very strong interest): Sustainable water resources management, impacts of existing or future policies on water resources. – Energy policies (very strong interest): Impacts of existing or future policies on the management of energy resources and the relative impacts on the environment. – Agriculture and food policies (very strong interest): Impacts of relative policies on agriculture and food. – Land use policies (very strong interest): Impacts of existing or future policies on land use management. – Climate policies (very strong interest): Impacts of existing or future policies on climate (e.g. climate change). – Tourist policies (moderate interest): Impacts of the tourist sector on natural resources.

Greenpeace-Greece		
Dimensions	Sub-dimension	Description
Stakeholder's role		NGO. Protection, preservation and sustainable management of natural environment and natural resources. Special emphasis on climate, energy, agricultural and food sectors (http://www.greenpeace.org/greece/el/).
Stakeholder's power and its source	Formal power	No formal power mandated by law.
	Informal power	Campaign group / Advocacy / Lobbyist – Exerts pressure during the policy design and policy implementation processes – Submission of proposals mainly concerning energy policy, agricultural policy and fishery.
	Source of power	One of the leading Greek NGOs – Knowledge-experience-expertise.
Stakeholder's interests		– Water policies (weak interest): Only in relation to the energy and agricultural sector. – Energy policies (very strong interest): Issues having to do with the rational and sustainable use of energy resources – Promotion of RES – Campaigns against lignite and use of conventional energy sources for energy production. – Agriculture and food policies (very strong interest): Sustainable development of agricultural sector, food safety, production of high quality agricultural products. – Land use policies (weak interest): Only in relation to the agricultural and energy sectors. – Climate policies (very strong interest): Protection of climate and atmosphere quality. – Tourist policies (no interest).

Hellenic Association for Cogeneration of Heat and Power		
Dimensions	Sub-dimension	Description
Stakeholder's role		Non-profit scientific organization. Promotes the evolution of cogeneration technologies – Offers technical, environmental,

		financial and legal support to its members – Advices Greek government on cogeneration issues (http://hacchp.gr/).
Stakeholder's power and its source	Formal power	No formal power mandated by law.
	Informal power	Consultant. Feedback on issues having to do with cogeneration, scientific and technical support, expertise and knowledge diffusion.
	Source of power	Knowledge-experience-expertise – Linkages to key stakeholders (businesses, research centers).
Stakeholder's interests		– Water policies (no interest). – Energy policies (very strong interest): Policy goals and policy means related to energy issues (emphasis on cogeneration). – Agriculture and food policies (no interest). – Land use policies (no interest). – Climate policies (very strong interest): Policies concerning climate change and the contribution of energy sector for combating climate change impacts. – Tourist policies (no interest).

Hellenic Association of Photovoltaic Energy Producers (SPEF)		
Dimensions	Sub-dimension	Description
Stakeholder's role		Business / Producers association supporting and promoting the interests of photovoltaic electricity producers. It also offers support on financial and legal issues, solutions on problems concerning photovoltaics, etc. (http://www.spef.gr/index.php/el/).
Stakeholder's power and its source	Formal power	No formal power mandated by law.
	Informal power	Consultant to the Ministry of Environment and Energy (YPEKA) as an energy expert - Promotion of financial and legal issues - Confrontation of problems related to the production of energy from photovoltaic plants – Simplification of procedures concerning the authorization and operation of PV parks - Consultation to its members - Actions for eliminating greenhouse effect – Representation of its members to the government, international authorities and media offering defense on their economic and professional interests.
	Source of power	Knowledge-expertise-experience – Linkages to key stakeholders (politicians, businessmen, etc.) – Highly reputed opinion leaders.
Stakeholder's interests		– Water policies (weak interest): Limited to issues concerning hydropower. – Energy policies (very strong interest): Interested in energy policies design and implementation, especially those related to photovoltaics (authorization and operation of PVs). – Agriculture and food policies (weak interest): Competitive activities in cases where the development of both agricultural and photovoltaic activities is permitted. – Land use policies (weak interest): Limited to competitive to PVs land uses (agricultural sector, tourist sector, etc.) – Land availability for the development of photovoltaic activities. – Climate policies (strong interest): Limitation of the greenhouse effect, adaptation to climate change impacts, mitigation

		strategies. – Tourist policies (weak interest): Limited to issues concerning PVs visual disturbance within tourist areas.

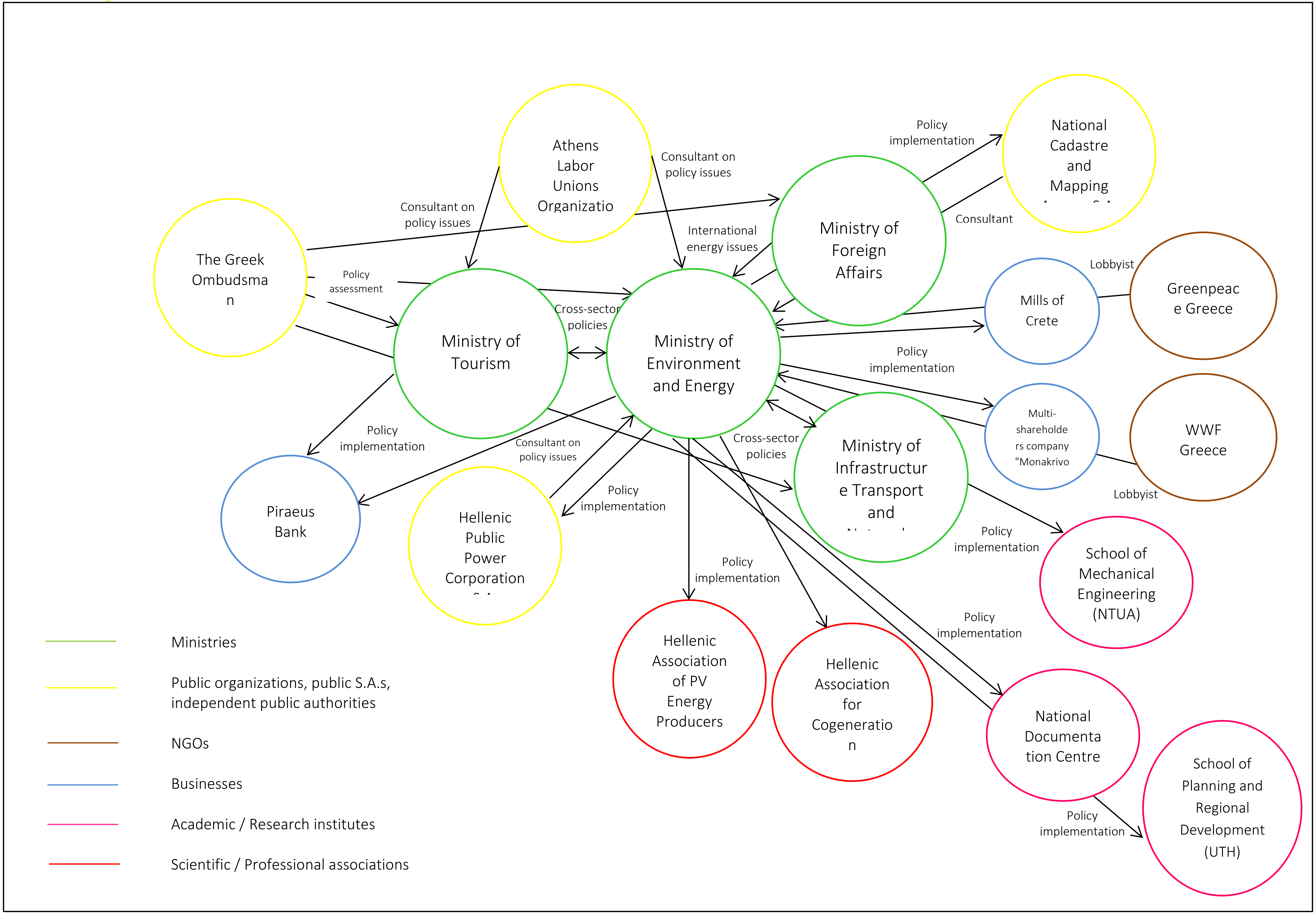
Multi-shareholders Company 'Monopati-Monakrivo'		
Dimensions	Sub-dimension	Description
Stakeholder's role		Private multi-shareholders S.A. Production of high quality and certified olive oil (http://www.monakrivo.com/).
Stakeholder's power and its source	Formal power	No formal power mandated by law.
	Informal power	Increasing olive oil producers' awareness and social awareness on issues concerning: olive trees cultivation, olive oil production and certification (quality), funding policies for the development of agricultural sector, trade of olive products and olive oil, agricultural training programmes.
	Source of power	Knowledge-experience-expertise – Business and trade.
Stakeholder's interests		– Water policies (very strong interest): Available water resources for irrigation purposes - Water saving (smart agriculture). – Energy policies (strong interest): Available energy resources meeting the needs of the agricultural sector - Energy pricing for farmers - Energy consumption by pumping - Energy saving (smart agriculture). – Agriculture and food policies (very strong interest): Policies regulating the development of the agricultural and food sector - Funding opportunities - Future strategic directions - Certification of agricultural products' quality - Trade of agricultural products. – Land use policies (very strong interest): Available land for the development of agricultural activities - Land use conflicts with livestock. – Climate policies (weak interest): Limited to the possible need for adaptation of the agricultural sector to climate change impacts. – Tourist policies (no interest)

Mills of Crete		
Dimensions	Sub-dimension	Description
Stakeholder's role		Business – Food sector. Production of flour products, Cretan cheeses and fodders (http://www.mills.gr/).
Stakeholder's power and its source	Formal power	No formal power mandated by law.
	Informal power	Organization of meetings with producers (farmers) – Consultant on issues concerning the agricultural and food sectors.
	Source of power	Knowledge-experience-expertise – Business and trade.
Stakeholder's interests		– Water policies (no interest). – Energy policies (no interest). – Agriculture and food policies (very strong interest): Interest on agricultural products, food processing, food and fodder

		security. – Land use policies (weak interest): Only in the level of land availability for the development of agricultural and food processing activities. – Climate policies (no interest). – Tourist policies (no interest)

3.2. Stakeholders' map

In this section, the role and responsibility of each stakeholder and the relationships existing among them are briefly described, through a graphical representation. A stakeholders' map has been formed in order to visualize the relevant stakeholders and their interrelationships (the most representative). Each stakeholder is represented by a circle. The color of the circle indicates a different stakeholder or stakeholder group. It should be mentioned that stakeholders have been grouped into six broad categories: ministries, public organizations / public S.A.s / independent public authorities, NGOs, businesses, academic / research institutes, scientific / professional associations. The size of stakeholders is shown by using different sized circles (small circle = small stakeholder / stakeholder group, big circle = big stakeholder / stakeholder group). The relationships among the different stakeholders are indicated by the distance and overlapping of circles (bigger distance-weaker relationship). Overlapping means that the "small circle" stakeholder is a member of the "big circle" stakeholder. Arrows have been used to indicate the source and direction of the respective relationship while the graph has been enriched with labels, specifying the nature of the relationship, next to the arrow.



Athens Labor Unions Organizatio
National Cadastre and Mapping
The Greek Ombudsman
Ministry of Foreign Affairs
Ministry of Tourism
Ministry of Environment and Energy
Mills of Crete
Greenpeace Greece
Multi-shareholders company "Monakrivo
WWF Greece
Ministry of Infrastructure Transport and
Piraeus Bank
Hellenic Public Power Corporation
School of Mechanical Engineering (NTUA)
Hellenic Association of PV Energy Producers
Hellenic Association for Cogeneration
National Documentation Centre
School of Planning and Regional Development (UTH)
Consultant on policy issues
Consultant on policy issues
Consultant on policy issues
Policy implementation
Consultant
International energy issues
Policy assessment
Cross-sector policies
Cross-sector policies
Lobbyist
Lobbyist
Policy implementation
Policy implementation
Policy implementation
Policy implementation
Policy implementation
Policy implementation
Policy implementation
Ministries
Public organizations, public S.A.s, independent public authorities
NGOs
Businesses
Academic / Research institutes
Scientific / Professional associations

3.3. Stakeholders' power/interest grids

In this section stakeholders' power / interest grids are presented. Such grids have been automatically generated in the stakeholder register (excel file) once the data concerning the level of influence and level of interest of each stakeholder with respect to the nexus-related policies were filled in. Influence reflects the power that each stakeholder has over decisions in the several nexus-policy sectors. Interest has to do with the level of interest that each stakeholder has over decisions in the several nexus-policy sectors. Stakeholders' influence and interests have been rated in a scale from 0 (no influence / no interest) to 4 (very strong influence / very strong interest). The influence and interest of each stakeholder was rated with respect to each nexus component. For the Greek case study, influence and interest concerning agricultural and tourist sector policies have also been rated. The results are graphically represented in Diagrams 6-11 each one corresponding to the respective nexus components investigated in the Greek case study.

Diagram 6: Power / interest grid with respect to water

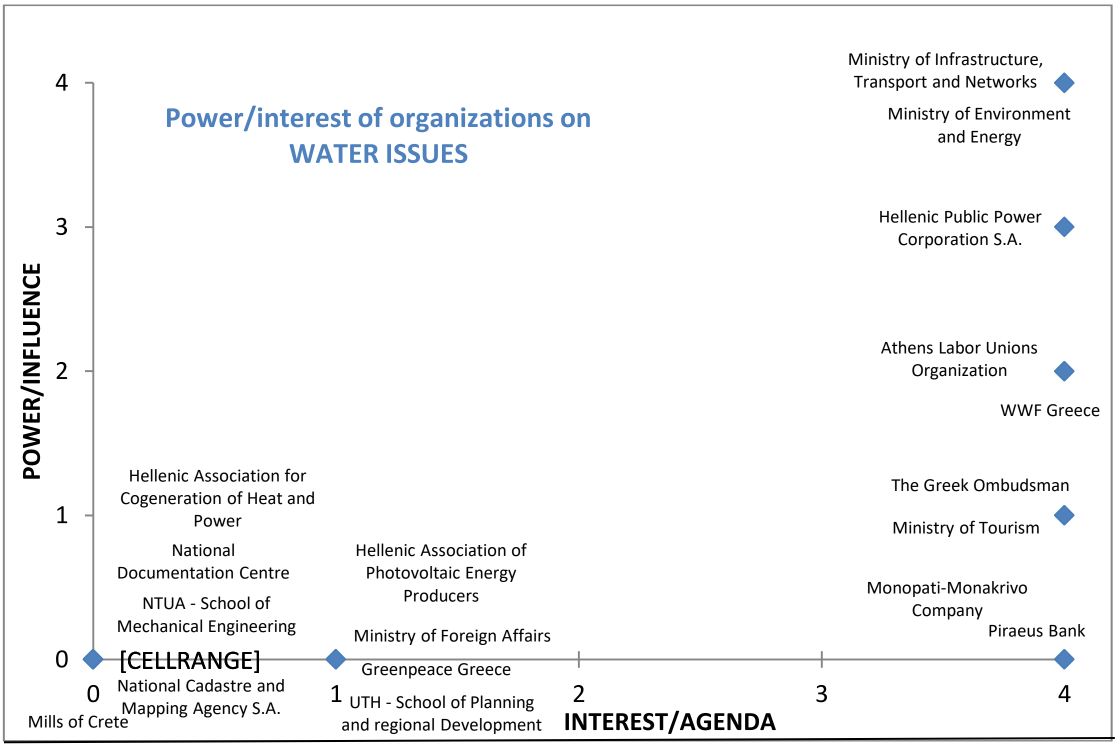


Diagram 7: Power / interest grid with respect to energy

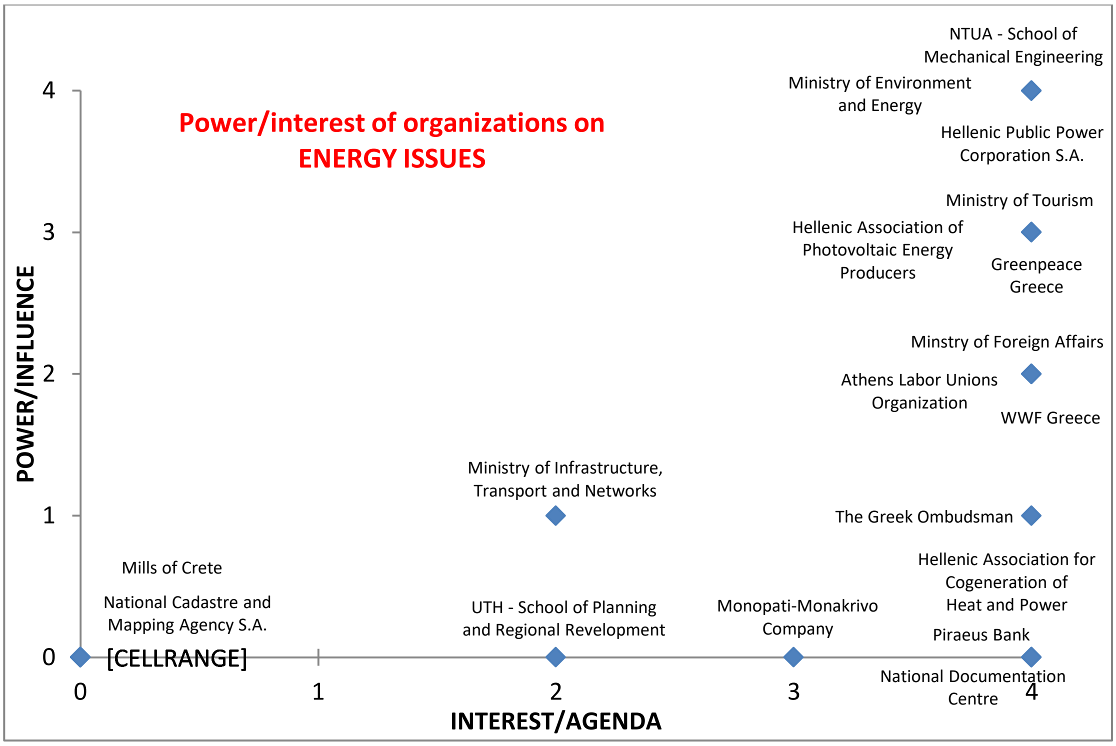


Diagram 8: Power / interest grid with respect to agriculture and food

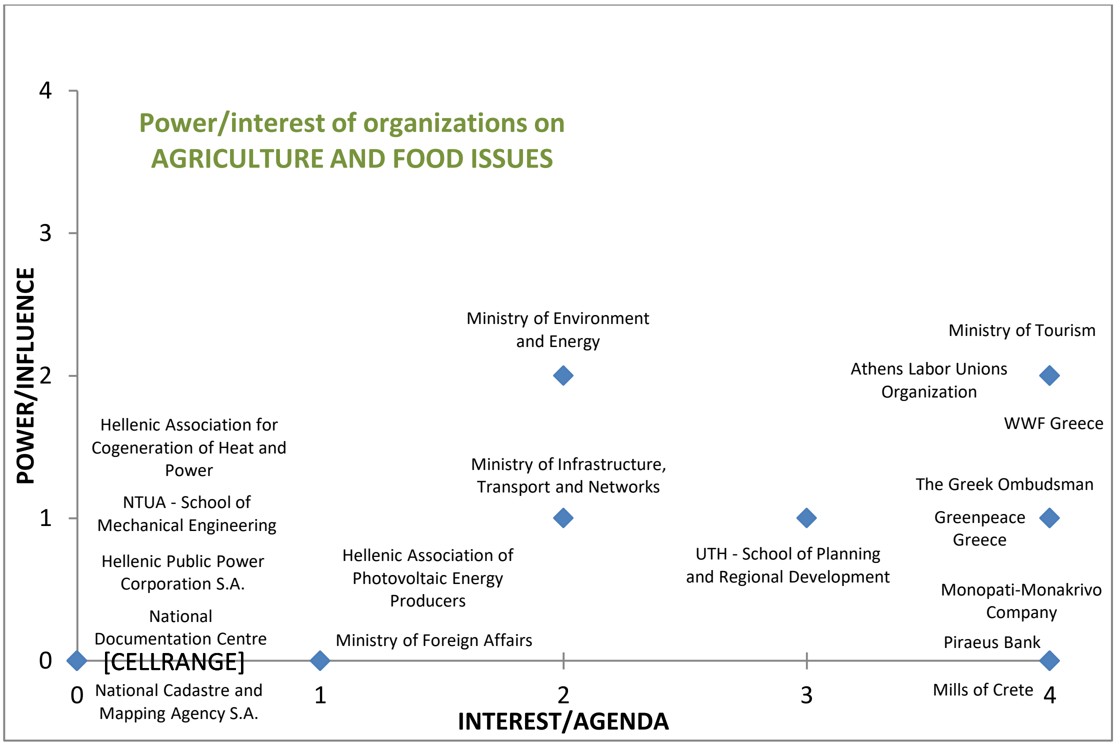


Diagram 9: Power / interest grid with respect to land

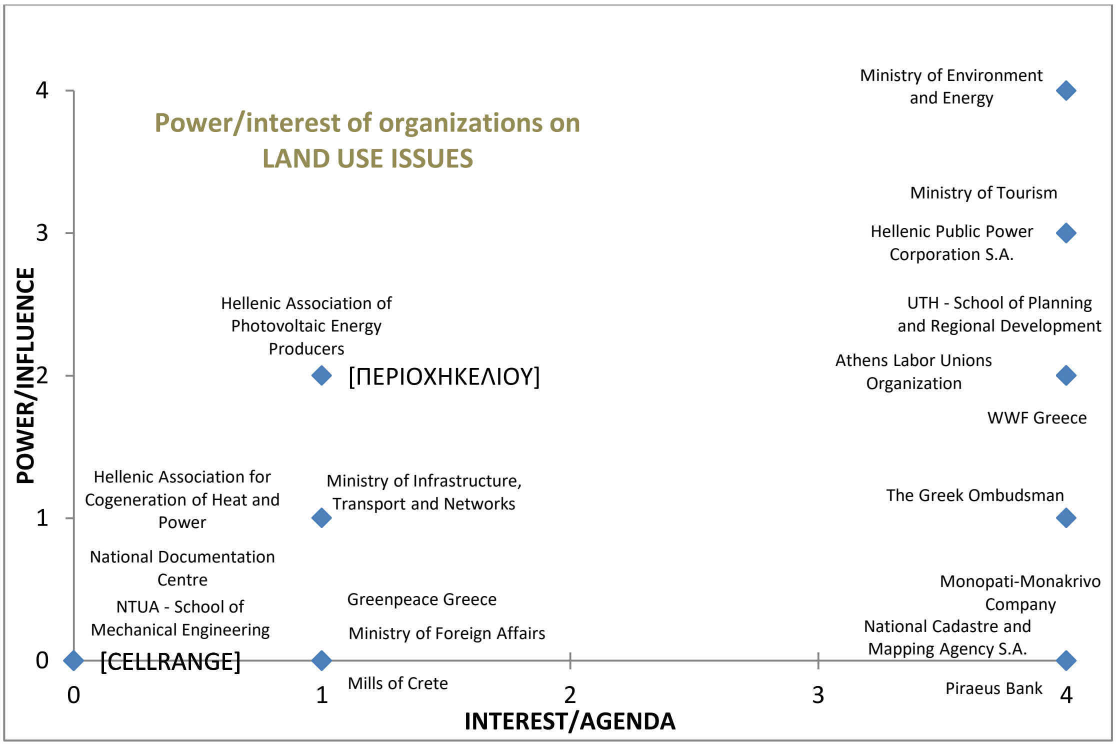


Diagram 10: Power / interest grid with respect to climate

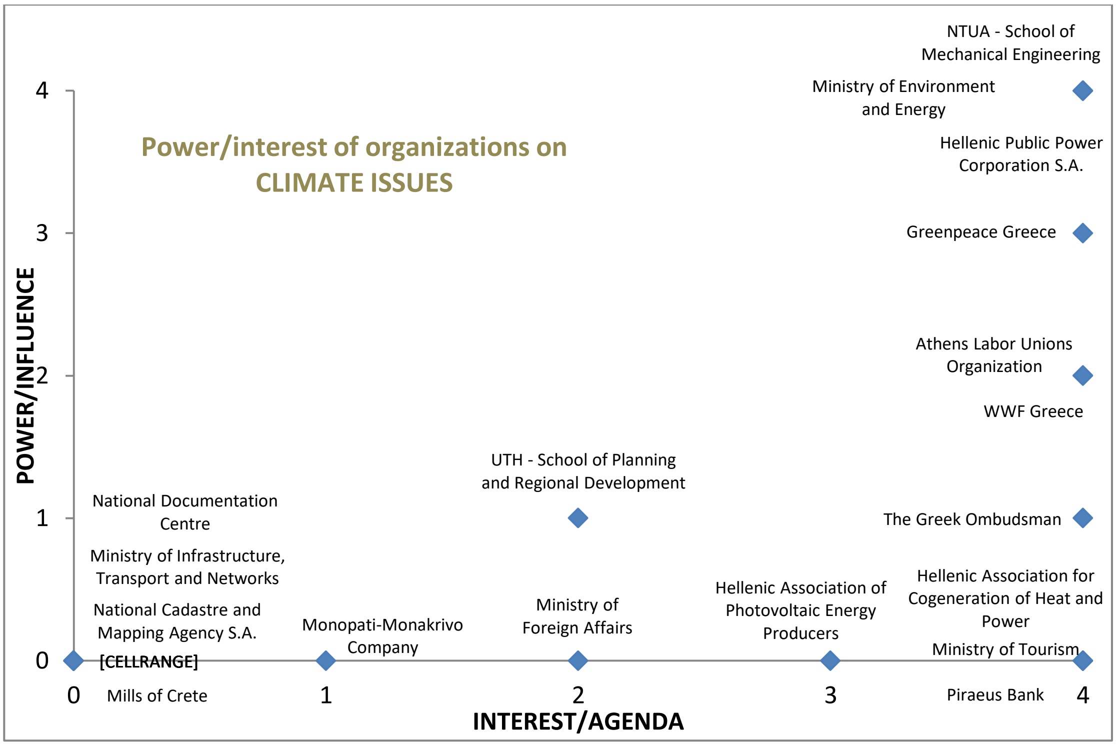
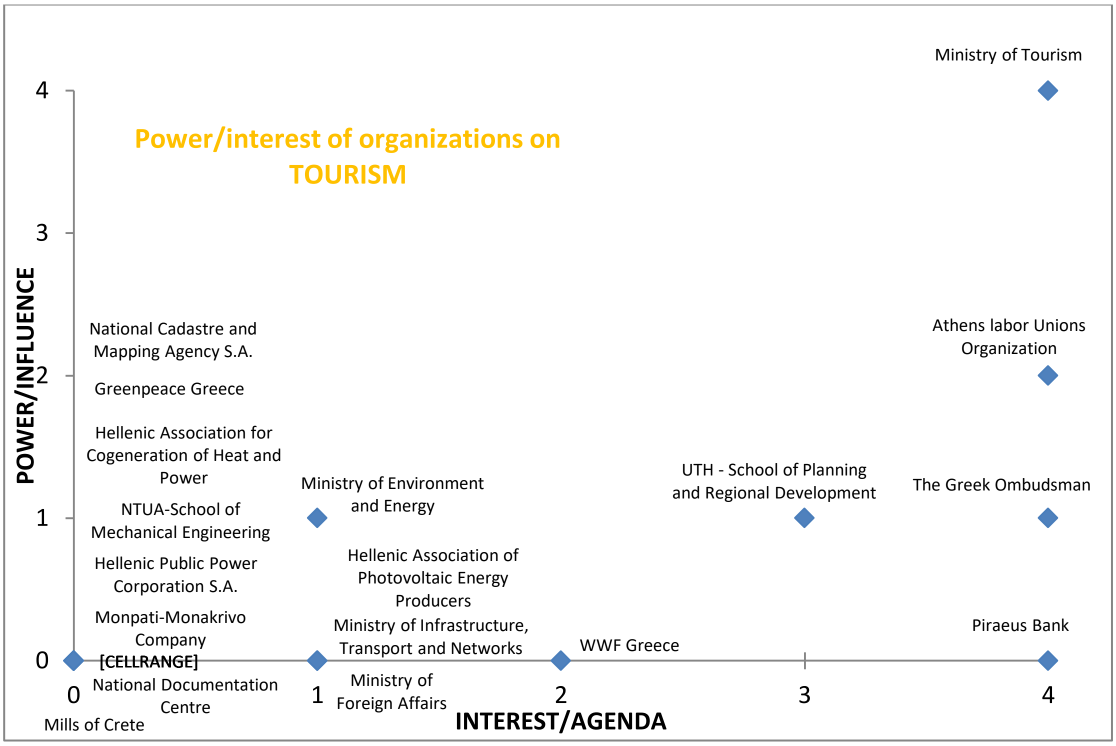


Diagram 11: Power / interest grid with respect to tourism



The power / interest grids show the differentiation among stakeholders with respect to the nexus-related policies. According to the role of each stakeholder – their specific activities and the available means – each of them has a respective influence during the policy design process. For example, the Ministry of Environment and Energy has a dominant role during the design of policies related to environmental management while, Piraeus Bank does not affect policy design but it is strongly interested in policies concerning water, energy, land, climate, agricultural and tourist sector in order to make investments. High influence rates correspond mainly to public authorities. High interest rates correspond to both public and private organizations as well as NGOs.

In general, Ministries and Central Government are the key players during policy design. Private stakeholders are interested in the relative policies setting the framework for the development of specific actions and the implementation of investments. It should be mentioned that in cases where cross-sector policies are structured, collaboration among the interested parts takes place. NGOs act mainly as lobbyists supporting the protection of natural environment and the sustainable management of natural resources. Open dialogue and consultancy are encouraged as they simplify the inherent complexity of the policy design process.

4 Mapping of policy goals and instruments

This chapter focuses on the identification of policy goals and policy means included in the policy documents (laws, ministerial decisions, national strategic plans, etc.) that were collected during the policy inventory phase. Policies reflect the preferences and choices of decision makers, determine what is allowed and what is prohibited as well as the terms and conditions within which several economic activities can be developed.

The policy areas investigated in the context of the present case study concern: the management of the available water and energy resources; the regulation of land uses; the management of agricultural, food and tourist sectors and also; the management of climate change impacts. Special emphasis is placed on the identification of policy priorities and future strategic actions for the sustainable management and rational use of natural resources. After the analysis of the policy content, a register containing policy goals, namely the aims and expectations of decision makers and; policy means, namely measures and techniques adopted or planned to be adopted for the accomplishment / achievement of the respective policy goals, was created.

The results of the policy content analysis (policy goals and policy instruments) are described in the following tables. In Table 11, a short description of each policy document including the type of each policy document, the title of each document, a short description of its content and information related to the life span of the respective policy is presented.

Table 11: Short description of the policy documents

Type of document	Title of document	Short description of document content	Life span of policy
Law (climate)	Law 3017/2002: Verification of the Kyoto Protocol in the United Nations Framework Convention on climate change	The document deals with sustainable management of emissions – Limitation and reduction of GHG emissions	2002-… 2012: first revision of the policy paper
Action of the Council of Ministers (climate)	National programme for the reduction of GHG emissions 2000-2010	The document deals with the reduction of GHG emissions according to the Kyoto Protocol	2002-2012: first period as defined by the Kyoto Protocol 2020: Scenario of the expected progress
Law (climate)	Law 4345/2015: Verification of the Doha's amendment on the Kyoto Protocol in the United Nations Framework Convention on climate change, having been verified by the Law 3017/2002	The document concerns the limitation and reduction of emissions until 2020	2015-2020
Law (climate)	Law 4426/2016: Verification of the Paris Convention in the United Nations Framework Convention on climate change	The document concerns the reinforcement of the United Nations Framework Convention implementation, the	2016-2020 2020-…

		limitation of temperature increase and the adaptation to climate change impacts	
National strategic plan (climate)	National strategic plan for climate change adaptation	The document deals with the country's resilience against climate change impacts and the mapping of relative strategic directions	2016-…
Decisions (climate)	Common Ministerial Decision 54409/2632 (2004): GHG emissions trading system in reconciliation with the 2003/87/EC Directive Common Ministerial Decision 57495/2959/E103 (2010): Amendment of Common Ministerial Decision 54409/2632 (2004) in order emissions by air transport to be included in the relative activities	The documents concern the protection of climate through the establishment of a national GHG emissions' trading system (rights of emissions) derived from several activities and gases – Air transport has been included in the relative activities from 2010	2006-2020
Law (water)	Law 3199/2003: Protection and management of water resources – Reconciliation with the WFD 2000/60/EC	The document concerns the sustainable management of water resources and the reconciliation of the national legislative framework with the WFD 2000/60/EC	2003-…
Presidential Decree (water)	Presidential decree 51/2007: Determination of measures and procedures for the integrated protection and management of water resources in compliance with the WFD 2000/60/EC	The document deals with the preparation of measures and procedures aiming at the integrated protection and management of inland surface waters, coastal water and groundwater	2007-…
Decision (water)	Decision 39626/2208/E130 (2009): Measures for the protection of groundwater from pollution and deterioration in compliance with the	The document concerns the determination of policy measures in order to prevent groundwater pollution and further deterioration	2009-…

	European Directive 2006/118/EC		
Decision (water)	Common Ministerial Decision 31822/1542/E103 (2010): Assessment and management of flood risk in compliance with the provisions of the European Directive 2007/60/EC	The document concerns the limitation of flood effects through the adoption of measures aiming at the assessment and management of flood risk	2010…
Decision (water)	Common Ministerial Decision 135275 (2017): General rules regulating the costs and pricing system of water services. Method and processes for recovery of costs for water services and for relative water uses	The document concerns the establishment of a national water pricing system and the determination of water costs	2017…
Management Plans for the Greek river basins (water)	River Basin Management Plans	Policy documents (totally 14) concerning the management of the river basins allocated in the 14 water districts of Greece	2014-…
Law (food and agri-food sector)	Law 3165/2003: Sanction of the International Convention on plant genetic resources for food and agriculture	The document concerns the sustainable use of plant genetic resources by the agricultural and food sector	2003-…
Law (agricultural sector)	Law 4056/2012: Regulations for farming activities, livestock and livestock facilities	The document concerns the determination of several procedures regulating the development of livestock	2012-…
Law (agricultural sector)	Law 4036/2012: Pesticides market in Greece – Rational use of pesticides	The document deals with the sustainable and rational use of pesticides	2012-…
Law (agricultural sector)	Law 4282/2014: Development of the aquaculture sector	The document concerns the establishment of a legislative framework regulating the sustainable development of the aquaculture sector in Greece	2014-…
Law (agricultural sector)	Law 4351/2015: Pastures and grazing land in Greece	The document deals with the identification and determination of	2015-… 2019: Deadline for the preparation of grazing

		grazing land / pastures in Greece	management plans
Law (agricultural sector)	Law 3874/2010: Register of farmers and farms	The document concerns the establishment of a register (database) including farmers and their plots	2010-...
Law (agricultural sector)	Law 4384/2016: Agricultural associations, types of collective organization of the agricultural land (rural areas)	The document concerns the determination of the necessary procedures for the constitution of agricultural associations	2016-...
Law (food)	Law 4235/2014: Administrative measures, processes and penalties for the implementation of the EU and national legislation in the food, fodder and health sector and protection of animals	The document deals with the establishment of measures aiming at food and fodders security, population's health and protection of animals	2014-...
Decision (energy)	Decision 49828-2008: Special legislative framework of spatial planning and sustainable development for the renewable energy sector and the respective environmental impact assessment	The document deals with issues concerning electricity production from RES and the installation of the respective power plants	2008-...
Law (energy)	Law 3468/2006: Electricity production from RES and cogeneration of high performance electricity and heat	The document concerns electricity production from RES, cogeneration of high performance electricity and heat and promotion of RES in the internal electricity market	2006-...
Law (energy)	Law 3734/2009: Promotion of cogeneration from two or more types of energy – Issues concerning the 'Mesochora' hydroelectric plant project	The document deals with the promotion of energy cogeneration in the internal market	2009-...
Law (energy)	Law 3851/2010: Acceleration of RES	The document concerns the	2010-... 2020: Attainment of

	development for combating climate change	attainment of the national energy goals and RES sharing in the final gross energy consumption	the national energy goals
Law (energy)	Law 4001/2011: Operation of electricity markets and natural gas markets – Research, production and transmission networks for hydrocarbons	The document concerns the internal electricity and natural gas market	2011-…
Law (energy)	Law 4414/2016: Support of electricity production from RES and cogeneration of high performance electricity and heat– Legal and operational separation of natural gas supply and distribution	The document deals with the promotion of electricity production from RES, energy and heat cogeneration, exploitation of national RES potential, differentiation of the national energy mix, energy efficiency and energy saving	2016-…
Decision (land)	Decision 6876/481-2008: General legislative framework for spatial planning and sustainable development	The document deals with the identification of strategic directions aiming at the integrated spatial and sustainable development of the Greek territory	2023
Law (land)	Law 4269/2014: Spatial and urban planning reformation – Sustainable development	The document deals with the design of a national strategic framework concerning spatial and urban planning	2014-…
Decision (land)	Decision 31722-2011: Special legislative framework for spatial planning and sustainable development of the aquaculture sector and the respective strategic environmental impact assessment	The document concerns the identification of rules, strategic directions, promotion and development of the aquaculture sector	2024
Decision (land)	Decision 11508-2009: Special legislative framework for spatial planning and sustainable development of the industrial sector and the respective strategic	The document deals with the sustainable development of the industrial sector, its spatial organization and its future strategic directions	2013 2021

	environmental impact assessment		
Law (tourist sector)	Law 4179/2013: Simplification of procedures that support tourist entrepreneurship – Reformation of the Greek Tourism Organization	The document concerns the strengthening of tourist entrepreneurship and the re-organization of the Greek Tourism Organization	2013-…
Law (tourist sector)	Law 3105/2003: Tourist training and regulations concerning the tourist sector	The document deals with issues concerning the organization of tourist training schools, the goals of the tourist training organization and other issues concerning the tourist sector	2003-…

The analysis of policy documents unfolded several policy objectives having been set for the sustainable development of all nexus components. Policy objectives were classified into overarching and specific policy objectives. The results are presented in Tables 12-18, each table corresponding to each policy component/sector investigated.

Table 12: Overarching and specific policy objectives for climate

Climate Policy		
Overarching objectives	Specific objectives	Reference documents
Advancement / Promotion of sustainable development Limitation and reduction of emissions	Limitation and reduction of GHG emissions not monitored by the Montreal Protocol	Law 3017/2002: Verification of the Kyoto Protocol in the United Nations Framework Convention on climate change
Reduction of GHG emissions	Forecasting future GHG emissions Scenario describing the expected progress	Action 5 (27.02.2003) – Action of the Council of Ministers: National programme for the reduction of GHG emissions 2000-2010
Limitation and reduction of emissions	Amendment of Annex B of Kyoto's Protocol (quantitative commitments for the limitation or reduction of emissions – 80% of the base year for Greece) Common implementation (EU members) of the quantitative commitments for the limitation or reduction of emissions (second period of Kyoto's Protocol)	Law 4345/2015: Verification of the Doha's amendment on Kyoto Protocol in the United Nations Framework Convention on climate change, having been verified by the Law 3017/2002
Reduction of GHG emissions Reinforcing the implementation of the United	Increase the adaptation ability and resilience to climate change impacts	Law 4426/2016: Verification of the Paris Convention in the United Nations Framework Convention on climate change

Nations Framework Convention on climate change Reinforcing global response against climate change threat and elimination of poverty	Hold the increase of the global average temperature below 2^0 C above the pre-industrial levels Constant efforts to hold the increase of the global average temperature below $1,5^0$ C above the pre-industrial levels	
Reinforcement of country's (Greece) resilience against climate change impacts Mapping out national strategic directions Definition of actions and policies for the adaptation of all economic sectors (emphasis is placed on most vulnerable sectors)	Systemization and improvement of decision making process (short-term and long-term decisions) with respect to climate change adaptation Establishment of a linkage between climate change adaptation and sustainable development patterns through the design and implementation of regional/local plans of action Establishment of a mechanism for monitoring, evaluation/assessment and update of the relative adaptation actions and policies Reinforcement of the society's adaptation ability – Increasing social awareness	National strategic plan for climate change adaptation
Protection of climate	Establishment of a national GHG emissions trading system Inclusion of air transport in the GHG emissions trading system Limitation of GHG emissions in a cost-effective and economic-efficient way	Common Ministerial Decision 54409/2632 (2004): GHG emissions trading system in reconciliation with the 2003/87/EC Directive Common Ministerial Decision 57495/2959/E103 (2010): Amendment of Common Ministerial Decision 54409/2632 (2004) in order emissions by air transport to be included in the relative activities

Table 13: Overarching and specific policy objectives for water

Water Policy		
Overarching objectives	Specific objectives	Reference documents
Protection and management of surface water and groundwater	Preparation of analytical reports describing the state of the art of the Greek river basins Determination of administrative issues (administrative bodies responsible for water resources management)	Law 3199/2003: Protection and management of water resources – Reconciliation with the WFD 2000/60/EC

Implementation of several national legislative provisions concerning sustainable management of water resources (Law 1650/1986 and Law 3199/2003) Reconciliation of the national legislation for water resources management with the WFD 2000/60/EC (sustainable use of water) Incorporation (in the national legislative framework) of definitions included in the WFD 2000/60/EC	Preparation of specific measures and procedures for the integrated protection and management of inland surface waters, transitional waters, coastal water and groundwater Protection of water resources quality Preventing further deterioration of aquatic ecosystems Long-term protection of the available water resources Protection and improvement of the aquatic environment Reduction of discharges and emissions into water resources Reduction of groundwater pollution Mitigation of floods' and drought's effects Protection, upgrading and restoration of surface water systems and artificial or particularly modified water systems (water quality, chemical status, ecological potential)	Presidential Decree 51/2007: Determination of measures and procedures for the integrated protection and management of water resources in compliance with the WFD 2000/60/EC
Protection of groundwater against pollution and deterioration	Institution of proactive measures for monitoring pollution and deterioration of groundwater	Decision 39626/2208/E130 (2009): Measures for the protection of groundwater from pollution and deterioration in compliance with the European Directive 2006/118/EC
Assessment and management of flood risk	Limitation of flood effects on: human health, natural environment, cultural heritage and economic activities related to floods Implementation of the decision in the 14 national water districts	Common Ministerial Decision 31822/1542/E103 (2010): Assessment and management of flood risk in compliance with the provisions of the European Directive 2007/60/EC
Sustainable use of water resources Establishment of a national water pricing system	Determination of water prices for water services Determination of costs for water services Recovery of costs for water services	Common Ministerial Decision 135275 (2017): General rules regulating the costs and pricing system of water services. Method and processes for recovery of costs for water services and for relative water uses

Sustainable management and protection of water resources	Description of the specific characteristics of the river basins located within the 14 national water districts Preparation of a register containing information and operational directions for the integrated management of the Greek river basins Determination of specific goals for each water district	River basin management plans

Table 14: Overarching and specific policy objectives for agriculture

Agricultural Policy		
Overarching objectives	Specific objectives	Reference documents
Preservation and sustainable use of plant genetic resources for food and agriculture	Fair and equitable sharing of benefits derived from the use of plant genetic resources in harmonization with the convention for biodiversity , sustainable agriculture and food security	Law 3165/2003: Sanction of the International Convention on plant genetic resources for food and agriculture
Determination of regulations for the development of livestock activities and livestock facilities	Determination of special measures and criteria for the development and spatial organization of livestock activities Categorization of livestock activities	Law 4056/2012: Regulations for farming activities, livestock and livestock facilities
Reconciliation with the Directive 2009/128/EC: ‘Establishing a framework for Community action to achieve the sustainable use of pesticides’	Definition of provisions for the rational use of pesticides	Law 4036/2012: Pesticides market in Greece – Rational use of pesticides
Sustainable development of aquaculture	Determination of measures and criteria for the development and spatial organization of the aquaculture sector Categorization of aquaculture activities	Law 4282/2014: Development of the aquaculture sector
Identification of pastures and grazing lands in Greece	Mapping pastures and their specific characteristics	Law 4351/2015: Pastures and grazing land in Greece
Creation of a register containing farmers and their plots	Determination of the necessary individual procedures needed for the creation of the register	Law 3874/2010: Register of farmers and farms
Determination of processes regulating the establishment of	Definition of administrative and procedural issues	Law 4384/2016: Agricultural associations, types of collective

agricultural associations		organization of the agricultural land (rural areas)

Table 15: Overarching and specific policy objectives for food

Food Policy		
Overarching objectives	Specific objectives	Reference documents
Ensuring security in the food sector	Implementation of EU and national legislation in the food sector, fodder sector and the sector of animals' protection and health	Law 4235/2014: Administrative measures, processes and penalties for the implementation of the EU and national legislation in the food, fodder and health sector and protection of animals

Table 16: Overarching and specific policy objectives for energy

Energy Policy		
Overarching objectives	Specific objectives	Reference documents
Identification of rules and criteria for the sustainable management of RES Attainment of the national energy goals for climate change adaptation and mitigation	Definition of policies regulating the installation of RES power plants for electricity production Determination of the procedures needed for RES power plants installation – Permissions	Decision 49828-2008: Special legislative framework of spatial planning and sustainable development for the renewable energy sector and the respective environmental impact assessment
Incorporation of the Directive 2001/77/EC: 'Promotion of electricity produced from RES in the internal electricity market'	Electricity production from RES and cogeneration of high performance electricity and heat in the internal market	Law 3468/2006: Electricity production from RES and cogeneration of high performance electricity and heat
Reconciliation with the Directive 2004/8/EC: 'Promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC'	Energy cogeneration from two or more useful types of energy	Law 3734/2009: Promotion of cogeneration from two or more types of energy – Issues concerning the 'Mesochora' hydroelectric plant project
Attainment of national energy goals (2020) - Energy production from RES	RES sharing in the gross final energy consumption: 20%, RES sharing in the gross final electricity consumption: 40%, RES sharing in final energy consumption for heating and cooling: 20%, RES sharing in the transportation sector: 10%	Law 3851/2010: Acceleration of RES development for combating climate change
Incorporation of the Directive 2009/72/EC: 'Common rules for the internal market in electricity and repealing Directive 2003/54/EC'	Identification of general principles concerning the undertaking of activities related to the energy sector (e.g. power plants for energy production, energy supply, etc.)	Law 4001/2011: Operation of electricity markets and natural gas markets – Research, production and transmission networks for hydrocarbons

Incorporation of the Directive 2009/73/EC: 'Common rules for the internal market in natural gas and repealing Directive 2003/55/EC'	Determination of energy pricing system Establishment of a national system for natural gas management	
Introduction of a new framework supporting electricity production from RES and cogeneration of high performance electricity and heat	Incorporation and increasing share of RES power plants and cogeneration power plants to the electricity market Exploitation of national RES potential for electricity production aiming at environmental protection, differentiation of the national energy mix, safety of energy supply and economic development Increase RES sharing to the final gross energy consumption Energy efficiency and energy saving	Law 4414/2016: Support of electricity production from RES and high performance electricity and heat cogeneration – Legal and operational separation of natural gas supply and distribution

Table 17: Overarching and specific policy objectives for land

Land Policy		
Overarching objectives	Specific objectives	Reference documents
Identification of strategic directions for the integrated spatial and sustainable development of Greece for the next 15 years	Sustainable spatial development Development of a balanced and competitive economy (economic development) Strengthening economic and social cohesion Strengthening country's position in the regional and international environment	Decision 6876/481-2008: General legislative framework for spatial planning and sustainable development
Development of a national strategy for spatial and urban planning	Determination of administrative issues concerning spatial planning Design of national, regional (NUTS 2) and specific local spatial plans for national, regional (NUTS 2) and local spatial development Definition of a legislative code regulating spatial and urban planning	Law 4269/2004: Spatial and urban planning reformation – Sustainable development

General directions, rules and criteria for the spatial structure, spatial organization and development of the aquaculture sector	Development of the necessary aquaculture infrastructures under the framework of environmental protection Support competitiveness of the aquaculture sector Support of national aquaculture products	Decision 31722-2011: Special legislative framework for spatial planning and sustainable development of the aquaculture sector and the respective strategic environmental impact assessment
Transformation of the spatial structure of the industrial sector towards the direction of sustainable development National directions for the spatial organization of the industrial sector	Long-term spatial organization of the industrial sector Development of the industrial sector in the local level Strengthening the competitiveness of industrial sector Enhancement of industrial entrepreneurship Broadening the geographical scale of the industrial sector (regional and inter-regional scale)	Decision 11508-2009: Special legislative framework for spatial planning and sustainable development of the industrial sector and the respective strategic environmental impact assessment

Table 18: Overarching and specific policy objectives for tourism

Tourist Policy		
Overarching objectives	Specific objectives	Reference documents
Sustainable development of the tourist sector Development of tourist entrepreneurship	Strengthening tourist entrepreneurship Reorganization of the Greek Tourism Organization	Law 4179/2013: Simplification of procedures that support tourist entrepreneurship – Reformation of the Greek Tourism Organization
Development of tourist training	Organization of tourist training schools Definition of goals and responsibilities of the Tourist Training Organization Improvement of the Greek tourist product	Law 3105/2003: Tourist training and regulations concerning the tourist sector

The analysis of policy documents unfolded also policy means/instruments through which the respective goals may be implemented. Policy means were classified into general instruments or instrument categories and specific policy instruments. The results are presented in Tables 19-25, each table corresponding to each policy component/sector investigated.

Table 19: General and specific policy instruments for climate

Climate Policy		
General instrument or	Specific policy instruments	Reference documents

instrument category		
Increasing energy efficiency in several economic sectors Promotion of research and development in the field of RES Broad adoption of RES for energy production Adoption of policy measures for the reduction of GHG emissions, not monitored by the Montreal Protocol Establishment of broad co-operations among the parts subscribing the Kyoto Protocol in order to enhance policy implementation effectiveness	Protection and reinforcement of sinkholes and GHG stock not monitored by the Montreal Protocol Promotion of sustainable agriculture Use of technologies that 'capture' Carbon Dioxide - Use of innovative and environmental friendly technologies Market adaptation towards reducing emissions (economic stimuli) Reduction of methane emissions Enhancement of knowledge, experience and information sharing and dissemination Preparation of national programmes for combating climate change	Law 3017/2002: Verification of the Kyoto Protocol in the United Nations Framework Convention on climate change
Forecasting energy consumption and GHG emissions Deregulation of the electricity market Promotion of RES, cogeneration and energy saving Exploitation and promotion of natural gas for heating and cooling Energy saving by the industry sector Construction of wind parks Construction of hydroelectric plants Installation of central photovoltaic systems Exploitation of the available geothermal potential Promotion of biomass for	Adoption of a methodological framework for emissions forecasting (ENPEP model) Specific measures for the reduction of GHG Reduction of emissions of new-technology cars Improvement of buildings' thermal behavior (households and tertiary sector) Maintenance or replacement of boilers used for central heating (households and tertiary sector) Shading and roof fan-systems, night aeration Use of effective air conditioning systems Use of effective electrical appliances Use of high performance lamps Lighting automation	Action 5 (27.02.2003) – Action of the Council of Ministers: National programme for the reduction of GHG emissions 2000-2010

electricity production	Solar collectors for water and space heating Roof-top solar systems Exploitation of biomass for tele-thermoscope purposes Maintenance of cars and trucks Buses that use natural gas Improvement of traffic lights Promotion of public transportation Use of biofuels Promotion of natural gas, solar systems and biomass in the industry sector Development of natural gas cogeneration systems Reduction of nitrogenous fertilizers - promotion of biological crops Reorganization of the chemical industry	
Measures for the implementation of the national quantitative commitments for the limitation or reduction of emissions	Common implementation of commitments with the other EU members Reduction of emissions by 80% in comparison to the base year for Greece	Law 4345/2015: Verification of the Doha's amendment on Kyoto Protocol in the United Nations Framework Convention on climate change, having been verified by the Law 3017/2002
Register of emissions and contribution of each part (of the Paris convention) towards the reduction of GHG emissions Formulation and dissemination of long-term strategies for the limitation of GHG emissions Enhancing the scientific knowledge about climate Assessment of climate change impacts and the respective susceptibility	Preservation and improvement of GHG tanks Sustainable management of forest land Incentives to the private and public sector for the limitation of GHG emissions Monitoring and evaluation of climate change impacts and the respective susceptibility	Law 4426/2016: Verification of the Paris Convention in the United Nations Framework Convention on climate change

Improvement of socioeconomic resilience and ecological systems resilience		
Measures for the sustainable management of natural resources (soil, water, biodiversity, pastures) Risk and disaster management (climate change impacts) Monitoring, preservation and restoration of biodiversity components Measures of the preservation of vulnerable NATURA2000 ecosystems Regulation of land uses Promotion of alternative tourism Sustainable management of biological sea resources Projects for the management of climate change impacts on water resources (monitoring climate change impacts on groundwater, improvement of existing meteorological network, etc.) Coordination of measures concerning the energy sector with measures concerning the agricultural sector, water resources and built environment Adaptation of urban planning (architecture of buildings, urban green space, etc.) Limitation of thermal and energy needs	Increasing public awareness – Consultation and promotion of public dialogue Innovative knowledge dissemination and sharing between experts-trainers and farmers (training of farmers) Establishment of a National Council for Climate Change Construction of a database containing climate change impacts on agricultural sector Funding programmes concerning agricultural sector's adaptation to climate change Changes on biological material and cultivation techniques Design of regional plans for the sustainable development of agricultural sector Protection-preservation of forest biodiversity - Limitation of forest fires (mapping out forest land, legislative framework, afforestation, proactive planning, etc.) Production of usable water by forests Acquisition of knowledge concerning climate change impacts on fishery (temporal differentiation of fishery production, spatial and temporal differentiation of adopted techniques, etc.) and aquaculture sector Water resources saving-Effective use of water-Limitation of pumping Differentiation of tourist activities with respect to the region (spatial scale) and seasonality (temporal scale)	National strategic plan for climate change adaptation

	(region attractiveness, thermal convenience indicators)	
Development of integrated policies Reduction of "human-produced" GHG emissions	Categorization of activities producing emissions Adoption and use of suitable technologies Categorization of greenhouse gases Establishment of a national authority having the responsibility for the implementation of the respective ministerial decisions Establishment of processes and conditions for the acquisition of permissions for GHG emissions and relative rights (emissions trading system) Establishment of a national GHG emissions distribution system Transfer, return and cancellation of "emissions rights" Creation of a national registry for the assignment, occupation, transfer and cancellation of "emissions rights" Incorporation of annexes (Directive 2003/87/EC) including activities with GHG emissions and classification of greenhouse gases	Common Ministerial Decision 54409/2632 (2004): GHG emissions trading system in reconciliation with the 2003/87/EC Directive Common Ministerial Decision 57495/2959/E103 (2010): Amendment of Common Ministerial Decision 54409/2632 (2004) in order emissions by air transport to be included in the relative activities

Table 20: General and specific policy instruments for water

Water Policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Preparation of analytical reports including: the characteristics of each river basin, the possible effects of human activities on surface water and groundwater, the economic analysis of water uses in each river basin Preparation of a national register including protected	Establishment of a National Committee for Water Resources responsible for water policy design, water management and protection, monitoring and control of policy implementation, acceptance of national programmes concerning protection and management of water potential in Greece	Law 3199/2003: Protection and management of water resources – Reconciliation with the WFD 2000/60/EC

areas Establishment of a national monitoring network (quality and quantity of water) Preparation of regional river basin management plans Development of programmes and measures for monitoring water resources status Establishment of general rules regulating water use (water supply, irrigation, industrial use, energy production, recreation activities) Permissions for water use and implementation of projects for water exploitation Definition of penalties concerning water pollution	Establishment of a National Council for Water Resources Establishment of a Central Water Service whose main responsibilities are: generation of national programmes concerning protection and management of water potential in Greece, monitoring the implementation of the aforementioned programmes, coordination of the relevant public services, introduction of general rules for water prices, maintenance of a database for the management of hydrological and meteorological data at national level Establishment of a Water Resources Directorate in each Greek region (NUTS 2), responsible for the protection and management of the river basins extended within its administrative boundaries Establishment of regional Water Resources Councils, responsible for promoting participatory actions and public involvement in issues related to management and protection of water resources Establishment of special measures against pollution by each region (achieving high ecological quality) Cost recovery for water services	
Identification of Greek river basins (water districts) Measures for preventing deterioration of surface waters, limitation of groundwater pollution, preventing further deterioration of groundwater Identification of each river basin's and each water district's characteristics, overview of environmental	Identification of water resources used for drinking water supply Combined approach for monitoring point and diffuse sources of pollution (discharges into surface waters) Monitoring the status of surface waters, groundwater and protected areas Programme of measures (part of the river basin management	Presidential Decree 51/2007: Determination of measures and procedures for the integrated protection and management of water resources in compliance with the WFD 2000/60/EC

impacts caused by human activities at both surface waters and groundwater, economic analysis of water use Incorporation of the WFD 2000/60/EC annexes in the Greek legislative framework for water resources	plans) concerning the implementation of EU legislation for the protection of water resources, recovery of costs for water services, sustainable water use, etc. Programme of specific measures against water resources pollution Publication of river basin management plans - Public consultation (preparation-elaboration-revision-update of river basin management plans) Submission of progress reports to the European Commission	
Definition of evaluation criteria for assessing the chemical status of groundwater Definition of the evaluation process for assessing the chemical status of groundwater	Definition of groundwater quality standards Definition of maximum accepted values for pollutants Monitoring the chemical status of groundwater in pre-determined points (network of control points) Registration of groundwater pollution trends (pollution indicators) Determination of threatened groundwater systems Special measures for the limitation of pollutants' penetration into groundwater	Decision 39626/2208/E130 (2009): Measures for the protection of groundwater from pollution and deterioration in compliance with the European Directive 2006/118/EC
Identification of the Public Authority (Special Secretariat for Water), responsible for the implementation of this Decision Preparation of a national program concerning flood risk management	Monitoring (and evaluating) the implementation of the national program concerning flood risk management Proactive assessment of flood risk for each river basin Description of floods having taken place in each river basin during the past Assessment of potential future effects of floods on human health, natural environment, cultural heritage and economic activities	Common Ministerial Decision 31822/1542/E103 (2010): Assessment and management of flood risk in compliance with the provisions of the European Directive 2007/60/EC

	Preparation of flood risk maps Determination of special zones with high flood risk Public participation / consultation in flood risk management processes Increasing public awareness with respect to flood risk	
Rules and measures (directions) aiming at the improvement of water services Establishment of a common process for water services pricing system Determination of water pricing for: water supply, sewerage and wastewater treatment Establishment of a general framework regulating agricultural water use	Stimuli for water users aiming at the efficient use of water resources Establishment of rules regulating the financial cost Establishment of rules regulating the environmental cost Establishment of rules regulating water resources cost Volumetric charge per cubic meter of water (charge fee) Establishment of general rules regulating agricultural water pricing in case of organized collective agricultural networks Establishment of general rules regulating agricultural water pricing in case of non-organized and nom-collective agricultural networks Establishment of a mechanism for monitoring water services	Common Ministerial Decision 135275 (2017): General rules regulating the costs and pricing system of water services. Method and processes for recovery of costs for water services and for relative water uses
Description of the most important pressures imposed by humans on water resources Register of environmental goals concerning water resources in the 14 Greek water districts Register of water resources and their characteristics	Monitoring ecological, chemical and quantitative status of water resources in the 14 national water districts Economic analysis of water uses in the 14 national water districts Summary of the programmes of measures that will be set in each river basin Analytical description of the participation-consultation process	River basin management plans

	Analytical description of each water district (rainfall, river basins, geographical and social characteristics, water demand, etc.) Analytical description of water bodies (surface water, groundwater) of each water district Analytical description of pressures put in the aquatic environment (e.g. pollution) Analytical description of the status of each aquatic system Analytical economic analysis of water uses in each water district	

Table 21: General and specific policy instruments for agriculture

Agricultural Policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Establishment of close links between the Convention on plant genetic resources for food and agriculture and the United Nations Organization for food and agriculture as well as the Convention for biodiversity Preservation, exploration, collection, identification, assessment and documentation of plant genetic resources for food and agriculture Establishment of international co-operations - Promotion of cooperation among international plant genetic resources networks Cooperation of contracting parts (Convention on plant genetic resources for food and agriculture) for the development and promotion of an international information system for plant genetic resources	Adoption / implementation of differentiated agricultural systems, promotion of research, promotion of differentiated crop patterns, locally adapted crops, etc. Creation of a register of plant genetic resources for food and agriculture Technical assistance Protection and promotion of farmers' rights Sharing of benefits Facilitation of access to plant genetic resources for food and agriculture	Law 3165/2003: Sanction of the International Convention on plant genetic resources for food and agriculture

Classification of livestock facilities (criteria: buildings, capacity) Register (database) of farms (Ministry of Rural Development and Food) - Enhancement of transparency - Mapping out pastures	Determination of permission processes for the establishment of livestock activities and the installation of livestock facilities Determination of suitable locations, minimum area and minimum distance among livestock facilities Monitoring livestock activities - Administrative, sanitary and spot tests Special regulations for the installation of farms in forest or public land Management of animals (sheep, goats and cattle) living outside of the farms	Law 4056/2012: Regulations for farming activities, livestock and livestock facilities
Monitoring plant protection products Measures for the sustainable use of pesticides Regulation of pesticides trade activities Monitoring the rational use of pesticides Promotion of integrated plant protection activities	Processes for obtaining permissions (published by SEA) for the development of pesticide market Establishment of a 'Pesticide Scientific Committee' (consultant) Monitoring residues of plant protection products Establishment of training programmes for the sustainable use of pesticides Creation of a register including pesticide industries / pesticide small-industries Creation of a register (database) including certified pesticides - electronic register of pesticides distribution / trade Increasing awareness (public involvement) concerning pesticides Check the equipment for pesticide use Monitoring crop dusting Reduction of pesticide use in specific areas	Law 4036/2012: Pesticides market in Greece – Rational use of pesticides

	Regulations for the management, application and storage of pesticides Monitoring the prices of plant protection products	
Establishment of a National programme for aquaculture development (public involvement during the decision making processes, production of high quality food products, employment, research and development, permission processes, land use regulation) Management of areas where organized aquaculture development activities are taking place (areas of organized aquaculture development) Expansion and relocation of waterborne aquaculture units Definition of procedures regulating the installation of aquaculture units – Prohibitions	Establishment of a National Council for the Aquaculture Sector (consultant on policy issues concerning aquaculture) Regulations concerning direct leasing of water areas – Leasing renewal - Commitments of lease-holders / renters Installation of anchorages Limitations for leasing sea and lake water areas Regulations for using water areas without exchange Regulations for the private use of public mainland areas for the development of aquaculture activities	Law 4282/2014: Development of the aquaculture sector
Development of grazing management plans Mapping of pastures	Creation of a National geo-database named: "Pastures - Grazing Lands of Greece" including the Greek grazing land / pastures - Register of Greek pastures Establishment of committees for monitoring the preparation and implementation of grazing management plans Determination of grazing (land use for grazing) rights within pastures National programme for the collection and management of dead animals Creation of databases including 'animal origin' for food sector and 'animal origin' for animal	Law 4351/2015: Pastures and grazing land in Greece

	sub-products	
Creation of a national register (database) including farmers and their plots	Clarification of the registry process Constant update of the register Unification of relative databases	Law 3874/2010: Register of farmers and farms
Clarification of processes concerning the establishment of agricultural associations – Definition of penalties	Memorandum of agricultural associations – Commitments and rights – Capitals / Financial management – Member responsibilities – Supervision of agricultural associations by the State of Greece / government Classification of the several types of agricultural associations (networking among agricultural and other firms, trade contracts, protection and management of PDOs, PGIs) Training and awareness activities concerning agricultural networking and agricultural partnerships supported by a specific funding mechanism Digital database for the traceability of agricultural products offered by agricultural associations (products certification) Foundation of an organization responsible for the management of agricultural land and the respective equipment	Law 4384/2016: Agricultural associations, types of collective organization of the agricultural land (rural areas)

Table 22: General and specific policy instruments for food

Food Policy		
General instrument or instrument category	**Specific policy instruments**	**Reference documents**
Identification of pertinent authorities for the implementation of the articles 1-36 of the Law 4235/2014 Definition of relative penalties in case of non-compliance (compliance recommendations, administrative penalties, constraints or prohibitions for food and beverages trade)	Determination of specific administrative measures for compliance with EU legislation Monitoring, confiscation, withdrawal or destruction of non-secure food or fodder Constraints and prohibitions concerning the market of animal by-products / sub-products Compliance measures	Law 4235/2014: Administrative measures, processes and penalties for the implementation of the EU and national legislation in the food, fodder and health sector and protection of animals

Controls in food and fodder industry and imposition of penalties in case of offenses Rules and measures ensuring food and fodder security	concerning imports from third countries Definitions of commitments for non-Greek food businesses or food businesses that do not have even a branch in Greece	

Table 23: General and specific policy instruments for energy

Energy Policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Identification of suitable areas for the installation of wind parks and wind turbines (spatial and environmental criteria) Identification of areas where the installation of wind parks and wind turbines is prohibited Identification of suitable areas for the installation of small scale hydropower plants Identification of areas where the installation of small scale hydropower plants is prohibited Definition of criteria for the installation of photovoltaics (barren or low-productivity land, invisible areas, connection capabilities) Definition of criteria for the installation of biomass/biofuels processing units (next to agricultural areas, large farms, landfills, etc.) Identification of areas where installation of biomass/biofuels units is prohibited Definition of criteria for the installation of geothermal plants (geothermal potential / geothermal fields) Exploration of the possibility for energy production from the sea (waves)	Definition of special criteria for the installation of wind parks in the mainland (maximum land cover percentage, minimum distances, integration of wind parks to the landscape) Definition of special criteria for the installation of wind parks in the islands (maximum land cover percentage, minimum distances, integration of wind parks to the landscape) Definition of special criteria for the installation of wind parks in the region (NUTS 2) of Attica (maximum land cover percentage, integration of wind parks to the landscape) Definition of special criteria for the installation of wind parks in the sea and uninhabited islands (construction rules, minimum distances, prohibitions) Definition of 'Wind Priority Areas' and 'Wind Suitability Areas' Identification of water districts with exploitable hydraulic potential Definition of special criteria for the installation of small scale hydropower plants (minimization of visual effect, accessibility) Definition of criteria for the assessment of hydropower receptors' carrying capacity	Decision 49828-2008: Special legislative framework of spatial planning and sustainable development for the renewable energy sector and the respective environmental impact assessment

	(satisfaction of water supply, irrigation and ecological needs, etc.) Restoration of landscape	
Regulations concerning installation and operation of RES power plants and plants for high performance electricity and heat cogeneration Determination of a pricing system for the electricity produced from RES power plants and cogeneration power plants Establishment of a national programme concerning the development and promotion of photovoltaics	Definition of processes for obtaining the necessary permissions concerning electricity production from RES (installation of the relative infrastructure / equipment, location, installed power, etc.) - Cases where permission is not needed (exceptions) - Permissions concerning hybrid RES power plants, RES power plants and plants for high performance electricity and heat cogeneration Determination of procedures for the access / incorporation of RES power plants and electricity and heat cogeneration power plants to the national electricity distribution system / interconnected power network Incorporation / inclusion of RES power plants and electricity and heat cogeneration power plants to the non-interconnected islands Connection of RES power plants to the national electricity distribution system / network Warranties of the origin of the produced electricity - Identification of organizations, responsible for publishing and monitoring the relative electricity origin warranties Establishing a committee for the promotion of large-scale investment projects for RES and large scale investment projects for electricity and heat cogeneration power plants Generation of reports concerning RES development (share of RES in the national energy mix)	Law 3468/2006: Electricity production from RES and cogeneration of high performance electricity and heat
Use of two or more energy	Adoption of cogeneration	Law 3734/2009: Promotion of

resources for energy cogeneration Promotion of energy cogeneration	technologies Establishment of a methodology for the computation of electricity production from cogeneration Establishment of a methodology for the computation of cogeneration performance Specific measures for the promotion of cogeneration and high performance cogeneration (energy pricing, transmission and distribution of the produced electricity) Warranties concerning the origin of electricity produced from high performance cogeneration Regulations concerning cogeneration power stations that are not characterized as high performance plants Assessment of the national cogeneration potential Commitments of the owners of cogeneration power plants for providing data and information concerning cogeneration power plants operation and electricity production – Penalties	cogeneration from two or more types of energy – Issues concerning the 'Mesochora' hydroelectric plant project
RES environmental impacts assessment study Amendment of older energy legislative provisions for the efficient combating of climate change Regulation of issues concerning location and installation of RES power plants (spatial and urban plans, special legislative framework of spatial planning and sustainable development for the renewable energy sector and the respective strategic	Definition of criteria for the release of permissions for energy production from RES and cogeneration Special duties and incentives to domestic users in the areas where RES power plants are installed Development and promotion of RES use in buildings Promotion of energy saving in buildings Foundation of a special RES	Law 3851/2010: Acceleration of RES development for combating climate change

environmental impact assessment, etc.)	service	
Identification of general principles concerning the undertaking / implementation of activities in the energy sector (rational management of energy resources, competitive prices, development and promotion of RES, balanced regional development among Greek NUTS 2, combating energy poverty, etc.) Establishment of a national system for the management of natural gas Development and promotion of natural gas market	Organization and operation of a Greek Regulatory Authority for Energy (monitoring, regulation and supervision of the Greek energy market, security of energy supply, publish of relative permissions, infrastructures development, electricity and natural gas transmission network, energy pricing, monitoring and supervision of electricity market, protection of consumers, regional cooperations, collection of economic-technical and other energy data, public consultation, etc.) Definition of commitments of the energy suppliers (equal treatment of customers, protection of susceptible customers, awareness, etc.) Transparency of pricing system (charges) and information availability Adoption of smart systems for measuring energy consumption Permissions for the construction of natural gas infrastructures, ownership of natural gas infrastructures, natural gas distribution Exploration of the available hydrocarbons potential, research and exploitation of hydrocarbons	Law 4001/2011: Operation of electricity markets and natural gas markets – Research, production and transmission networks for hydrocarbons
Development and support of RES and cogeneration power plants in the internal energy market – Increase of sharing in the total energy mix	Operational incentives (compensation-economic incentives) for RES and cogeneration power plants owners Establishment of a methodology for the computation of a special price for buying RES and cogeneration technologies	Law 4414/2016: Support of electricity production from RES and high performance electricity and heat cogeneration – Legal and operational separation of natural gas supply and distribution

	Competitive procedures for submission of quotes for RES and cogeneration power plants Supporting measures for the development of RES and cogeneration power plants in the non-interconnected islands Supporting the operation of hybrid stations in the non-interconnected islands	

Table 24: General and specific policy instruments for land

Land Policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Land use regulation (spatial organization of several sectors and activities) Measures for biodiversity protection Promotion of unique natural and cultural resources Greece as a transport, energy and telecommunication hub Development of transboundary and other synergies in several sectors (European and international synergies) Promotion of research, technology, innovation and tourism Limitation of urbanization - Development of rural regions (increasing complementarity between urban and rural regions) Protection and promotion of the local identity Adaptation to / mitigation of climate change impacts (energy saving, promotion of RES, protection of forests and wetlands) Dynamic incorporation of	Promotion and development of the transportation, energy and telecommunication sector Development of an 'economy of knowledge' Promotion of entrepreneurship Spatially-dependent and specialized policy incentives (comparative advantages of each region) Elimination of land use conflicts Production of high quality national products Management - Elimination of spatial inequalities Development of isolated mountainous regions and islands Improvement of access to transportation, energy and telecommunication networks – Infrastructures Strengthening social infrastructures (education, health, social welfare, etc.) Proactive planning for possible natural disasters and restoration of damaged areas	Decision 6876/481-2008: General legislative framework for spatial planning and sustainable development

Greece to the European and international environment Balanced and multi-central national development (several urban centers) Development of a well-organized spatial structure of strategic infrastructure networks and transportation-energy-telecommunication services	Improvement of spatial and urban planning quality - Regeneration of deprived areas Integrated development of transportation means - TEN-T Connection with European economic hubs Incorporation of Athens and Thessaloniki to the international and European metropolitan networks Development of a well-organized urban network – Enhancement of synergies among urban centers Spatial organization of the main national poles (network of poles) and the international and inter-regional entries / gates of Greece Promotion of specialization and complementarity among productive sectors Use of spatial planning indicators for monitoring and evaluating progress	
Design of national strategic directions for spatial planning Design of regional (NUTS 2) strategic directions for spatial planning (more specific strategies, based on the special characteristics of each Greek NUTS 2 region) Design of local strategic directions for spatial planning (more specific strategies, municipality level, comparative advantages and weaknesses of each region)	Establishment of a national council for spatial planning (public consultation, public participation actions related to spatial planning and sustainable development, consultant during the design of national legislative frameworks for spatial planning) Development of specialized spatial plans (local level) by taking into consideration the existing local conditions (regions of specific characteristics, special regulations for land uses, special terms of local development) Definition of building coefficient / building restrictions of each region Monitoring urban plans implementation	Law 4269/2004: Spatial and urban planning reformation – Sustainable development

	Register (database) of determined land uses (terms, data and information of land uses) Classification / categorization of land use (domestic use, tourism, urban centre, trade, urban green, technological parks, etc.)	
Spatial organization of the aquaculture sector – Land use regulations Establishment of a national pattern for the spatial organization of the aquaculture sector	Classification / Categorization of several types of aquaculture activities Definition of criteria for assessing the compatibility of aquaculture activities with the special characteristics of human and natural environment Rational use of the available land / space by the aquaculture sector - Protection of vulnerable resources Identification of the available land for aquaculture development	Decision 31722-2011: Special legislative framework for spatial planning and sustainable development of the aquaculture sector and the respective strategic environmental impact assessment
Spatial organization of the industrial sector – Land use regulations Development of the industrial sector with respect to land use regulations Coordination of policies concerning the industrial sector with policies containing the spatial dimension (e.g. spatial planning policies) Sectoral directions and directions of special characteristics for the strategic spatial organization of the industrial sector	Promotion of a spatial pattern that creates external economies in the industrial sector Promotion of a multi-centric pattern of industrial development – Decentralization of the industrial sector Definition of terms regulating the scattering spatial pattern of the industrial sector - Special terms for special categories of industrial activities Promotion of organized industrial spatial patterns (organized industrial areas, etc.) - Terms for the development of organized industrial areas Design of a national pattern for the spatial organization of the industrial sector (poles and axes of industrial development, areas of intense industrial activities, categorization of space based on the comparative advantages and constraints of each region)	Decision 11508-2009: Special legislative framework for spatial planning and sustainable development of the industrial sector and the respective strategic environmental impact assessment

	with respect to the existing potential for the development of industrial activities Promotion of organized receptors for the development of industrial activities Criteria assessing the compatibility of industrial activities (location of new industries or industrial receptors) with the particular characteristics of each region	

Table 25: General and specific policy instruments for tourism

Tourist Policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Promotion of organized and sophisticated tourist investments Specific land use regulations for the development of tourist activities Definition of measures, terms and conditions for the development of organized receptors for the establishment of tourist activities (minimum distances from transportation networks, building coefficients, minimum distance from the coastline, etc.) Establishment of a tourist observatory Enhancement and promotion of tourist training activities and tourist expertise	Determination of building coefficients concerning tourist infrastructures Differentiation of tourist activities and tourist product according to the special characteristics of each region Definition of terms and conditions for the development of complex / sophisticated tourist infrastructures (e.g. conference centers, ski resorts) - Building coefficients, land suitability, minimum available area Identification of areas that are suitable for the development of Integrated tourist activities Generation of hostels for youths Online services by the Greek Tourist Organization (documents concerning permissions, digitization of archives, etc.) Definition of rules for the operation of tourist ports (marinas) Identification of areas satisfying the criteria for the establishment and operation of	Law 4179/2013: Simplification of procedures that support tourist entrepreneurship – Reformation of the Greek Tourism Organization

	tourist ports (marinas) Rules for the development of other activities within marinas' zone Rules and directions for the development of ski resorts and mountainous shelters (lodges) Regulations concerning the administrative role and the respective services of the Greek Tourism Organization Terms and conditions for the development of spa and medical tourism Responsibilities of the hotels chamber Procedures for the publication of permissions for the development of tourist activities Terms and conditions for the development of fishery tourism	
Organization of tourist education and training Networking / development of synergies between public and private tourist organizations	Tourist training courses in a theoretical and practical level Modernization of the tourist training Increasing tourist training awareness Foundation, organization and operation of tourist training schools Strengthening research in the tourist sector (studies, statistical researches, proposals for tourist development) Certification of the available 'tourist skills' Networking among tourist entrepreneurships Training of employees (seminars, educational programmes, publications, conferences, etc.)	Law 3105/2003: Tourist training and regulations concerning the tourist sector

	Production of tourist educational material Funding of the Tourist Training Organization Identification of responsibilities of the Tourist Training Organization Establishment of higher education schools for tourist training Regulation of issues concerning touristic ports (marinas), tourist real estate, mountainous shelters (lodges)	

Except for the general legislative-policy framework, there are several Common Ministerial Decisions clarifying the content of each policy document and giving special directions for its implementation according to the special characteristics of each region. There are also urban plans, for each urban area, that contain the main directions for the development of Greek cities. Special legislation regulates what is allowed and what is prohibited in areas of special natural, cultural and architectural characteristics. Such policy papers were not analyzed in the present report as they concern local spatial scale and thus, they don't determine policy priorities, policy goals and measures in the general national scale.

5 Assessment of policy coherence

In this chapter, the assessment of coherence among the nexus-related policies is presented. An in-depth analysis of the policy goals and policy instruments, identified in the previous chapter, has taken place and shed light on existing or possible future conflicts and synergies mainly concerning the policy implementation stage. The policy coherence analysis was based on the policy mapping stage, the relevant literature as well as on the interviews with the involved stakeholders.

Apart from the literature and the respective policy papers, the contribution of stakeholders at this stage was of exceptional importance. Stakeholders (Table 26) helped us understand better what works and what does not work in practice according to their experience and expertise. Interviews with selected stakeholders (18 stakeholders) were organized in order to explore policy conflicts and synergies and also learn about how such conflicts, synergies and trade-offs are managed in a practical level.

Table 26: Interviewed stakeholders

Stakeholder	Sector	Date of Interview
Ministry of Environment and Energy	– Energy – Climate – Water – Land	09/03/2017
Ministry of Foreign Affairs	– Energy	27/03/2017
Ministry of Tourism	– Tourism	04/04/2017
Ministry of Infrastructure, Transport and Networks	– Water	20/10/2017
National Cadastre and Mapping Agency S.A.	– Land	24/10/2017
Hellenic Public Power Corporation S.A. (PPC)	– Energy – Climate	18/05/2017
Athens Labor Unions Organization	– Climate – Energy – Water – Food – Land – Agriculture – Tourism	17/03/2017
The Greek Ombudsman	– Climate – Energy – Water – Food – Land – Agriculture – Tourism	20/06/2017
School of Mechanical	– Energy	19/09/2017

Engineering (NTUA)	– Climate	
School of Planning and Regional Development (UTH)	– Land – Agriculture – Tourism – Climate	05/03/2018
National Documentation Centre (National H2020 Contact Point on Energy Issues)	– Energy	05/10/2017
Piraeus Bank	– Agriculture – Tourism – Climate	30/03/2017
WWF Greece	– Water – Energy – Food – Land – Climate – Agriculture	13/12/2017
Greenpeace Greece	– Energy – Climate – Food – Agriculture	11/01/2018
Hellenic Association for Cogeneration of Heat and Power	– Energy – Climate	10/10/2017
Hellenic Association of Photovoltaic Energy Producers	– Energy – Climate	24/03/2017
Multi-shareholders Company 'Monopati-Monakrivo'	– Agriculture – Food	04/04/2017
Company 'Mills of Crete'	– Agriculture – Food	09/11/2017

The chapter includes five sections. The first section focuses on the selection of the nexus critical policy objectives and the assessment of interactions among them. The second section concerns the identification of the nexus critical policy instruments and the assessment of interactions among these instruments and the nexus critical objectives. In the third section, the assessment of vertical interactions among policies is investigated. The fourth section focuses on the description of formal and informal arrangements for the management of conflicts-synergies and trade-offs. In the fifth section, success stories and failures are presented.

5.1. Assessment of interactions between nexus critical objectives

This section focuses on the identification of the nexus critical objectives and the assessment of interactions between pairs of objectives, based on policy mapping (block 1) and interviews with stakeholders already engaged in the project. A nexus critical objective is defined as "the policy objective that according to the stakeholders and the policy analysis is highly relevant for the issues under investigation in the case study and has a potentially high number of interactions with other objectives in the nexus" (Munaretto and Witmer, 2017).

In case of the Greek case study, 30 nexus critical policy objectives were selected: 5 for climate, 5 for water, 6 for agriculture and food, 6 for energy, 4 for land and 4 for tourism. These goals are presented in Table 27 accompanied with a detailed description that justifies the reason why they are considered particularly critical in a nexus perspective. Such goals reflect important national priorities as to the several nexus sectors and their future sustainable development in Greece. In addition, the majority of stakeholders are interested in them as they affect their future plans and projects.

Table 27: Nexus critical objectives

Climate		
Code	**Heading**	**Detailed description**
C1	Reduction of GHG emissions	Reduction of emissions from all greenhouse gases according to the respective national and European goals
C2	Increase the adaptation ability and resilience against climate change	Reinforcement of the country's adaptation ability against climate change impacts
C3	Mapping out national strategic directions (policies and actions) against climate change	Establishment of specific policy measures for combating climate change
C4	Increase social awareness with respect to climate change	Establishment of participatory actions in order to increase public awareness and involve citizens in actions having to do with climate change confrontation
C5	Establishment of a GHG emissions trading system (in reconciliation with the 2003/87/EC Directive)	Establishment/adoption of rules which regulate the trade of GHG emissions from the energy and industrial sectors
Water		
Code	**Heading**	**Detailed description**
W1	Protection and sustainable management of surface water	Protection of quality and quantity of surface water
W2	Protection and sustainable management of groundwater	Protection of quality and quantity of groundwater
W3	Preventing further deterioration of aquatic ecosystems	Monitoring sources of pollution and reduction of water resources pollution
W4	Mitigation of floods' and drought's effects	Proactive planning and measures for the management of floods and drought
W5	Establishment of a national water pricing system (establishment of the process)	Definition of water prices / costs of water for several uses (agricultural, domestic, etc.)
Food and Agriculture		
Code	**Heading**	**Detailed description**
F1	Sustainable development of agriculture	Rational use of resources (mainly land and water) by the agricultural sector, adoption of modern agricultural practices and relative technologies for the sustainable management of agricultural sector
F2	Preservation and sustainable use of plant genetic resources for food and agriculture	Equitable sharing of benefits derived from the use of plant genetic resources in harmonization with the convention for biodiversity , sustainable agriculture and food security
F3	Spatial organization of livestock	Categorization of livestock activities, mapping of pastures and their specific

		characteristics, terms and conditions for the development of livestock activities
F4	Rational use of pesticides	Definition of provisions for the rational use of pesticides, protection of land and water resources from pesticides
F5	Sustainable development of aquaculture	Determination of measures and criteria for the development and spatial organization of the aquaculture sector, categorization of aquaculture activities
F6	Ensuring security in the food and fodder sectors	Institution of measures for ensuring food and fodder safety, protection of citizens' and animals' health
Energy		
Code	Heading	Detailed description
E1	Attainment of the national renewable energy goals	RES share in the gross final energy consumption, adaptation of the national energy mix: 20%; RES share in the gross final electricity consumption: 40%; RES share in the final energy consumption for heating and cooling: 20%; RES share in the transportation sector: 10%
E2	Expand electricity production from RES	Exploitation of renewable energy sources for energy production, installation of wind parks, hydroelectric power plants, PVs, geothermal power plants, processing of biomass
E3	Expand cogeneration of high performance electricity and heat	Energy and heat cogeneration from two or more useful types of energy sources
E4	Establishment of a national energy pricing system (establishment of the process)	Determination of a pricing system concerning: energy cogeneration, renewables and conventional energy
E5	Establishment of a national system for natural gas management	This goal mainly concerns natural gas supply and distribution system
E6	Increase energy efficiency and saving	Increase energy efficiency in all productive sectors, energy saving in buildings (target for 2020: 24,7 Mtoe)
Land		
Code	Heading	Detailed description
L1	Sustainable and integrated spatial development	Establishment of a balanced spatial pattern of development between urban and rural regions, protection of biodiversity, protection of natural and cultural resources
L2	Development of a balanced and competitive economy	Strengthening economic and social cohesion, strengthening country's position in the regional (EU) and international environment
L3	Improve spatial organization of aquaculture sector	Development of the necessary aquaculture infrastructures under the framework of environmental protection
L4	Improve spatial organization of industrial sector	Long-term and sustainable spatial organization of the industrial sector
Tourism		
Code	Heading	Detailed description
T1	Sustainable development of the tourist sector	Rational use of resources (water, energy, land) by the tourist sector, adaptation of tourist sector to the special characteristics

		of each region
T2	Development of tourist entrepreneurship	Reinforcement and support of tourist entrepreneurship activities
T3	Development of tourist training	Promotion of tourist training activities, organization and modernization of tourist training schools, definition of goals and responsibilities of the Tourist Training Organization
T4	Improvement of the Greek tourist product	Upgrading the quality of tourist products and tourist services

After the identification of the nexus critical objectives / goals, a scoring matrix including the assessment of interactions among them was built. The objectives were reported in both rows and columns. A scoring scale (-3 to +3) was adopted in order to assess the interactions. The meaning of the respective values is (Munaretto and Witmer, 2017):

- -3 (cancelling): Progress in one objective makes it impossible to reach another objective and possibly leads to a deteriorating state of the second. A choice has to be made between the two (trade-off).
- -2 (counteracting): The pursuit of one objective counteracts another objective.
- -1 (constraining): The pursuit of one objective sets a condition or a constraint on the achievement of another objective.
- 0 (consistent): There is no significant interaction between two objectives.
- +1 (enabling): The pursuit of one objective enables the achievement of another objective.
- +2 (reinforcing): One objective directly creates conditions that lead to the achievement of another objective.
- +3 (indivisible): One objective is inextricably linked to the achievement of another objective.

In general, negative scores identify conflicts between pairs of objectives while positive scores identify synergies between pairs of objectives (Munaretto and Witmer, 2017).

The scoring matrix for the Greek case study (Table 28) consists of 30 rows and 30 columns. The scoring of interactions was conducted by Greek CS researchers based on: the relative literature, the policy analysis that took place in block 1, stakeholders' opinions expressed during the interviews and also on experts' judgments. The scoring matrix is accompanied by justification of the scoring of each cell.

Table 28: Matrix of coherence among policy objectives

	W1	W2	W3	W4	W5	E1	E2	E3	E4	E5	E6	L1	L2	L3	L4	F1	F2	F3	F4	F5	F6	C1	C2	C3	C4	C5	T1	T2	T3	T4
W1		+3	+3	+3	+2	0	0/-1	0	0	0	0	+1	0	+2	+1	+2	0	+1	-1	+1	0	0	+2	+2	+1	0	0/+1	0	0	0
W2	+3		+2	+1	+2	0	0	0	0	0	0	+1	0	0	0/+1	+2	0	+1	-1	0	0	0	+2	+2	+1	0	0	0	0	0
W3	+3	+3		0	0	0	0/-1	0	0	0	0	+1	0	+2	+1	+2	0	+1	-1	+1	0	+1	+2	+2	+1	0	0/+1	0	0	0/+1
W4	+2	+2	0		0	0	0	0	0	0	0	0	0	0	0	0/+1	0	0	0	0	0	0	+3	+2	+1	0	0/+1	0	0	0
W5	+2	+2	0	0		0	0	0	0	0	0/+1	0	0	0	0	0	0	0	0	0	0	0	0/+1	0	0	0	0	0	0	0
E1	0	0	0	0	0		+3	+1	+2	+1	+2	0	0	0	0	+1	0	+1	0	0	0	+3	+2	+2	+2	+3	0/+1	0	0	0
E2	-1	0	-1	0	0	+3		+1	-1	0	0	+1	0	0	0/+1	-1/+1	0	0	0	0	0	+3	+3	+3	+2	+2	+1	0	0	0
E3	0	0	0	0	0	+1	+1		+2	+2	+3	0	0	0	0/+1	0	0	0	0	0	0	+3	+2	+2	0	+3	0/+1	0	0	0
E4	0	0	0	0	0	+1	+1	+1		+1	+2	0	+1	0	0	0	0	0	0	0	0	+2	0	0	0	+1	0	0	0	0
E5	0	0	0	0	0	+1	0	+1	+1		+1	0/+1	0	0	0/+1	0	0	0	0	0	0	+2	+1	+1	+1	+1	0/+1	0	0	0
E6	0	0	0	0	+1	+3	+3	+3	+2	+3		0	0	0	0/+1	+1	0	+1	0	0	0	+2	+2	+2	+2	+2	+1	0	0	0
L1	+1	+1	+1	+1	0	0	0	0	0	0	0		+2	+2	+2	+3	0	+3	0	+3	0	0/+1	0/+1	0	0	0	+2	0	0	0
L2	0	0	0	0	0	0	0	0	0	0	0/+1	+1		+1	+2	+2	0	+2	0	+1	+1	0	0/+1	0	0	+1	+2	+2	0	+1
L3	-1	0	-1	0	0	0	0	0	0	0	0	+2	0/+1		0	0	0	0	0	+3	0	0	0	0	0	0	-1	0	0	0
L4	0/-1	0/-1	0/-1	0	0	0	+1	0	0	0/+1	0	+2	+2	0		-1	0	-1	0	0	0	+1	0	+1	0	+2	0	0	0	0
F1	+2	+2	+1	0	+2	0	-1	0	0/+1	0	0/+1	+2	+1	+3	0		+3	+2	+3	+3	+3	+1	+1	+2	0/+1	0	0/+1	0/+1	0	0/+1
F2	0	0	0	0	0	0	0	0	0	0	0	0/+1	0	0	0	+3		0	+1	0	+3	0	+1	0	0	0	0	0	0	0
F3	-1	-1	-1	0	+1	0	-1	0	0/+1	0	0/+1	+2	+1	0	0	+2	0		0	0	+1	0	0	0	0	0	0	0	0	0
F4	+1	+1	+1	0	0	0	0	0	0	0	0	0	0	0/-1	0	+3	+2	0		0	+3	0	0	0	0	0	0	0	0	0
F5	+1	0	+1	0	0	0	0	0	0	0	0	+2	+1	+3	0	+2	0	0	0		+1	0	0	+2	0	0	0	0	0	0
F6	+1	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	+2	+3	+2	+3	+2		0	0	0	0	0	0	0	0	0/+1
C1	0	0	0	0	0	+3	+3	+3	+1	+2	+3	0	+1	0	0/+1	+1	0	+1	0	0	0		+3	+3	+2	+3	+1	0	0	0
C2	+1	+1	+1	+3	+1	+3	+3	+3	+1	+2	+3	+1	0	0	0/+1	+1	+1	0	0	0	0	+3		+3	+2	+3	+1	0	0	0
C3	+1	+1	+1	+3	+1	+2	+2	+2	+2	+2	+2	+1	0/+1	0	0/+1	0/+1	0	0	0	0	0	+3	+3		0	+1	+1	0	0	0
C4	0	0	0	0	0	+1	+1	0	0	0/+1	+1	+1	0	0	0	0/+1	0	0	0	0	0	+1	0/+1	0		0	0/+1	0	0	0
C5	0	0	0	0	0	+3	+1	+1	+2	0	+2	0	+1	0	+1	0	0	0	0	0	0	+3	+2	+1	0		0	0	0	0
T1	+1	+1	+1	0/+1	+2	0/+1	+1	0/+1	0	0/+1	+1	+1	+2	-1	0	0/+1	0	0	0	0	0	0/+1	+1	+2	0	0		+2	+2	+2
T2	0	0	0	0	0	0	0	0	0	0	0	+1	+2	0	0	0/+1	0	0	0	0	0	0	0	0	0	0	+2		+2	+3
T3	0	0	0	0	0	0	0	0	0	0	0	0	0/+1	0	0	0	0	0	0	0	0	0	0	0	0	0	+3	+2		+2
T4	0/+1	0	0/+1	0/+1	0	0	0	0	0	0	0	0/+1	+2	0	0/+1	0/+1	0	0	0	0	0	0	+1	+1	0	0	+3	+2	+2	

What happens to objective x (in rows) → (affected)
If we make progress on objective y (in column) ↓ (affecting)

Interaction	Score	Justification
Water to Water		
W2>W1	+3	Protection and management of groundwater is intertwined with the protection and sustainable management of surface water as surface water bodies communicate directly with groundwater and vice versa (environmental impacts on groundwater entail impacts on surface water)
W3>W1	+3	Preventing deterioration of aquatic ecosystems is inextricably linked to the efforts towards surface water protection as environmental impacts on aquatic ecosystems entail impacts on surface water
W4>W1	+3	Proactive planning for the mitigation of drought's and floods' effects is intertwined with the sustainable management of surface water and the availability of water resources for covering water needs
W5>W1	+2	Water pricing constitutes a strong incentive for (reinforces) the sustainable management and distribution of water resources
W1>W2	+3	The quality and quantity of surface water is intertwined with the quality and quantity of groundwater
W3>W2	+2	Preventing deterioration of aquatic ecosystems reinforces the efforts towards groundwater protection as aquatic ecosystems communicate with groundwater bodies and affect their quality
W4>W2	+1	Mitigation of drought's and floods' effects enables the sustainable management of groundwater as it affects the availability of groundwater resources and also the quality of water that supplies groundwater bodies
W5>W2	+2	Water pricing creates the conditions for (reinforces) the sustainable management and distribution of groundwater as it puts constraints on possible misuses and waste of the available groundwater
W1>W3	+3	Protection of surface water is inextricably linked to the elimination of aquatic ecosystems' deterioration as it has to do with the reduction of pollution and the protection of quality of surface water
W2>W3	+3	Protection of groundwater is inextricably linked to the elimination of aquatic ecosystems' deterioration as it has to do with the reduction of pollution and the protection of quality of groundwater
W4>W3	0	There is no significant interaction between the two goals
W5>W3	0	There is no significant interaction between the two goals
W1>W4	+2	Sustainable management of surface water reinforces the need for mitigating floods' and drought's effects in order to ensure water availability
W2>W4	+2	Sustainable management of groundwater reinforces the need for mitigating floods' and drought's effects in order to ensure water availability
W3>W4	0	There is no significant interaction between the two goals
W5>W4	0	There is no significant interaction between the two goals
W1>W5	+2	Sustainable management of surface water reinforces the need for water pricing in order to limit water misuses
W2>W5	+2	Sustainable management of groundwater reinforces the need for water pricing in order to limit water misuses (especially by the agricultural sector)
W3>W5	0	There is no significant interaction between the two goals
W4>W5	0	There is no significant interaction between the two goals
Water to Energy		
W1>E1	0	There is no significant interaction between the two goals
W2>E1	0	There is no significant interaction between the two goals
W3>E1	0	There is no significant interaction between the two goals
W4>E1	0	There is no significant interaction between the two goals
W5>E1	0	There is no significant interaction between the two goals
W1>E2	-1	Only in case of hydroelectric power plants that may have impacts on surface water resources
W2>E2	0	There is no significant interaction between the two goals
W3>E2	-1	Only in case of hydroelectric power plants that may have impacts on aquatic

		ecosystems
W4>E2	0	There is no significant interaction between the two goals
W5>E2	0	There is no significant interaction between the two goals
W1>E3	0	There is no significant interaction between the two goals
W2>E3	0	There is no significant interaction between the two goals
W3>E3	0	There is no significant interaction between the two goals
W4>E3	0	There is no significant interaction between the two goals
W5>E3	0	There is no significant interaction between the two goals
W1>E4	0	There is no significant interaction between the two goals
W2>E4	0	There is no significant interaction between the two goals
W3>E4	0	There is no significant interaction between the two goals
W4>E4	0	There is no significant interaction between the two goals
W5>E4	0	There is no significant interaction between the two goals
W1>E5	0	There is no significant interaction between the two goals
W2>E5	0	There is no significant interaction between the two goals
W3>E5	0	There is no significant interaction between the two goals
W4>E5	0	There is no significant interaction between the two goals
W5>E5	0	There is no significant interaction between the two goals
W1>E6	0	There is no significant interaction between the two goals
W2>E6	0	There is no significant interaction between the two goals
W3>E6	0	There is no significant interaction between the two goals
W4>E6	0	There is no significant interaction between the two goals
W5>E6	+1	The establishment of a water pricing system enables energy saving in case of water misuses [e.g. misuse of water from drills (for irrigation) that consume energy by the agricultural sector]
Water to Land		
W1>L1	+1	Protection and sustainable management of surface water enables the protection of biodiversity and natural resources
W2>L1	+1	Protection and sustainable management of groundwater enables the protection of biodiversity and natural resources
W3>L1	+1	Preventing deterioration of aquatic ecosystems enables the protection of biodiversity and natural resources
W4>L1	+1	Mitigation of floods' and drought's effects enables the protection of biodiversity and natural resources as impacts from floods and drought on flora and fauna are constantly limited
W5>L1	0	There is no significant interaction between the two goals
W1>L2	0	There is no significant interaction between the two goals
W2>L2	0	There is no significant interaction between the two goals
W3>L2	0	There is no significant interaction between the two goals
W4>L2	0	There is no significant interaction between the two goals
W5>L2	0	There is no significant interaction between the two goals
W1>L3	-1	Protection of surface water puts constraints on the development of aquaculture activities in order to avoid possible water pollution
W2>L3	0	There is no significant interaction between the two goals
W3>L3	-1	Preventing further deterioration of aquatic ecosystems puts constraints on the development of aquaculture activities in order to avoid possible pollution of the respective ecosystems
W4>L3	0	There is no significant interaction between the two goals
W5>L3	0	There is no significant interaction between the two goals
W1>L4	0/-1	Protection of surface water may put constraints on the development of industrial activities in order to avoid possible water pollution
W2>L4	0/-1	Protection of groundwater may put constraints on the development of industrial activities in order to avoid possible water pollution
W3>L4	0/-1	Preventing further deterioration of aquatic ecosystems may put constraints on the development of industrial activities in order to avoid possible pollution of

		the respective ecosystems
W4>L4	0	There is no significant interaction between the two goals
W5>L4	0	There is no significant interaction between the two goals
Water to Food and Agriculture		
W1>F1	+2	Sustainable management of surface water reinforces the sustainable management and rational use of water resources by the agricultural sector (reduction of water losses, sustainable use of surface water for irrigation)
W2>F1	+2	Sustainable management of groundwater reinforces the sustainable management and rational use of water resources by the agricultural sector (reduction of water losses, sustainable use of groundwater for irrigation)
W3>F1	+1	Preventing the quality of aquatic ecosystems from further deterioration enables the activities towards the sustainable use of resources by the agricultural sector
W4>F1	0	There is no significant interaction between the two goals
W5>F1	+2	Water pricing reinforces the efforts towards the rational use of water resources by the agricultural sector and puts constraints on possible waste of water resources
W1>F2	0	There is no significant interaction between the two goals
W2>F2	0	There is no significant interaction between the two goals
W3>F2	0	There is no significant interaction between the two goals
W4>F2	0	There is no significant interaction between the two goals
W5>F2	0	There is no significant interaction between the two goals
W1>F3	-1	Only in case where livestock activities threaten quality and quantity of surface water
W2>F3	-1	Only in case where livestock activities threaten quality and quantity of groundwater
W3>F3	-1	Only in case where livestock activities threaten quality and quantity of aquatic ecosystems
W4>F3	0	There is no significant interaction between the two goals
W5>F3	+1	Water pricing enables the sustainable management and rational use of water resources by the sector of livestock
W1>F4	+1	Protection of surface water enables the goal for rational use of pesticides in order to ensure protection of surface water resources
W2>F4	+1	Protection of groundwater enables the goal for rational use of pesticides in order to ensure protection of groundwater
W3>F4	+1	Preventing deterioration of aquatic ecosystems enables the rational use of pesticides in order to ensure quality of aquatic ecosystems
W4>F4	0	There is no significant interaction between the two goals
W5>F4	0	There is no significant interaction between the two goals
W1>F5	+1	Protection of surface water enables the development of aquaculture activities under sustainability objectives
W2>F5	0	There is no significant interaction between the two goals
W3>F5	+1	Preventing deterioration of aquatic ecosystems enables the development of aquaculture activities under sustainability objectives
W4>F5	0	There is no significant interaction between the two goals
W5>F5	0	There is no significant interaction between the two goals
W1>F6	+1	Protection of surface water enables the production of ‘safe’ food and fodder (it mainly concerns agricultural products)
W2>F6	+1	Protection of groundwater enables the production of ‘safe’ food and fodder (it mainly concerns agricultural products)
W3>F6	+1	Preventing deterioration of aquatic ecosystems enables the production of ‘safe’ food and fodder (it mainly concerns agricultural products)
W4>F6	0	There is no significant interaction between the two goals
W5>F6	0	There is no significant interaction between the two goals
Water to Climate		
W1>C1	0	There is no significant interaction between the two goals

W2>C1	0	There is no significant interaction between the two goals
W3>C1	0	There is no significant interaction between the two goals
W4>C1	0	There is no significant interaction between the two goals
W5>C1	0	There is no significant interaction between the two goals
W1>C2	+1	Sustainable management of surface water enables adaptation ability to and resilience against climate change impacts (protection and availability of surface water resources)
W2>C2	+1	Sustainable management of groundwater enables adaptation ability to and resilience against climate change impacts (protection and availability of groundwater)
W3>C2	+1	Preventing deterioration of aquatic ecosystems enables adaptation ability to and resilience against climate change impacts
W4>C2	+3	Mitigation of floods' and drought's effects consists a critical factor towards the efforts for increasing the adaptation ability and resilience against climate change impacts as floods and drought are two of the most representative impacts of climate change
W5>C2	+1	Water pricing enables the goal for increasing adaptation ability and resilience against climate change impacts as it ensures better management of water resources and less waste of water resources
W1>C3	+1	Sustainable management of surface water enables the establishment of measures for combating climate change, having to do with surface water (e.g. proactive planning)
W2>C3	+1	Sustainable management of groundwater enables the establishment of measures for combating climate change, having to do with groundwater (e.g. proactive planning)
W3>C3	+1	Preventing deterioration of aquatic ecosystems enables the establishment of measures for combating climate change, having to do with the quality and future sustainability of aquatic ecosystems
W4>C3	+3	Mitigation of floods' and drought's effects is intertwined with the undertaking of policy measures for combating climate change as floods and droughts are two of the most basic impacts of climate change
W5>C3	+1	Water pricing enables the design of measures for combating climate change as it sets the basis for the better management of water resources in the future and the proactive management of water shortage
W1>C4	0	There is no significant interaction between the two goals
W2>C4	0	There is no significant interaction between the two goals
W3>C4	0	There is no significant interaction between the two goals
W4>C4	0	There is no significant interaction between the two goals
W5>C4	0	There is no significant interaction between the two goals
W1>C5	0	There is no significant interaction between the two goals
W2>C5	0	There is no significant interaction between the two goals
W3>C5	0	There is no significant interaction between the two goals
W4>C5	0	There is no significant interaction between the two goals
W5>C5	0	There is no significant interaction between the two goals
Water to Tourism		
W1>T1	+1	Sustainable management of surface water enables the rational use of water resources by the tourist sector
W2>T1	+1	Sustainable management of groundwater enables the rational use of water resources by the tourist sector
W3>T1	+1	Preventing deterioration of aquatic ecosystems enables the rational use of water resources by the tourist sector and also the adaptation of tourist activities to the special characteristics of such systems
W4>T1	0/+1	Proactive planning for the mitigation of floods' and drought's effects may enable the sustainable future viability of the tourist sector in specific regions (e.g. regions that are vulnerable to drought and floods)

W5>T1	+2	Water pricing reinforces the sustainable use of water resources by the tourist sector and puts constraints on possible waste of water
W1>T2	0	There is no significant interaction between the two goals
W2>T2	0	There is no significant interaction between the two goals
W3>T2	0	There is no significant interaction between the two goals
W4>T2	0	There is no significant interaction between the two goals
W5>T2	0	There is no significant interaction between the two goals
W1>T3	0	There is no significant interaction between the two goals
W2>T3	0	There is no significant interaction between the two goals
W3>T3	0	There is no significant interaction between the two goals
W4>T3	0	There is no significant interaction between the two goals
W5>T3	0	There is no significant interaction between the two goals
W1>T4	0/+1	Protection of surface water may enable the improvement of tourist product and services having to do with water resources (e.g. rafting)
W2>T4	0	There is no significant interaction between the two goals
W3>T4	0/+1	Preventing deterioration of aquatic ecosystems may enable the improvement of tourist product and services having to do with water resources and relative tourist activities (e.g. eco-tourism)
W4>T4	0/+1	Proactive planning for the mitigation of floods' and drought's effects may enable the improvement of the Greek tourist product in regions that are vulnerable to droughts and floods
W5>T4	0	There is no significant interaction between the two goals
Energy to Water		
E1>W1	0	There is no significant interaction between the two goals
E2>W1	0/-1	There is no significant interaction between the two goals / Only in case of hydropower plants that use surface water and may have effects on the quality and quantity of surface water
E3>W1	0	There is no significant interaction between the two goals
E4>W1	0	There is no significant interaction between the two goals
E5>W1	0	There is no significant interaction between the two goals
E6>W1	0	There is no significant interaction between the two goals
E1>W2	0	There is no significant interaction between the two goals
E2>W2	0	There is no significant interaction between the two goals
E3>W2	0	There is no significant interaction between the two goals
E4>W2	0	There is no significant interaction between the two goals
E5>W2	0	There is no significant interaction between the two goals
E6>W2	0	There is no significant interaction between the two goals
E1>W3	0	There is no significant interaction between the two goals
E2>W3	0/-1	There is no significant interaction between the two goals / Only in case of hydropower plants that may have impacts on aquatic ecosystems
E3>W3	0	There is no significant interaction between the two goals
E4>W3	0	There is no significant interaction between the two goals
E5>W3	0	There is no significant interaction between the two goals
E6>W3	0	There is no significant interaction between the two goals
E1>W4	0	There is no significant interaction between the two goals
E2>W4	0	There is no significant interaction between the two goals
E3>W4	0	There is no significant interaction between the two goals
E4>W4	0	There is no significant interaction between the two goals
E5>W4	0	There is no significant interaction between the two goals
E6>W4	0	There is no significant interaction between the two goals
E1>W5	0	There is no significant interaction between the two goals
E2>W5	0	There is no significant interaction between the two goals
E3>W5	0	There is no significant interaction between the two goals
E4>W5	0	There is no significant interaction between the two goals
E5>W5	0	There is no significant interaction between the two goals

E6>W5	0/+1	Energy saving may enable the attainment of the goal for the establishment of a water pricing system especially in agricultural sector where energy saving has to do with the exploitation of water for irrigation
Energy to Energy		
E2>E1	+3	Electricity production from RES is intertwined with the attainment of the national energy goals and the adaptation of the national energy mix as it entails the increase of RES use for electricity production and the reduction of conventional energy resources
E3>E1	+1	The promotion of cogeneration technologies enables the attainment of the national energy goals as it supports energy efficiency and energy saving
E4>E1	+2	Energy pricing system reinforces the attainment of the national energy goals as it puts constraints on possible energy misuse
E5>E1	+1	Sustainable management of natural gas enables the efforts towards the reduction of oil and coal for energy production
E6>E1	+2	Energy saving is a critical dimension that reinforces the attainment of the national energy goals
E1>E2	+3	The attainment of the national energy goals is intertwined with the goal for electricity production from RES
E3>E2	+1	Cogeneration enables the promotion of RES for electricity production especially in cases where cogeneration systems use biomass (e.g. biomass from industrial waste)
E4>E2	-1	Renewables are usually more expensive than conventional sources of energy
E5>E2	0	There is no significant interaction between the two goals
E6>E2	0	There is no significant interaction between the two goals
E1>E3	+1	Attainment of the national energy goals enables the undertaking of activities having to do with energy saving and increase of energy efficiency such as cogeneration
E2>E3	+1	In case where biomass is exploited (as raw material) by cogeneration systems
E4>E3	+2	The establishment of a national energy pricing system reinforces the use of cogeneration technologies as energy costs in the case of cogeneration systems are reduced (however the initial cost for the installation of cogeneration systems is very high)
E5>E3	+2	The establishment of a natural gas management system reinforces the development and promotion of cogeneration technologies as natural gas is exploited (as raw material) by cogeneration systems
E6>E3	+3	The goal for energy saving is inextricably linked to the development of cogeneration systems as such systems are more efficient and they save energy
E1>E4	+1	The attainment of the national energy goals enables the goal for establishing a well-defined energy pricing system
E2>E4	+1	Electricity production from RES enables the goal for establishing a well-defined energy pricing system in order to determine production and consumption costs for energy produced from RES
E3>E4	+1	The adoption of cogeneration technologies enables the establishment of a well-defined energy pricing system in order costs related to energy produced by cogeneration technologies to be clearly determined
E5>E4	+1	Natural gas management system enables the establishment of a well-defined energy pricing system in order costs related to natural gas exploitation for energy production and consumption to be clearly determined
E6>E4	+2	Energy saving reinforces the establishment of an energy pricing system in order to reduce possible energy misuses
E1>E5	+1	The goal for adaptation of the national energy mix enables the use of natural gas and the establishment of a national system for natural gas management in order to reduce the use of oil
E2>E5	0	There is no significant interaction between the two goals
E3>E5	+1	Cogeneration development enables the establishment of a natural gas management system as it uses natural gas (as raw material) for energy

		production
E4>E5	+1	The establishment of an energy pricing system has positive advantages on the promotion of natural gas as it determines energy production and consumption costs
E6>E5	+1	Energy saving reinforces the use of natural gas as an "energy saving" fuel
E1>E6	+3	Attainment of the national energy goals is intertwined with the undertaking of actions having to do with energy saving
E2>E6	+3	Electricity production from RES is intertwined with the undertaking of actions having to do with energy saving
E3>E6	+3	Cogeneration development strongly supports the goal for energy saving as cogeneration technologies contribute in a high level to energy saving
E4>E6	+2	The establishment of an energy pricing system reinforces energy saving as it limits energy misuses
E5>E6	+3	Use of natural gas entails energy saving
Energy to Land		
E1>L1	0	There is no significant interaction between the two goals
E2>L1	0	There is no significant interaction between the two goals
E3>L1	0	There is no significant interaction between the two goals
E4>L1	0	There is no significant interaction between the two goals
E5>L1	0	There is no significant interaction between the two goals
E6>L1	0	There is no significant interaction between the two goals
E1>L2	0	There is no significant interaction between the two goals
E2>L2	0	There is no significant interaction between the two goals
E3>L2	0	There is no significant interaction between the two goals
E4>L2	0	There is no significant interaction between the two goals
E5>L2	0	There is no significant interaction between the two goals
E6>L2	0/+1	Energy saving may entail positive advantages for the national economy
E1>L3	0	There is no significant interaction between the two goals
E2>L3	0	There is no significant interaction between the two goals
E3>L3	0	There is no significant interaction between the two goals
E4>L3	0	There is no significant interaction between the two goals
E5>L3	0	There is no significant interaction between the two goals
E6>L3	0	There is no significant interaction between the two goals
E1>L4	0	There is no significant interaction between the two goals
E2>L4	+1	Electricity production from RES enables the spatial organization of industrial activities related to the renewable energy sector
E3>L4	0	There is no significant interaction between the two goals
E4>L4	0	There is no significant interaction between the two goals
E5>L4	0/+1	Natural gas supply and distribution system may enable the spatial organization of industrial activities that have a close relationship with the natural gas sector
E6>L4	0	There is no significant interaction between the two goals
Energy to Food and Agriculture		
E1>F1	0	There is no significant interaction between the two goals
E2>F1	-1	Electricity production from RES creates land use conflicts with the agricultural sector especially in the case of PVs
E3>F1	0	There is no significant interaction between the two goals
E4>F1	0/+1	The establishment of a national energy pricing system may enable the sustainable use of energy resources by the agricultural sector
E5>F1	0	There is no significant interaction between the two goals
E6>F1	0/+1	The goal for energy saving may enable the sustainable use of energy resources by the agricultural sector
E1>F2	0	There is no significant interaction between the two goals
E2>F2	0	There is no significant interaction between the two goals
E3>F2	0	There is no significant interaction between the two goals
E4>F2	0	There is no significant interaction between the two goals

E5>F2	0	There is no significant interaction between the two goals
E6>F2	0	There is no significant interaction between the two goals
E1>F3	0	There is no significant interaction between the two goals
E2>F3	-1	Electricity production from RES creates land use conflicts with livestock especially in the case of PVs
E3>F3	0	There is no significant interaction between the two goals
E4>F3	0/+1	The establishment of a national energy pricing system may enable the sustainable use of energy resources by the sector of livestock
E5>F3	0	There is no significant interaction between the two goals
E6>F3	0/+1	The goal for energy saving may enable the sustainable use of energy resources by the sector of livestock
E1>F4	0	There is no significant interaction between the two goals
E2>F4	0	There is no significant interaction between the two goals
E3>F4	0	There is no significant interaction between the two goals
E4>F4	0	There is no significant interaction between the two goals
E5>F4	0	There is no significant interaction between the two goals
E6>F4	0	There is no significant interaction between the two goals
E1>F5	0	There is no significant interaction between the two goals
E2>F5	0	There is no significant interaction between the two goals
E3>F5	0	There is no significant interaction between the two goals
E4>F5	0	There is no significant interaction between the two goals
E5>F5	0	There is no significant interaction between the two goals
E6>F5	0	There is no significant interaction between the two goals
E1>F6	0	There is no significant interaction between the two goals
E2>F6	0	There is no significant interaction between the two goals
E3>F6	0	There is no significant interaction between the two goals
E4>F6	0	There is no significant interaction between the two goals
E5>F6	0	There is no significant interaction between the two goals
E6>F6	0	There is no significant interaction between the two goals
Energy to Climate		
E1>C1	+3	Attainment of the national energy goals is intertwined with the reduction of GHG emissions
E2>C1	+3	Electricity production from RES is intertwined with the reduction of GHG emissions
E3>C1	+3	The development of cogeneration technologies is inextricably linked to the reduction of GHG emissions
E4>C1	+1	The establishment of a pricing system for the energy sector enables the efforts towards the reduction of GHG emissions
E5>C1	+2	The promotion of natural gas reinforces the reduction of GHG emissions as it gradually replaces oil
E6>C1	+3	Energy saving is intertwined with to the reduction of GHG emissions
E1>C2	+3	Attainment of the national energy goals is inextricably linked to the increase of the country's adaptation ability against climate change as it entails the reduction of impacts derived from the energy sector to climate
E2>C2	+3	Electricity production from RES is inextricably linked to the increase of the country's adaptation ability against climate change as it entails the reduction of impacts derived from the energy sector to climate
E3>C2	+3	The development of cogeneration technologies is inextricably linked to the increase of the country's adaptation ability against climate change as it entails the reduction of impacts derived from the energy sector to climate
E4>C2	+1	The establishment of a national energy pricing system enables the increase of the country's adaptation ability as it entails a more effective management of energy resources while it also regulates energy consumption
E5>C2	+2	Promotion of natural gas reinforces the increase of the country's adaptation ability as it entails the reduction of oil for energy production

E6>C2	+3	Energy saving is intertwined with the efforts towards the increase of the country's adaptation ability against climate change as it entails the reduction of emissions
E1>C3	+2	Attainment of the national energy goals reinforces the efforts towards mapping out strategic directions against climate change with respect to the energy sector
E2>C3	+2	Electricity production from RES reinforces the efforts towards mapping out strategic directions against climate change with respect to the renewable energy sector
E3>C3	+2	The development of cogeneration technologies reinforces the efforts towards mapping out strategic directions against climate change with respect to the energy sector
E4>C3	+2	The establishment of a national energy pricing system enhances the efforts towards the establishment of specific measures against climate change having to do with energy production and consumption costs
E5>C3	+2	A national system regulating the management of natural gas reinforces the establishment of specific measures against climate change having to do with the promotion of natural gas and the reduction of oil
E6>C3	+2	Energy saving reinforces the establishment of specific measures against climate change having to do with the regulation of energy consumption by several sectors
E1>C4	+1	Attainment of the national energy goals enables the increase of social awareness on climate change as it needs citizens' contribution with respect to energy saving and the exploitation of RES for electricity production, heating and cooling
E2>C4	+1	Electricity production from RES has to do with citizens' involvement as the promotion and further exploitation of RES needs to be supported by society
E3>C4	0	There is no significant interaction between the two goals
E4>C4	0	There is no significant interaction between the two goals
E5>C4	0/+1	The goal concerning natural gas supply and distribution, may enable the increase of social awareness with respect to climate change only in relation to the contribution of natural gas for the reduction of oil use for energy production
E6>C4	+1	Energy saving enables the increase of social awareness with respect to climate change as it boosts citizens to use energy resources in a more efficient way
E1>C5	+3	Attainment of the national energy goals stimulates directly the establishment of a GHG emissions trading system for the management of GHG emissions and the reduction of emissions
E2>C5	+1	Electricity production from RES enables the establishment of a GHG emissions trading system as it underlines the need for a rational management of emissions
E3>C5	+1	The development and promotion of cogeneration technologies enables the establishment of a GHG emissions trading system as it underlines the need for a rational management of emissions
E4>C5	+2	The establishment of a national energy pricing system reinforces the establishment of a GHG emissions system as it affects / regulates the energy costs
E5>C5	0	There is no significant interaction between the two goals
E6>C5	+2	Energy saving reinforces the establishment of a GHG emissions trading system as it supports the reduction of emissions mainly by the industrial sector
Energy to Tourism		
E1>T1	0/+1	Attainment of the national energy goals may affect positively the sustainable development of the tourist sector only in the part that has to do with the rational use of energy resources by the tourist sector
E2>T1	+1	Electricity production from RES enables the sustainable development of the tourist sector and the rational use of energy resources as it boosts the use of RES by the tourist sector
E3>T1	0/+1	Promotion of cogeneration systems may enable the sustainable development of tourism in case where cogeneration technologies are used by the tourist sector

E4>T1	0	There is no significant interaction between the two goals
E5>T1	0/+1	Promotion of natural gas may enable the sustainable development of tourism in case where natural gas is used instead of oil by the tourist sector
E6>T1	+1	Energy saving enables the sustainable development of tourism as it contributes to the reduction of energy consumption and energy losses
E1>T2	0	There is no significant interaction between the two goals
E2>T2	0	There is no significant interaction between the two goals
E3>T2	0	There is no significant interaction between the two goals
E4>T2	0	There is no significant interaction between the two goals
E5>T2	0	There is no significant interaction between the two goals
E6>T2	0	There is no significant interaction between the two goals
E1>T3	0	There is no significant interaction between the two goals
E2>T3	0	There is no significant interaction between the two goals
E3>T3	0	There is no significant interaction between the two goals
E4>T3	0	There is no significant interaction between the two goals
E5>T3	0	There is no significant interaction between the two goals
E6>T3	0	There is no significant interaction between the two goals
E1>T4	0	There is no significant interaction between the two goals
E2>T4	0	There is no significant interaction between the two goals
E3>T4	0	There is no significant interaction between the two goals
E4>T4	0	There is no significant interaction between the two goals
E5>T4	0	There is no significant interaction between the two goals
E6>T4	0	There is no significant interaction between the two goals
Land to Water		
L1>W1	+1	Sustainable spatial development enables the sustainable management of surface water as among its priorities is the protection of natural resources
L2>W1	0	There is no significant interaction between the two goals
L3>W1	+2	Sustainable development of aquaculture reinforces the protection and sustainable management of surface water as aquaculture exploits water resources for the development of several activities
L4>W1	+1	The industrial sector is a water-consuming sector. Thus its sustainable spatial organization enables the sustainable management of surface water.
L1>W2	+1	Sustainable spatial development enables the sustainable management of groundwater as among its priorities is the protection of natural resources
L2>W2	0	There is no significant interaction between the two goals
L3>W2	0	There is no significant interaction between the two goals
L4>W2	0/+1	Sustainable spatial organization of the industrial sector may enable the protection of groundwater and the reduction of possible groundwater pollution coming from industries
L1>W3	+1	Sustainable spatial development enables the protection of aquatic ecosystems from further deterioration as among its priorities is the protection of natural resources
L2>W3	0	There is no significant interaction between the two goals
L3>W3	+2	Sustainable development of the aquaculture sector reinforces the protection of aquatic ecosystems as aquaculture exploits water resources for the development of several activities
L4>W3	+1	Sustainable spatial organization of the industrial sector enables the protection of aquatic ecosystems and the reduction of possible pollution coming from industries
L1>W4	0	There is no significant interaction between the two goals
L2>W4	0	There is no significant interaction between the two goals
L3>W4	0	There is no significant interaction between the two goals
L4>W4	0	There is no significant interaction between the two goals
L1>W5	0	There is no significant interaction between the two goals
L2>W5	0	There is no significant interaction between the two goals

L3>W5	0	There is no significant interaction between the two goals
L4>W5	0	There is no significant interaction between the two goals
Land to Energy		
L1>E1	0	There is no significant interaction between the two goals
L2>E1	0	There is no significant interaction between the two goals
L3>E1	0	There is no significant interaction between the two goals
L4>E1	0	There is no significant interaction between the two goals
L1>E2	+1	Sustainable spatial development contributes to electricity production from RES as it highlights the need for the protection of biodiversity and natural resources
L2>E2	0	There is no significant interaction between the two goals
L3>E2	0	There is no significant interaction between the two goals
L4>E2	0/+1	Spatial organization of the industrial sector may enable electricity production from RES in case where industries are located in areas where exploitation of RES for energy production is possible
L1>E3	0	There is no significant interaction between the two goals
L2>E3	0	There is no significant interaction between the two goals
L3>E3	0	There is no significant interaction between the two goals
L4>E3	0/+1	Spatial organization of the industrial sector may enable the development of cogeneration in case where industries are located next to geothermal resources and can exploit geothermy as raw material in cogeneration systems
L1>E4	0	There is no significant interaction between the two goals
L2>E4	+1	The development of a balanced economy enables the definition of energy costs and the establishment of a national energy pricing system
L3>E4	0	There is no significant interaction between the two goals
L4>E4	0	There is no significant interaction between the two goals
L1>E5	0/+1	Sustainable spatial development may enable the establishment of a national system for natural gas management as natural gas replaces oil and has less environmental impacts
L2>E5	0	There is no significant interaction between the two goals
L3>E5	0	There is no significant interaction between the two goals
L4>E5	0/+1	Spatial organization of the industrial sector may enable the establishment of a national system for natural gas management in case where industries use natural gas for energy production / process natural gas / distribute natural gas
L1>E6	0	There is no significant interaction between the two goals
L2>E6	0	There is no significant interaction between the two goals
L3>E6	0	There is no significant interaction between the two goals
L4>E6	0/+1	Spatial organization of the industrial sector may enable the goal for energy saving in case where the industrial sector reduces energy costs and energy consumption by using relative technologies (e.g. cogeneration, RES)
Land to Land		
L2>L1	+2	The development of a balanced and competitive economy reinforces the goal for spatial integration and the establishment of a balanced spatial pattern of development
L3>L1	+2	Spatial organization of aquaculture sector reinforces the creation of a balanced spatial pattern of development and the protection of biodiversity and natural resources
L4>L1	+2	Spatial organization of industrial sector reinforces the creation of a balanced spatial pattern of development and to the protection of biodiversity and natural / cultural resources
L1>L2	+1	An integrated and sustainable spatial development enables the development of a balanced economy and the “equal” spatial distribution of activities with respect to the comparative advantages of each region
L3>L2	+1	Spatial organization of aquaculture sector enables the development of economic activities having to do with aquaculture and contributes to the creation of a national balanced economy

L4>L2	+2	Spatial organization of industrial sector reinforces the development of industrial activities which support national economy and contribute to the creation of a competitive economic environment
L1>L3	+2	The goal for a sustainable and integrated spatial development reinforces the spatial organization of aquaculture in order a balanced spatial pattern of development to be created
L2>L3	0/+1	The development of a balanced and competitive economy may enable the development of aquaculture economic activities
L4>L3	0	There is no significant interaction between the two goals
L1>L4	+2	The goal for a sustainable and integrated spatial development reinforces the spatial organization of industrial sector in order a balanced spatial pattern of development to be created
L2>L4	+2	The development of a balanced and competitive economy will reinforce the development of industrial activities that support national income
L3>L4	0	There is no significant interaction between the two goals
Land to Food and Agriculture		
L1>F1	+2	Sustainable and integrated spatial development reinforces the sustainable development of agricultural sector as it places emphasis on the reinforcement of rural regions and the protection of natural resources and biodiversity
L2>F1	+1	The development of a balanced economy enables the sustainable development of agriculture as it includes agricultural activities that support the national income
L3>F1	+3	Spatial organization of aquaculture is intertwined with the sustainable development of agriculture as aquaculture is an agricultural activity and thus it contributes to the integrated development of agricultural sector
L4>F1	0	There is no significant interaction between the two goals
L1>F2	0/+1	Sustainable integrated spatial development may have positive impacts on the preservation and sustainable use of plant genetic resources as it places emphasis on the protection of biodiversity
L2>F2	0	There is no significant interaction between the two goals
L3>F2	0	There is no significant interaction between the two goals
L4>F2	0	There is no significant interaction between the two goals
L1>F3	+2	Sustainable and integrated spatial development reinforces the spatial organization of livestock as it places emphasis on the reinforcement of rural regions and the several activities taking place in such regions
L2>F3	+1	The development of a balanced economy enables the development and spatial organization of livestock as it includes livestock activities that support the national income
L3>F3	0	There is no significant interaction between the two goals
L4>F3	0	There is no significant interaction between the two goals
L1>F4	0	There is no significant interaction between the two goals
L2>F4	0	There is no significant interaction between the two goals
L3>F4	0/-1	Spatial organization and development of aquaculture may put constraints on the use of pesticides even if they are used rationally as pesticides may affect water quality
L4>F4	0	There is no significant interaction between the two goals
L1>F5	+2	Sustainable and integrated spatial development reinforces the sustainable development of aquaculture as it places emphasis on strengthening rural regions and the relative activities taking place in such regions
L2>F5	+1	The development of a balanced economy enables the sustainable development of aquaculture as it includes aquaculture activities that support the national income
L3>F5	+3	Spatial organization of aquaculture is in close relationship and goes “hand in hand” with the sustainable development of the aquaculture sector
L4>F5	0	There is no significant interaction between the two goals

L1>F6	0	There is no significant interaction between the two goals
L2>F6	0	There is no significant interaction between the two goals
L3>F6	0	There is no significant interaction between the two goals
L4>F6	0	There is no significant interaction between the two goals
Land to Climate		
L1>C1	0	There is no significant interaction between the two goals
L2>C1	+1	The development of a balanced economy enables the attainment of the national energy goals through the promotion of practices, infrastructures and technologies that contribute to the reduction of emissions
L3>C1	0	There is no significant interaction between the two goals
L4>C1	0/+1	Spatial organization of the industrial sector may have positive impacts to the attainment of the national energy goals as it may entail the use of RES for energy production or reduction of energy consumption
L1>C2	+1	Sustainable spatial development enables the increase of the country's adaptation ability against climate change as it places emphasis on the sustainable management of natural resources and the protection of biodiversity
L2>C2	0	There is no significant interaction between the two goals
L3>C2	0	There is no significant interaction between the two goals
L4>C2	0/+1	Spatial organization of industrial sector may help to increase climate change adaptation ability in case where impacts on atmosphere and climate are reduced because of such specific spatial organization (e.g. location of industries next to RES)
L1>C3	+1	Sustainable spatial development enables the undertaking of measures having to do with combating climate change (e.g. management of energy resources, management of water resources, etc.)
L2>C3	0/+1	The development of a balanced economy may enable the undertaking of measures for combating climate change such as the sustainable management of the available resources
L3>C3	0	There is no significant interaction between the two goals
L4>C3	0/+1	Spatial organization of the industrial sector may enable the undertaking of specific measures for combating climate change (e.g. reduction of GHG emissions by the industrial sector, exploitation of RES for energy production in case industries are located next to the respective energy resources)
L1>C4	+1	Sustainable integrated spatial development includes the social dimension and thus it enables the increase of social awareness with respect to climate change through participatory actions for the environment
L2>C4	0	There is no significant interaction between the two goals
L3>C4	0	There is no significant interaction between the two goals
L4>C4	0	There is no significant interaction between the two goals
L1>C5	0	There is no significant interaction between the two goals
L2>C5	+1	The development of a balanced and competitive economy enables the determination of emission costs and the establishment of a relevant emissions trading system
L3>C5	0	There is no significant interaction between the two goals
L4>C5	+1	The sustainable spatial organization of industrial sector enables the establishment of a national GHG emissions trading system which will regulate the energy consumption and the emissions of industries
Land to Tourism		
L1>T1	+1	Sustainable and integrated spatial development enables the sustainable development of tourism as it boosts the sustainable and rational use of natural resources by the tourist sector
L2>T1	+2	The development of a balanced economy reinforces the sustainable development of tourism as a big contributor to the national income
L3>T1	-1	The development of aquaculture activities puts constraints on the development of tourist activities in case where land use conflicts between the two sectors

		exist
L4>T1	0	There is no significant interaction between the two goals
L1>T2	+1	The goal for sustainable and integrated spatial development enables the development of tourist entrepreneurship especially in rural regions
L2>T2	+2	The establishment of a balanced economy reinforces the development of tourist entrepreneurship as tourist activities represent an economic priority of the Greek economy
L3>T2	0	There is no significant interaction between the two goals
L4>T2	0	There is no significant interaction between the two goals
L1>T3	0	There is no significant interaction between the two goals
L2>T3	0/+1	The development of a balanced economy may enable tourist training activities in order innovative practices to be applied in the tourist sector
L3>T3	0	There is no significant interaction between the two goals
L4>T3	0	There is no significant interaction between the two goals
L1>T4	0/+1	Sustainable and integrated spatial development may enable the goal for improving the Greek tourist product as it places emphasis on the protection of biodiversity, natural and cultural resources which capture the interest of tourists
L2>T4	+2	The establishment of a balanced economy reinforces the improvement of the Greek tourist product in order the national income to be further supported by the tourist sector
L3>T4	0	There is no significant interaction between the two goals
L4>T4	0/+1	Spatial organization of the industrial sector may enable the goal for improving the Greek tourist product in case where industries are not located next to tourist regions
Food and Agriculture to Water		
F1>W1	+2	Sustainable development of agriculture reinforces the sustainable management of surface water as it promotes the rational and sustainable use of natural resources (e.g. surface water) by the agricultural sector
F2>W1	0	There is no significant interaction between the two goals
F3>W1	+1	Special measures and criteria for the development and spatial organization of livestock enables the protection of surface water as it reduces the impacts coming from the sector of livestock to surface water resources
F4>W1	-1	Use of pesticides has negative impacts on surface water resources even if we are talking about rational use of pesticides
F5>W1	+1	Sustainable development of aquaculture enables the sustainable management of surface water as it promotes the rational and sustainable use of natural resources (e.g. surface water) by the aquaculture sector
F6>W1	0	There is no significant interaction between the two goals
F1>W2	+2	Sustainable development of agriculture reinforces the sustainable management of groundwater as it promotes the rational and sustainable use of natural resources (e.g. groundwater) by the agricultural sector
F2>W2	0	There is no significant interaction between the two goals
F3>W2	+1	Special measures and criteria for the development and spatial organization of livestock enables the protection of groundwater as it reduces the impacts coming from the sector of livestock to groundwater
F4>W2	-1	Use of pesticides has negative impacts on groundwater even if we are talking about rational use of pesticides
F5>W2	0	There is no significant interaction between the two goals
F6>W2	0	There is no significant interaction between the two goals
F1>W3	+2	Sustainable development of agriculture reinforces the protection of aquatic ecosystems as it promotes the sustainable management of natural resources by the agricultural sector
F2>W3	0	There is no significant interaction between the two goals
F3>W3	+1	Special measures and criteria for the development and spatial organization of livestock enables the protection of aquatic ecosystems as it reduces the impacts

		coming from the sector of livestock to aquatic ecosystems
F4>W3	-1	Use of pesticides has negative impacts on aquatic ecosystems even if we are talking about rational use of pesticides
F5>W3	+1	Sustainable development of aquaculture enables the protection of aquatic ecosystems as it promotes the sustainable use of natural resources by the aquaculture sector
F6>W3	0	There is no significant interaction between the two goals
F1>W4	0/+1	Sustainable development of agriculture may enable the mitigation of floods' effects in case where relative projects are implemented in relation to the agricultural sector
F2>W4	0	There is no significant interaction between the two goals
F3>W4	0	There is no significant interaction between the two goals
F4>W4	0	There is no significant interaction between the two goals
F5>W4	0	There is no significant interaction between the two goals
F6>W4	0	There is no significant interaction between the two goals
F1>W5	0	There is no significant interaction between the two goals
F2>W5	0	There is no significant interaction between the two goals
F3>W5	0	There is no significant interaction between the two goals
F4>W5	0	There is no significant interaction between the two goals
F5>W5	0	There is no significant interaction between the two goals
F6>W5	0	There is no significant interaction between the two goals
Food and Agriculture to Energy		
F1>E1	+1	Sustainable development of agriculture enables the attainment of the national energy goals as it has to do with the sustainable management of energy resources and the reduction of energy consumption and emissions by the agricultural sector
F2>E1	0	There is no significant interaction between the two goals
F3>E1	+1	Sustainable development of livestock and the establishment of special criteria for its organization enables the attainment of the national energy goals as it has to do with the sustainable management of energy resources and the reduction of energy consumption and emissions by the sector of livestock
F4>E1	0	There is no significant interaction between the two goals
F5>E1	0	There is no significant interaction between the two goals
F6>E1	0	There is no significant interaction between the two goals
F1>E2	-1/+1	The agricultural sector may put constraints on electricity production from RES if there are land use conflicts between energy and agricultural sector OR it may enable electricity production from RES through the exploitation of agricultural biomass and the cultivation of energy crops
F2>E2	0	There is no significant interaction between the two goals
F3>E2	0	There is no significant interaction between the two goals
F4>E2	0	There is no significant interaction between the two goals
F5>E2	0	There is no significant interaction between the two goals
F6>E2	0	There is no significant interaction between the two goals
F1>E3	0	There is no significant interaction between the two goals
F2>E3	0	There is no significant interaction between the two goals
F3>E3	0	There is no significant interaction between the two goals
F4>E3	0	There is no significant interaction between the two goals
F5>E3	0	There is no significant interaction between the two goals
F6>E3	0	There is no significant interaction between the two goals
F1>E4	0	There is no significant interaction between the two goals
F2>E4	0	There is no significant interaction between the two goals
F3>E4	0	There is no significant interaction between the two goals
F4>E4	0	There is no significant interaction between the two goals
F5>E4	0	There is no significant interaction between the two goals
F6>E4	0	There is no significant interaction between the two goals

F1>E5	0	There is no significant interaction between the two goals
F2>E5	0	There is no significant interaction between the two goals
F3>E5	0	There is no significant interaction between the two goals
F4>E5	0	There is no significant interaction between the two goals
F5>E5	0	There is no significant interaction between the two goals
F6>E5	0	There is no significant interaction between the two goals
F1>E6	+1	The sustainable development of agricultural sector enables energy saving as it entails rational use of energy resources and reduction of energy consumption by the agricultural sector
F2>E6	0	There is no significant interaction between the two goals
F3>E6	+1	Sustainable spatial organization and management of livestock enables energy saving as it entails rational use of energy resources and reduction of energy consumption by the sector of livestock
F4>E6	0	There is no significant interaction between the two goals
F5>E6	0	There is no significant interaction between the two goals
F6>E6	0	There is no significant interaction between the two goals
Food and Agriculture to Land		
F1>L1	+3	Sustainable development of agriculture is inextricably linked to the spatial integrated development as it boosts the creation of a balanced spatial pattern between urban and rural regions
F2>L1	0	There is no significant interaction between the two goals
F3>L1	+3	Sustainable spatial organization of livestock is inextricably linked to the spatial integrated development as it boosts the creation of a balanced spatial pattern between urban and rural regions
F4>L1	0	There is no significant interaction between the two goals
F5>L1	+3	Sustainable development of aquaculture is intertwined with the goal for spatial integrated development as it boosts the creation of a balanced spatial pattern between urban and rural regions
F6>L1	0	There is no significant interaction between the two goals
F1>L2	+2	Sustainable development of agriculture reinforces the development of a balanced and competitive economy as agricultural sector is a basic contributor to the national income
F2>L2	0	There is no significant interaction between the two goals
F3>L2	+2	Sustainable spatial organization of livestock reinforces the development of a balanced and competitive economy as livestock supports the national income
F4>L2	0	There is no significant interaction between the two goals
F5>L2	+1	Sustainable development of aquaculture enables the development of a balanced and competitive economy as the aquaculture sector supports the national income
F6>L2	+1	Food and fodder security enables the development of a balanced and competitive economy as food sector supports the national income
F1>L3	0	There is no significant interaction between the two goals
F2>L3	0	There is no significant interaction between the two goals
F3>L3	0	There is no significant interaction between the two goals
F4>L3	0	There is no significant interaction between the two goals
F5>L3	+3	Sustainable development of aquaculture is inextricably linked to its spatial organization as the sustainable development of the sector is closely related to its spatial organization
F6>L3	0	There is no significant interaction between the two goals
F1>L4	-1	The sustainable development of agriculture puts constraints on the spatial organization of industrial sector in case where land use conflicts exist
F2>L4	0	There is no significant interaction between the two goals
F3>L4	-1	Spatial organization of livestock puts constraints on the spatial organization of industrial sector in case where land use conflicts exist
F4>L4	0	There is no significant interaction between the two goals

F5>L4	0	There is no significant interaction between the two goals
F6>L4	0	There is no significant interaction between the two goals
Food and Agriculture to Food and Agriculture		
F2>F1	+3	Preservation and sustainable use of plant genetic resources for food and agriculture guarantees the sustainable development of agriculture as it has to do with the production of high quality agricultural products, the protection of biodiversity and food security
F3>F1	+2	Special measures for the development and spatial organization of livestock reinforce the sustainable development of agricultural sector as they take into account the special characteristics of each region and they contribute to the limitation of land use conflicts between agriculture and livestock
F4>F1	+3	Rational use of pesticides is intertwined with the sustainable development of agriculture as it entails less impacts on natural environment coming from the agricultural sector
F5>F1	+3	Sustainable development of aquaculture is intertwined with the sustainable development of agricultural sector as an agricultural activity that promotes the rational use of natural resources and the protection of biodiversity
F6>F1	+3	Ensuring security in the food and fodder sectors is inherently linked to the sustainable development of agriculture as it places emphasis on the production of high quality agricultural products
F1>F2	+3	Sustainable development of agriculture presupposes the preservation and sustainable use of plant genetic resources in order to ensure the quality of agricultural products and the protection of biodiversity
F3>F2	0	There is no significant interaction between the two goals
F4>F2	+1	Rational use of pesticides enables the goal concerning food security and protection of biodiversity
F5>F2	0	There is no significant interaction between the two goals
F6>F2	+3	Ensuring security in food and fodder sectors is intertwined with the need for preserving plant genetic resources in order to enhance biodiversity protection and food security
F1>F3	+2	Sustainable development of agriculture reinforces the spatial and sustainable organization of livestock as it contributes to the reduction of land use conflicts between agriculture and livestock.
F2>F3	0	There is no significant interaction between the two goals
F4>F3	0	There is no significant interaction between the two goals
F5>F3	0	There is no significant interaction between the two goals
F6>F3	+1	Ensuring food and fodder security enables the goal for establishing terms and conditions for the development of livestock activities and the production of high quality dairy products and meat
F1>F4	+3	The sustainable development of agriculture is inextricably linked to the rational use of pesticides and the protection of water resources and agricultural land from impacts coming from the uncontrollable use of pesticides
F2>F4	+2	Preservation and sustainable use of plant genetic resources reinforces the need for rational use of pesticides in order to protect biodiversity
F3>F4	0	There is no significant interaction between the two goals
F5>F4	0	There is no significant interaction between the two goals
F6>F4	+3	Ensuring food and fodder security is inextricably linked to the rational use of pesticides in order high quality of food and fodders to be produced
F1>F5	+2	Sustainable development of agriculture reinforces the need for the sustainable development of aquaculture as a dimension of the agricultural sector (integrated agricultural activities)
F2>F5	0	There is no significant interaction between the two goals
F3>F5	0	There is no significant interaction between the two goals
F4>F5	0	There is no significant interaction between the two goals
F6>F5	+1	Ensuring food and fodder security enables the production of high quality food

		products by the sector of aquaculture
F1>F6	+2	Sustainable development of agriculture reinforces the goal for ensuring food and fodder security as it contributes to the production of high quality agricultural food products
F2>F6	+3	Preservation and sustainable use of plant genetic resources is intertwined with ensuring food and fodder security and the production of high quality food products
F3>F6	+2	The establishment of special terms and conditions for the development of livestock activities creates the necessary preconditions in order to ensure security and quality of livestock products
F4>F6	+3	Rational use of pesticides is inextricably linked to the production of secure and high quality agricultural products
F5>F6	+2	The sustainable development of aquaculture reinforces the production of secure and high quality aquaculture food products
Food and Agriculture to Climate		
F1>C1	+1	The sustainable development of agriculture enables the reduction of GHG emissions as it entails the reduction of emissions and the sustainable use of energy resources by the agricultural sector
F2>C1	0	There is no significant interaction between the two goals
F3>C1	+1	Special measures and criteria for the development of livestock enable the reduction of emissions and the sustainable use of energy resources by the sector of livestock
F4>C1	0	There is no significant interaction between the two goals
F5>C1	0	There is no significant interaction between the two goals
F6>C1	0	There is no significant interaction between the two goals
F1>C2	+1	The sustainable development of agriculture enables the country’s adaptation ability against climate change as it entails less emissions and sustainable use of energy resources by the agricultural sector
F2>C2	+1	Preservation and sustainable use of plant genetic resources enable the increase of the country’s adaptation ability against climate change as they contribute to the protection of biodiversity and the future “survival” of plant genetic resources
F3>C2	0	There is no significant interaction between the two goals
F4>C2	0	There is no significant interaction between the two goals
F5>C2	0	There is no significant interaction between the two goals
F6>C2	0	There is no significant interaction between the two goals
F1>C3	0/+1	The sustainable development of agriculture may enable the establishment of specific measures for combating climate change in relation to the agricultural sector (e.g. energy saving and reduction of emissions by the agricultural sector)
F2>C3	0	There is no significant interaction between the two goals
F3>C3	0	There is no significant interaction between the two goals
F4>C3	0	There is no significant interaction between the two goals
F5>C3	0	There is no significant interaction between the two goals
F6>C3	0	There is no significant interaction between the two goals
F1>C4	0/+1	Sustainable development of agriculture may enable the organization of participatory actions among farmers with respect to climate change and the contribution of the agricultural sector to combating climate change impacts
F2>C4	0	There is no significant interaction between the two goals
F3>C4	0	There is no significant interaction between the two goals
F4>C4	0	There is no significant interaction between the two goals
F5>C4	0	There is no significant interaction between the two goals
F6>C4	0	There is no significant interaction between the two goals
F1>C5	0	There is no significant interaction between the two goals
F2>C5	0	There is no significant interaction between the two goals
F3>C5	0	There is no significant interaction between the two goals

F4>C5	0	There is no significant interaction between the two goals
F5>C5	0	There is no significant interaction between the two goals
F6>C5	0	There is no significant interaction between the two goals
Food and Agriculture to Tourism		
F1>T1	0/+1	Sustainable development of agriculture may enable the development of agro-tourist activities (multifunctional role of agricultural land)
F2>T1	0	There is no significant interaction between the two goals
F3>T1	0	There is no significant interaction between the two goals
F4>T1	0	There is no significant interaction between the two goals
F5>T1	0	There is no significant interaction between the two goals
F6>T1	0	There is no significant interaction between the two goals
F1>T2	0/+1	Sustainable development of agriculture may enable the establishment of agro-tourist / rural enterprises (combined economic activities)
F2>T2	0	There is no significant interaction between the two goals
F3>T2	0	There is no significant interaction between the two goals
F4>T2	0	There is no significant interaction between the two goals
F5>T2	0	There is no significant interaction between the two goals
F6>T2	0	There is no significant interaction between the two goals
F1>T3	0	There is no significant interaction between the two goals
F2>T3	0	There is no significant interaction between the two goals
F3>T3	0	There is no significant interaction between the two goals
F4>T3	0	There is no significant interaction between the two goals
F5>T3	0	There is no significant interaction between the two goals
F6>T3	0	There is no significant interaction between the two goals
F1>T4	0/+1	Sustainable development of agriculture may enable the improvement of the Greek tourist product through the production of qualitative agricultural products and the establishment of agro-tourist activities
F2>T4	0	There is no significant interaction between the two goals
F3>T4	0	There is no significant interaction between the two goals
F4>T4	0	There is no significant interaction between the two goals
F5>T4	0	There is no significant interaction between the two goals
F6>T4	0	There is no significant interaction between the two goals
Climate to Water		
C1>W1	0	There is no significant interaction between the two goals
C2>W1	+2	Increase the country's adaptation ability against climate change reinforces the goal for the sustainable management and protection of surface water in order to avoid possible future water shortage or drought due to climate change
C3>W1	+2	Mapping out national strategic directions against climate change reinforces the design of policy measures concerning the future sustainable management of surface water in relation to climate change
C4>W1	+1	Increase of social awareness against climate change enables the sustainable management of surface water as it involves citizens in actions having to do with the protection of surface water under climate change conditions
C5>W1	0	There is no significant interaction between the two goals
C1>W2	0	There is no significant interaction between the two goals
C2>W2	+2	Increase of the country's adaptation ability against climate change reinforces the goal for the sustainable management and protection of groundwater in order to avoid possible future water shortage or drought due to climate change
C3>W2	+2	Mapping out national strategic directions against climate change reinforces the design of policy measures concerning the future sustainable management of groundwater in relation to climate change (rational use of groundwater in order to avoid possible shortage)
C4>W2	+1	Increase of social awareness against climate change enables the sustainable management of groundwater as it involves citizens in actions having to do with the protection of groundwater in relation to climate change impacts

C5>W2	0	There is no significant interaction between the two goals
C1>W3	+1	Reduction of GHG emissions enables the protection of aquatic ecosystems from further deterioration as it places emphasis on the reduction of atmospheric (air) pollutants transferred to aquatic ecosystems
C2>W3	+2	Increase of the country's adaptation ability against climate change reinforces the goal for protecting aquatic ecosystems in order to avoid possible future water shortage or drought due to climate change
C3>W3	+2	Mapping out national strategic directions against climate change reinforces the design of policy measures concerning the protection of aquatic ecosystems from pollution
C4>W3	+1	Increasing social awareness against climate change enables the protection of aquatic ecosystems as it involves citizens in actions having to do with the protection of such ecosystems under climate change conditions
C5>W3	0	There is no significant interaction between the two goals
C1>W4	0	There is no significant interaction between the two goals
C2>W4	+3	Increasing country's adaptation ability against climate change is intertwined with the undertaking of measures having to do with the mitigation of floods' and drought's effects caused by climate change
C3>W4	+2	Mapping out national strategic directions against climate change reinforces the design of policy measures concerning mitigation of floods' and drought's effects caused by climate change
C4>W4	+1	Increasing social awareness against climate change helps people understand the need for proactive planning and the establishment of measures for the management of floods and drought
C5>W4	0	There is no significant interaction between the two goals
C1>W5	0	There is no significant interaction between the two goals
C2>W5	0/+1	Increasing country's adaptation ability against climate change may enable the establishment of a water pricing system that will contribute to a better management of water resources
C3>W5	0	There is no significant interaction between the two goals
C4>W5	0	There is no significant interaction between the two goals
C5>W5	0	There is no significant interaction between the two goals
Climate to Energy		
C1>E1	+3	Reduction of GHG emissions is in close and strong relationship to the attainment of the national energy goals. It depends on the attainment of the national energy goals.
C2>E1	+2	Increasing country's adaptation ability against climate change reinforces the attainment of the national energy goals and it partially depends on it
C3>E1	+2	Mapping out national strategic directions against climate change reinforces the design of policy measures for combating climate change on the basis of the national energy goals
C4>E1	+2	Increasing social awareness against climate change helps people: a) understand the importance of the national energy goals and b) contribute to the attainment of such goals
C5>E1	+3	The establishment of a national GHG emissions trading system is inextricably linked to the attainment of the national energy goals
C1>E2	+3	The reduction of GHG emissions is in full compliance with the exploitation of RES for electricity production
C2>E2	+3	Increasing country's adaptation ability against climate change is inherently linked to the exploitation of RES for electricity production
C3>E2	+3	Mapping out national strategic directions against climate change is inextricably linked to the undertaking of measures that promote electricity production from RES
C4>E2	+2	Increasing social awareness against climate change helps people understand the importance of RES exploitation for electricity production and the importance to replace conventional energy sources by renewables

C5>E2	+2	The establishment of a national GHG emissions trading system reinforces the use of RES for electricity production
C1>E3	+3	The reduction of GHG emissions is inextricably linked to the promotion and development of cogeneration technologies as such technologies entail less emissions to the atmosphere
C2>E3	+2	Increasing country's adaptation ability against climate change reinforces the exploitation of cogeneration technologies for a better atmosphere quality and less air pollutants
C3>E3	+2	Mapping out national strategic directions against climate change reinforces the undertaking of measures that promote the use of cogeneration technologies especially by the industrial and building sectors
C4>E3	0	There is no significant interaction between the two goals
C5>E3	+3	The establishment of a national GHG emissions trading system is intertwined with the use of cogeneration technologies as the adoption of such technologies contributes to the reduction of emissions
C1>E4	+2	The reduction of GHG emissions reinforces the establishment of a national energy pricing system in order to achieve a better management of energy resources and the relative emissions
C2>E4	0	There is no significant interaction between the two goals
C3>E4	0	There is no significant interaction between the two goals
C4>E4	0	There is no significant interaction between the two goals
C5>E4	+1	The establishment of a GHG emissions trading system enables the development of an energy pricing system concerning energy cogeneration, renewables and conventional energy
C1>E5	+2	The reduction of GHG emissions reinforces the promotion and management of natural gas in order to replace oil, something that entails less emissions
C2>E5	+1	Increasing country's adaptation ability against climate change enables the promotion of natural gas as a way to limit the use of oil
C3>E5	+1	Mapping out national strategic directions against climate change enables the undertaking of measures that promote the use of natural gas
C4>E5	+1	Increasing social awareness against climate change helps people understand the importance of using natural gas instead of oil
C5>E5	+1	Establishment of a national GHG emissions trading system enables the use of natural gas as it contributes to the reduction of emissions
C1>E6	+2	Reduction of GHG emissions reinforces energy saving through actions like energy saving in buildings
C2>E6	+2	Increase of the country's adaptation ability against climate change reinforces actions aiming at energy saving
C3>E6	+2	Mapping out national strategic directions against climate change reinforces the undertaking of measures having to do with energy saving (adoption of relative technologies in buildings, etc.)
C4>E6	+2	Increasing social awareness against climate change helps people understand and participate in several actions towards energy saving
C5>E6	+2	The establishment of a national GHG emissions trading system reinforces the undertaking of actions towards energy saving as energy saving entails the reduction of emissions
Climate to Land		
C1>L1	0/+1	The reduction of GHG emissions may enable the development of an integrated and sustainable spatial pattern of development as it contributes to the protection of biodiversity and natural resources
C2>L1	0/+1	Increasing country's adaptation ability against climate change may enable sustainable spatial development as it has to do with the protection of biodiversity and natural resources from climate change impacts
C3>L1	0	There is no significant interaction between the two goals
C4>L1	0	There is no significant interaction between the two goals
C5>L1	0	There is no significant interaction between the two goals

C1>L2	0	There is no significant interaction between the two goals
C2>L2	0/+1	Increasing country's adaptation ability against climate change may enable the development of a balanced economy that will not be so vulnerable to climate change impacts
C3>L2	0	There is no significant interaction between the two goals
C4>L2	0	There is no significant interaction between the two goals
C5>L2	+1	The establishment of a national GHG emissions trading system enables the development of a balanced economy with positive impacts on the industrial sector
C1>L3	0	There is no significant interaction between the two goals
C2>L3	0	There is no significant interaction between the two goals
C3>L3	0	There is no significant interaction between the two goals
C4>L3	0	There is no significant interaction between the two goals
C5>L3	0	There is no significant interaction between the two goals
C1>L4	+1	The reduction of GHG emissions enables the sustainable organization of the industrial sector with respect to the management of emissions coming from industrial activities
C2>L4	0	There is no significant interaction between the two goals
C3>L4	+1	Mapping out national strategic directions against climate change enables the sustainable spatial development of industrial activities as it sets directions for the future development of the sector under climate change conditions
C4>L4	0	There is no significant interaction between the two goals
C5>L4	+2	The establishment of a national GHG emissions trading system reinforces the sustainable development and sustainable operation of industrial sector
Climate to Food and Agriculture		
C1>F1	+1	The reduction of GHG emissions enables the sustainable development of agriculture as it promotes the reduction of emissions and the sustainable use of energy resources by the agricultural sector
C2>F1	+1	Increasing country's adaptation ability against climate change enables the undertaking of actions having to do with the sustainable future development of agriculture under climate change conditions
C3>F1	+2	Mapping out national strategic directions against climate change reinforces the undertaking of specific policy measures having to do with the sustainable future development of agriculture under climate change conditions
C4>F1	0/+1	Increasing social awareness against climate change may help farmers understand the need for the development of a more sustainable agricultural pattern that places emphasis on the rational use of land, water and energy under climate change conditions
C5>F1	0	There is no significant interaction between the two goals
C1>F2	0	There is no significant interaction between the two goals
C2>F2	+1	Increase of the country's adaptation ability against climate change enables the preservation of plant genetic resources in order to ensure their future "existence" under climate change conditions
C3>F2	0	There is no significant interaction between the two goals
C4>F2	0	There is no significant interaction between the two goals
C5>F2	0	There is no significant interaction between the two goals
C1>F3	0	There is no significant interaction between the two goals
C2>F3	0	There is no significant interaction between the two goals
C3>F3	0	There is no significant interaction between the two goals
C4>F3	0	There is no significant interaction between the two goals
C5>F3	0	There is no significant interaction between the two goals
C1>F4	0	There is no significant interaction between the two goals
C2>F4	0	There is no significant interaction between the two goals
C3>F4	0	There is no significant interaction between the two goals
C4>F4	0	There is no significant interaction between the two goals

C5>F4	0	There is no significant interaction between the two goals
C1>F5	0	There is no significant interaction between the two goals
C2>F5	0	There is no significant interaction between the two goals
C3>F5	+2	Mapping out national strategic directions against climate change reinforces the undertaking of specific policy measures having to do with the sustainable future development of aquaculture under climate change conditions
C4>F5	0	There is no significant interaction between the two goals
C5>F5	0	There is no significant interaction between the two goals
C1>F6	0	There is no significant interaction between the two goals
C2>F6	0	There is no significant interaction between the two goals
C3>F6	0	There is no significant interaction between the two goals
C4>F6	0	There is no significant interaction between the two goals
C5>F6	0	There is no significant interaction between the two goals
Climate to Climate		
C2>C1	+3	Increasing country's adaptation ability against climate change depends directly on the reduction of GHG emissions
C3>C1	+3	Mapping out national strategic directions against climate change is in strong and close relationship with the reduction of GHG emissions
C4>C1	+2	Increasing social awareness against climate change helps people understand and participate in actions having to do with the reduction of GHG emissions
C5>C1	+3	The establishment of a national GHG emissions trading system is inextricably linked to the reduction of GHG emissions by putting relative constraints
C1>C2	+3	The reduction of GHG emissions set the basis for the increase of the country's adaptation ability against climate change
C3>C2	+3	Mapping out national strategic directions against climate change is intertwined with the increase of the country's adaptation ability against climate change
C4>C2	+2	Increasing social awareness against climate change helps people understand the need to increase adaptation ability and resilience of the country against climate change and undertake relative actions (e.g. adoption of technologies that contribute to energy saving)
C5>C2	+3	The establishment of a national GHG emissions trading system supports directly the efforts towards increasing the country's adaptation ability against climate change through the sustainable management of emissions
C1>C3	+3	The reduction of GHG emissions is inextricably linked to the undertaking of additive policy measures for combating climate change
C2>C3	+3	Increasing country's adaptation ability against climate change is inextricably linked to the undertaking of relative policy measures aiming at combating climate change impacts
C4>C3	0	There is no significant interaction between the two goals
C5>C3	+1	The establishment of a national GHG emissions trading system enables the undertaking of policy measures concerning the management of GHG emissions
C1>C4	+1	The reduction of GHG emissions enables the increase of social awareness against climate change in order relative knowledge to be diffused as a way of mobilizing people to participate in relative actions
C2>C4	0/+1	Increasing country's adaptation ability against climate change may enable participatory actions in order to increase public awareness with respect to the need for adaptation
C3>C4	0	There is no significant interaction between the two goals
C5>C4	0	There is no significant interaction between the two goals
C1>C5	+3	The reduction of GHG emissions is inextricably linked to the establishment of a national GHG emissions trading system for the sustainable management of emissions
C2>C5	+2	Increasing country's adaptation ability against climate change reinforces the establishment of a national GHG emissions trading system for the sustainable management of emissions

C3>C5	+1	Mapping out national strategic directions against climate change enables the establishment of a GHG emissions trading system in order to control and limit emissions (especially emissions derived from the industrial sector)
C4>C5	0	There is no significant interaction between the two goals
Climate to Tourism		
C1>T1	0/+1	The reduction of GHG emissions may enable the sustainable use of energy resources and the sustainable management of emissions by the tourist sector
C2>T1	+1	Increasing country's adaptation ability against climate change enables the undertaking of relative actions towards the adaptation of the tourist sector to climate change impacts
C3>T1	+2	Mapping out national strategic directions against climate change reinforces the undertaking of specific policy measures having to do with the sustainable future development of the tourist sector under climate change conditions
C4>T1	0	There is no significant interaction between the two goals
C5>T1	0	There is no significant interaction between the two goals
C1>T2	0	There is no significant interaction between the two goals
C2>T2	0	There is no significant interaction between the two goals
C3>T2	0	There is no significant interaction between the two goals
C4>T2	0	There is no significant interaction between the two goals
C5>T2	0	There is no significant interaction between the two goals
C1>T3	0	There is no significant interaction between the two goals
C2>T3	0	There is no significant interaction between the two goals
C3>T3	0	There is no significant interaction between the two goals
C4>T3	0	There is no significant interaction between the two goals
C5>T3	0	There is no significant interaction between the two goals
C1>T4	0	There is no significant interaction between the two goals
C2>T4	+1	Increasing country's adaptation ability against climate change enables the respective adaptation of the offered tourist products and services (e.g. development of innovative tourist activities, change of the tourist pattern)
C3>T4	+1	Mapping out national strategic directions against climate change enables the undertaking of specific policy measures having to do with the improvement of the Greek tourist product under climate change conditions
C4>T4	0	There is no significant interaction between the two goals
C5>T4	0	There is no significant interaction between the two goals
Tourism to Water		
T1>W1	0/+1	Sustainable development of tourism may enable the sustainable management of surface water as it promotes the rational use of water resources by the tourist sector
T2>W1	0	There is no significant interaction between the two goals
T3>W1	0	There is no significant interaction between the two goals
T4>W1	0	There is no significant interaction between the two goals
T1>W2	0	There is no significant interaction between the two goals
T2>W2	0	There is no significant interaction between the two goals
T3>W2	0	There is no significant interaction between the two goals
T4>W2	0	There is no significant interaction between the two goals
T1>W3	0/+1	Sustainable development of tourism may enable the protection of aquatic ecosystems from further deterioration as it promotes the sustainable use and protection of natural resources by the tourist sector
T2>W3	0	There is no significant interaction between the two goals
T3>W3	0	There is no significant interaction between the two goals
T4>W3	0/+1	Improvement of the Greek tourist product may enable the protection of aquatic ecosystems from further deterioration as except from upgrading the tourist services it places emphasis on upgrading the quality of natural environment
T1>W4	0/+1	Sustainable development of tourism may enable the undertaking of measures aiming at the mitigation of floods' and drought's effects as some tourist regions

		are highly affected by floods and drought (or will be affected in the future due to climate change)
T2>W4	0	There is no significant interaction between the two goals
T3>W4	0	There is no significant interaction between the two goals
T4>W4	0	There is no significant interaction between the two goals
T1>W5	0	There is no significant interaction between the two goals
T2>W5	0	There is no significant interaction between the two goals
T3>W5	0	There is no significant interaction between the two goals
T4>W5	0	There is no significant interaction between the two goals
Tourism to Energy		
T1>E1	0/+1	The sustainable development of tourism may enable the attainment of the national energy goals through the rational use of energy resources and the adoption of RES by the tourist sector
T2>E1	0	There is no significant interaction between the two goals
T3>E1	0	There is no significant interaction between the two goals
T4>E1	0	There is no significant interaction between the two goals
T1>E2	+1	The sustainable development of tourism enables electricity production from RES as it promotes the adoption of RES for energy production by the tourist sector
T2>E2	0	There is no significant interaction between the two goals
T3>E2	0	There is no significant interaction between the two goals
T4>E2	0	There is no significant interaction between the two goals
T1>E3	0/+1	The sustainable development of tourism may enable the use of cogeneration technologies as it promotes the adoption of cogeneration systems for heating and cooling
T2>E3	0	There is no significant interaction between the two goals
T3>E3	0	There is no significant interaction between the two goals
T4>E3	0	There is no significant interaction between the two goals
T1>E4	0	There is no significant interaction between the two goals
T2>E4	0	There is no significant interaction between the two goals
T3>E4	0	There is no significant interaction between the two goals
T4>E4	0	There is no significant interaction between the two goals
T1>E5	0/+1	The sustainable development of tourism may enable the goal for establishing a national system for natural gas management as it promotes the use of natural gas for covering energy needs of the tourist sector
T2>E5	0	There is no significant interaction between the two goals
T3>E5	0	There is no significant interaction between the two goals
T4>E5	0	There is no significant interaction between the two goals
T1>E6	+1	The sustainable development of tourism enables the goal for energy saving as it promotes energy saving in buildings (tourist infrastructures) and also the sustainable use of energy resources by the tourist sector
T2>E6	0	There is no significant interaction between the two goals
T3>E6	0	There is no significant interaction between the two goals
T4>E6	0	There is no significant interaction between the two goals
Tourism to Land		
T1>L1	+2	The sustainable development of tourism reinforces the integrated spatial development as it places emphasis on the protection of natural and cultural resources as well as on the rational spatial organization of the tourist sector with respect of the specific characteristics of each region
T2>L1	0	There is no significant interaction between the two goals
T3>L1	0	There is no significant interaction between the two goals
T4>L1	0	There is no significant interaction between the two goals
T1>L2	+2	The sustainable development of tourism reinforces the development of a balanced and competitive economy as it constitutes a “key” economic sector in Greece
T2>L2	+2	The development of tourist entrepreneurship strongly supports and reinforces

		the national economy
T3>L2	0	There is no significant interaction between the two goals
T4>L2	+1	Improvement of the Greek tourist product enables the development of the national economy by offering high quality products and services
T1>L3	-1	There may be land use conflicts among tourist sector and aquaculture sector
T2>L3	0	There is no significant interaction between the two goals
T3>L3	0	There is no significant interaction between the two goals
T4>L3	0	There is no significant interaction between the two goals
T1>L4	0	There is no significant interaction between the two goals
T2>L4	0	There is no significant interaction between the two goals
T3>L4	0	There is no significant interaction between the two goals
T4>L4	0	There is no significant interaction between the two goals
Tourism to Food and Agriculture		
T1>F1	0/+1	The sustainable development of tourism may enable the development of agro-tourist activities and the establishment of a "cooperation" between tourist and agricultural sector
T2>F1	0/+1	The development of tourist entrepreneurship may enable the development of agro-tourist enterprises
T3>F1	0	There is no significant interaction between the two goals
T4>F1	0/+1	Improvement of the Greek tourist product may enable the sustainable development of agriculture in order higher quality agricultural products to be produced
T1>F2	0	There is no significant interaction between the two goals
T2>F2	0	There is no significant interaction between the two goals
T3>F2	0	There is no significant interaction between the two goals
T4>F2	0	There is no significant interaction between the two goals
T1>F3	0	There is no significant interaction between the two goals
T2>F3	0	There is no significant interaction between the two goals
T3>F3	0	There is no significant interaction between the two goals
T4>F3	0	There is no significant interaction between the two goals
T1>F4	0	There is no significant interaction between the two goals
T2>F4	0	There is no significant interaction between the two goals
T3>F4	0	There is no significant interaction between the two goals
T4>F4	0	There is no significant interaction between the two goals
T1>F5	0	There is no significant interaction between the two goals
T2>F5	0	There is no significant interaction between the two goals
T3>F5	0	There is no significant interaction between the two goals
T4>F5	0	There is no significant interaction between the two goals
T1>F6	0	There is no significant interaction between the two goals
T2>F6	0	There is no significant interaction between the two goals
T3>F6	0	There is no significant interaction between the two goals
T4>F6	0/+1	Improving the Greek tourist product entails the undertaking of actions for ensuring food security (restaurants, hotels, etc.)
Tourism to Climate		
T1>C1	+1	The sustainable development of tourism will enable energy efficiency and reduction of emissions by the tourist sector
T2>C1	0	There is no significant interaction between the two goals
T3>C1	0	There is no significant interaction between the two goals
T4>C1	0	There is no significant interaction between the two goals
T1>C2	+1	The sustainable development of tourism will enable the increase of the country's adaptation ability against climate change as it places emphasis on the sustainable use of natural resources by the tourist sector
T2>C2	0	There is no significant interaction between the two goals
T3>C2	0	There is no significant interaction between the two goals
T4>C2	0	There is no significant interaction between the two goals

T1>C3	+1	The sustainable development of tourism will enable the establishment of policy measures having to do with the adaptation of the tourist sector to climate change impacts
T2>C3	0	There is no significant interaction between the two goals
T3>C3	0	There is no significant interaction between the two goals
T4>C3	0	There is no significant interaction between the two goals
T1>C4	0/+1	The sustainable development of tourism may enable the organization of participatory actions among tourist actors with respect to climate change
T2>C4	0	There is no significant interaction between the two goals
T3>C4	0	There is no significant interaction between the two goals
T4>C4	0	There is no significant interaction between the two goals
T1>C5	0	There is no significant interaction between the two goals
T2>C5	0	There is no significant interaction between the two goals
T3>C5	0	There is no significant interaction between the two goals
T4>C5	0	There is no significant interaction between the two goals
Tourism to Tourism		
T2>T1	+2	Tourist entrepreneurship reinforces the sustainable development of tourism
T3>T1	+2	Tourist training sets the basis for the sustainable development of tourism
T4>T1	+2	Improvement of the Greek tourist product is a basic dimension towards (reinforces) the sustainable development of the tourist sector
T1>T2	+2	Sustainable tourist development presupposes and reinforces the development of relative tourist entrepreneurship
T3>T2	+2	Tourist training reinforces the development of modern and well-organized tourist enterprises
T4>T2	+3	Improvement of the Greek tourist product is inextricably linked to the development of tourist enterprises that will offer high quality tourist products and services
T1>T3	+3	Sustainable development of tourism goes "hand in hand" with the development of training activities that will support the development of expertise in the tourist sector
T2>T3	+2	Development of tourist entrepreneurship reinforces tourist training activities in order modern and innovative tourist enterprises to be created
T4>T3	+2	Improvement of the Greek tourist product reinforces the undertaking of tourist training activities in order innovative tourist products and services to be offered in the future
T1>T4	+3	Sustainable development of tourism goes "hand in hand" with the offer of high quality products and services
T2>T4	+2	Development of tourist entrepreneurship is strongly based on the quality of tourist products and services
T3>T4	+2	Tourist training activities reinforce the offer of innovative and high quality tourist products and services

The assessment of interactions showed that most synergies are created among goals referring to the same nexus sector (e.g. synergies among goals concerning water resources management) while in most cases, a high level of complementarity exists among goals of the same sector. Synergies have been also detected between energy and climate goals, food/agriculture and land goals and; water and climate goals. Such synergies are fully justified as:

- the majority of energy goals are strongly related to the protection of climate,
- goals concerning the sustainable management of water resources are closely linked to goals having to do with combating climate change impacts and adaptation to climate change, and

- goals that place emphasis on the sustainable development of agriculture are in close relationship with the sustainable management of land and the adoption of a balanced land use pattern.

On the other hand, there are no very strong conflicts among the nexus critical goals. However, according to stakeholders, conflicts arise in a more-specific (practical) level, during the policy implementation phase. Such conflicts concern:

- Management of geothermal springs.
- Water allocation / Water use by several sectors. Such conflicts include: water demand by the agricultural sector for irrigation, water use for environmental flow (farmers' opposition), water supply for domestic use, water demand by the tourist sector, water demand by the Public Power Corporation S.A. for energy production. These conflicts are also closely linked to the seasonality of water needs.
- Land use management. Conflicts exist between current land uses and the respective land uses described in several technical studies that regulate land use distribution and the respective "land use legal rights".
- Use of pesticides and the impacts on water quality.
- Efforts for combating water shortage and the parallel water consumption (misuse) mainly by the agricultural sector to cover irrigation needs.
- Energy mix for 2030.
- Use of lignite for electricity production.
- Oppositions of some local authorities to the construction of RES infrastructures.
- Hydrocarbons exploitation in Epirus Region and the respective impacts to the natural environment and landscape.
- Deregulation of the internal electricity market (Government-PPC-Investors).
- PVs infrastructures in high-productivity agricultural land.

5.2. Assessment of interactions between nexus critical instruments and nexus critical objectives

This section concerns the identification of the nexus critical instruments and the assessment of interactions between such instruments and the respective nexus critical objectives, based on policy mapping (block 1) and stakeholders' interviews. A nexus critical instrument is defined as "the policy instrument that according to the stakeholders and the policy analysis is highly relevant for the issues under investigation in the case study and has a potentially high number of interactions with the nexus critical objectives" (Munaretto and Witmer, 2017).

In case of the Greek case study, 43 nexus critical policy instruments were selected: 6 for climate, 7 for water, 6 for agriculture and food, 9 for energy, 9 for land and 6 for the tourist sector. These instruments are presented in Table 29 accompanied with a detailed description that justifies the reason why they are considered particularly critical in a nexus perspective. Such instruments reflect important national priorities as to the several nexus sectors and their future sustainable development in Greece. They have a large number of interactions with the respective nexus critical objectives while they are also relevant for the design of the serious game for the Greek case study. In addition, the majority of stakeholders are interested in them.

It should be mentioned that some of these instruments will be implemented in the thematic models and the SDM of the Greek CS. In this context, they will be further refined in order to be "translated" into assumptions and variables that will be used in the models for implementing each policy.

Table 29: Nexus critical instruments

Climate		
Code	Heading	Detailed description
Ca	Reinforcing research and technology in the field of RES	Development and promotion of innovative RES technologies
Cb	Use of technologies that “capture” Carbon Dioxide	Adoption of environmental friendly technologies that contribute to the reduction of CO_2 emissions
Cc	Adoption of technologies for the reduction of methane emissions	Adoption and extensive use of technologies that contribute to the reduction of methane emissions
Cd	Assessment of climate change impacts and the respective susceptibility	Adoption / use of indicators, methods and techniques for “measuring” climate change impacts
Ce	Initiatives to increase public awareness on climate change	Undertaking of actions for increasing public awareness and support participative actions against climate change - Consultation and promotion of public dialogue
Cf	Organized management of GHG emissions	Adoption of methods and indicators that calculate and monitor GHG emissions, development of systems that monitor GHG emissions, development of future scenarios for the management of carbon, carbon offset
Water		
Code	Heading	Detailed description
Wa	National monitoring network for water resources	Establishment of a national network for monitoring water quality and water quantity
Wb	Rules regulating water uses	Establishment of rules and measures regulating: domestic water supply, irrigation, industrial use of water, water use for energy production, water use for recreation activities
Wc	Monitoring water pollution by each region	Measures, rules and actions for monitoring water resources pollution
Wd	Cost recovery for water services	Water-pricing measures regulating efficient use of water resources, environmental and resource costs
We	National program concerning flood risk management and drought	Proactive planning for combating floods’ and drought’s impacts
Wf	Register of water resources and their characteristics	Analytical description of the available water resources and their special characteristics
Wg	Analytical reports for the Greek river basins (description of characteristics, integrated management of water districts)	Identification of Greek water districts and river basins, analytical description of their characteristics, sustainable management of the river basins and the surrounding areas
Food and Agriculture		
Code	Heading	Detailed description
Fa	Registry of plant genetic resources for	Exploration, collection, identification,

	food and agriculture	assessment and documentation of plant genetic resources for food and agriculture
Fb	Adoption of a sustainable and innovative agricultural pattern	Promotion of differentiated and locally adapted crops
Fc	Rules establishing terms and conditions for livestock development	Establishment of specific and detailed measures and rules regulating the terms and conditions under which livestock activities can take place. E.g. determination of suitable locations for the development of livestock, minimum area and minimum distance among livestock facilities, etc.
Fd	Monitoring rational use of pesticides	Adoption of methods and technologies that will monitor the use of pesticides and detect possible misuses
Fe	National program for aquaculture development	Production of high quality aquaculture food products, research and development, land use regulation, identification of suitable areas for the development of aquaculture activities, etc.
Ff	Monitoring and control rules in food and fodder industry	Monitoring quality of food and fodders, maintenance of the relative regulations and imposition of penalties in case of offenses
Energy		
Code	**Heading**	**Detailed description**
Ea	Construction of wind parks – Identification of suitable (“wind priority” and “wind suitability”) and non-suitable areas	Exploitation of wind for energy production – Creation of the relative infrastructures
Eb	Construction of hydroelectric power plants – Identification of suitable (hydraulic potential) and non-suitable areas	Exploitation of water for energy production – Creation of the relative infrastructures
Ec	Construction of geothermal power plants and biomass processing units	Exploitation of geothermy and biomass for energy production – Creation of the relative infrastructures
Ed	Installation of photovoltaics (barren or low-productivity land, invisible areas, connection capabilities)	Exploitation of the “sun” for energy production – Creation of the relative infrastructures
Ee	Adoption of cogeneration technologies	Promotion and use of cogeneration systems for energy production
Ef	Use of RES in buildings	Use of RES in buildings in order to replace conventional energy sources
Eg	Use of natural gas	Adoption of natural gas in order to replace oil
Eh	Transparency of the energy pricing system and information availability	Explicit definition of the several energy costs – Ensuring transparency of the relative processes
Ei	Adoption of smart systems for measuring energy consumption	Use of innovative technologies for monitoring energy consumption,

		possible losses, etc.
Land		
Code	Heading	Detailed description
La	Land use regulation	Limitation of land use conflicts – Explicit determination and spatial distribution of the several land uses
Lb	Development of economic synergies with other countries	Development of European or/and international synergies that will boost economic activities and support the national income
Lc	Measures and actions for the integrated development of urban and rural areas	Integrated pattern of spatial development – Development of a balanced spatial pattern between urban and rural areas that will place emphasis on spatial and economic complementarity
Ld	Promotion of entrepreneurship	Financial and regulatory incentives for the development of modern and innovative enterprises
Le	Strengthening social infrastructures	Development of infrastructures that will further support education, public health, social welfare, etc.
Lf	Promotion of specialization and complementarity among productive sectors	Development of economic synergies among the several productive sectors – Development of expertise
Lg	Terms and conditions for the location and spatial distribution of aquaculture facilities	Establishment of specific criteria, terms and conditions for the spatial organization of the aquaculture sector
Lh	Promotion of a multi-centric pattern of industrial development – Decentralization of the industrial sector	Balanced spatial distribution of industrial activities – Development of several industrial poles
Li	Development of national, regional (NUTS2) and local spatial plans	Development of plans that take into consideration the special characteristics, comparative advantages and weaknesses of each region
Tourism		
Code	Heading	Detailed description
Ta	Terms and conditions for the development of organized and sophisticated tourist investments	Definition of terms and conditions for the development of complex / sophisticated and organized tourist infrastructures (conference centers, ski resorts, marinas, etc.)
Tb	Specific land use regulations for the development of tourist activities	Reduction of land use conflicts (with other productive sectors) – Organized spatial distribution of the several tourist activities
Tc	Tourist observatory	Data and information with respect to the tourist trends, economic and environmental impacts, preferences of tourists, origin and profile of tourists
Td	Tourist training activities and tourist expertise	Organization of tourist schools, seminar courses and tourist educational centers – Diffusion of

		innovative knowledge and modern practices
Te	Differentiation of tourist activities and tourist product according to the special characteristics of each region	Adaptation of the tourist activities to the specific comparative advantages and peculiarities of each region
Tf	Networking among tourist entrepreneurships	Development of synergies among tourist entrepreneurships – Knowledge diffusion

After the identification of the nexus critical instruments, a scoring matrix including the assessment of interactions among policy instruments and policy goals/objectives was built. The instruments are reported in rows and the objectives in columns. In this second assessment, we explored how instruments affect the achievement of objectives. The scoring system is the same as the scoring system used for the assessment of objectives' interactions (scoring scale from -3 to +3).

The scoring matrix for the Greek case study (Table 30) consists of 43 rows (instruments) and 30 columns (goals/objectives). The scoring of interactions was conducted by Greek CS researchers based on: the relative literature, the policy analysis that took place in block 1, stakeholders' opinions expressed during the interviews and also on experts' judgments. The scoring matrix is accompanied by justification of the scoring of each cell.

Table 30: Matrix of coherence among policy instruments and policy objectives

	W1	W2	W3	W4	W5	E1	E2	E3	E4	E5	E6	L1	L2	L3	L4	F1	F2	F3	F4	F5	F6	C1	C2	C3	C4	C5	T1	T2	T3	T4	Tot. n. (+)	Tot. n. (-)	Tot. n. (-/+)
Wa	+3	+3	+3	+2	+1	0	0/+1	0	0	0	0	0/+1	0	+2	0/+1	+2	0	0/+1	+1	+2	0	0	+2	+2	0	0	0/+1	0	0	0	15	1	0
Wb	+3	+3	0	+2	+3	0	+1	0	0	0	0	0/+1	0	+2	+2	+2	0	+2	0	+2	0	0	+2	+2	0	0	+2	0	0	0	14	0	0
Wc	+3	+3	+3	0	0	0	-1	0	0	0	0	0/+1	0	-1	-1	0/+1	0	-1	0/-1	0/-1	0/+1	0	+1	0/+1	0	0	-1	0	0	0	8	7	0
Wd	+3	+3	+3	+1	+3	0	0/-1	0	0	0	0/+1	+1	0	-1	-1	-1	0	-1	0	-1	0	0	0/+1	0/+1	0	0	-1	0	0	0	9	7	0
We	+3	+3	0	+3	0	0	0/-1	0	0	0	0	+1	0	0	0	+1	0	0/+1	0	0	0	0	+3	+3	0	0	+1	0	0	0	9	1	0
Wf	+3	+3	+2	0/+1	0	0	+1	0	0	0	0	0/+1	0	+1	+1	+1	0	+1	-1	+1	+1	0	+2	+2	0	0	+1	0	0	0	15	1	0
Wg	+3	+3	+3	+3	+1	0	0/+1	0	0	0	0	0/+1	0	+2	-1	+1	0	0	-1	+2	0	0	+1	+1	0	0	0/+1	0	0	0	13	2	0
Ea	0	0	0/-1	0	0	+3	+3	+2	+1	0	0/+1	-1/+1	+1	0	0/-1	0/-1	0	0	0	0	0	+3	+3	+2	+1	0	0/-1	0/-1	0	0/-1	10	6	1
Eb	0/-1	0/+1	0/-1	0/+1	0	+3	+3	0	+1	0	0/+1	-1/+1	+1	+2	+2	+1	0	0	0	+2	0	+3	+3	+2	+1	0	0/+1	0/+1	0	0	17	2	1
Ec	0/-1	0/-1	0/-1	0	0	+3	+3	+2	+1	0	0/+1	-1/+1	+1	0	+2	+2	0	0	0	0	0	+3	+3	+2	+1	0	0/+1	0	0	0	13	3	1
Ed	0	0	0	0	0	+3	+3	0	+1	0	0/+1	-1/+1	+1	0	0/-1	0	0	0	0	0	0	+3	+3	+2	+1	0	0/+1	0	0	0/-1	10	2	1
Ee	0	0	0	0	0	+1	+1	+3	+1	+2	+2	0	0	0	+1	0/+1	0	0	0	0	0	+3	+3	+2	0	0	0/+1	0	0	0	12	0	0
Ef	0	0	0	0	0	+3	+3	0/+1	+1	0/-1	+2	+1	+1	0	0	0	0	0	0	0	0	+3	+3	+2	+2	0	+2	0	0	0/+1	13	1	0
Eg	0	0	0	0	0	+1	0	+2	+1	+3	+1	0	+1	0	+1	+1	0	0	0	0	0	+2	+2	+2	+2	0	+2	0	0	0/+1	14	0	0
Eh	0	0	0	0	0	+1	-1/+1	-1/+1	+3	-1/+1	+2	0	+2	0	0	0/+1	0	0	0	0	0	-2/+2	0/+1	0/+1	0/+1	+2	0/+1	0	0	0	10	0	4
Ei	0	0	0	0	0	0	0	0	0	0	+3	0	0	0	0/+1	+1	0	0	0	0	0	+1	+1	+1	+1	0/+1	0/+1	0	0	0	9	0	0
La	+1	+1	+1	+1	+1	+1	+1	0	0	-1/+1	0	+3	+2	+3	+3	+3	0	+3	+1	+2	0	0/+1	+1	+1	0	0	+3	+1	0	+1	21	0	1
Lb	0	0	0	0	0	0	0	0	0	0	0	+1	+3	0/+1	0/+1	0/+1	0	0	0	0/+1	0	0	0	0	0	+1	0/+1	+2	0	+1	10	0	0
Lc	0	0	0	0	0	0	0	0	0	0	0	+3	+3	+1	+1	+1	0	+1	0	+1	0	0	0	0	0	0	+1	+1	0	0	9	0	0
Ld	0	0	0	0	0	0	+1	0	0	0	0	+1	+3	+1	+1	+1	+1	+1	0	+1	+1	0/+1	0	0	0	+1	+1	+2	+1	+1	16	0	0
Le	0	0	0	0	0	0	0	0	0	0	0	+2	+2	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	0	0	+1	4	0	0
Lf	0	0	0	0	0	+1	+2	+2	0	0/+1	+2	+1	+3	+1	+1	+2	+2	+1	+1	+2	+2	+2	+2	+2	+1	+2	+2	+2	+2	+2	24	0	0
Lg	+1	0	0/+1	0	0	0	0	0	0	0	0	+2	+1	+3	0	0	0	0	0	+3	0	0	0	0	0	0	0	0/+1	0	0	7	0	0
Lh	0/-1	0/-1	0/-1	0	0	+1	+1	+1	0	+1	+1	+3	+2	0	+3	0/-1	0/+1	0	0	0	0/+1	-1/+1	0	0	0	0	0/-1	0	0	0	10	5	1
Li	+1	+1	+1	+2	0	0	+1	0	0	0	0	+3	+2	+3	+3	+3	0	+3	0	+2	0	0	+1	+1	0	0	+3	+1	0	+1	17	0	0
Fa	0	0	0	0	0	0	0	0	0	0	0	0	0/+1	0	0	+2	+3	0	0	0	+2	0	0	0/+1	0	0	0	0/+1	0	0	6	0	0
Fb	+2	+2	+1	+1	0	0	0	0/+1	0	0	0/+1	+2	+2	0	0/-1	+3	+1	0/-1	+2	0	+2	0	+1	+2	0	0	0/-1	0	0	0	14	3	0
Fc	+1	+1	+1	0	0	0	-1	0/+1	0	0	0/+1	+3	+1	0	0/-1	-1	0	+3	0	0	+2	0	+1	+1	0	0	0/-1	0	0	0	11	4	0
Fd	+2	+2	+2	0	0	0	0	0	0	0	0	+1	0	0	0	+3	0	0	+3	0	+3	0	0	0	0	0	0	0	0	0	7	0	0
Fe	+1	+1	+1	0	0	0	0	0	0	0	0	+2	+1	+3	0	0	0	0	0	+3	+1	0	0	+1	0	0	0/-1	0	0	0	9	1	0
Ff	0	0	0	0	0	0	0	0	0	0	0	0	+1	0	0	0/+1	+1	0	+2	0	+3	0	0	0	0	0	0	0	0	0	5	0	0
Ca	0/+1	0	0	0	0	+3	+3	+3	+1	0	+3	0	0/+1	0	0/+1	0	0	0	0	0	0	+3	+3	+3	+2	+1	+1	0	0	0	14	0	0
Cb	0	0	0	0	0	+3	0	0	0	0	+1	0/+1	0	0	0	+1	0	0	0	0	0	+3	+3	+3	0	+3	0	0	0	0	8	0	0
Cc	0	0	0	0	0	+3	0	+1	0	0	0	0/+1	0	0	0	+1	0	0	0	0	0	+3	+3	+3	+1	+3	0	0	0	0	9	0	0
Cd	+3	+3	+2	+3	+2	+3	+3	+2	+2	-1	+2	+2	+1	0/+1	-1/+1	-1/+1	+1	+1	+1	+1	0	+3	+3	+3	+2	+2	+2	-1/+1	0/+1	+1	25	1	3
Ce	0/+1	0/+1	0/+1	+1	+1	+3	+3	+2	+1	-1	+2	+2	0	0	0	0/+1	0/+1	0	0/+1	0	0	+3	+3	+3	+3	+2	0/+1	0	0	0/+1	21	1	0
Cf	0/+1	0/+1	0/+1	0/+1	0	+3	+2	+2	+2	-1	+3	0	+1	0	0/+1	0/+1	0	0	0	0	0	+3	+3	+3	+1	+3	0/+1	0	0	0	18	1	0
Ta	0	0	0	0	0	0	0	0	0	0	0/+1	+1	+2	0/-1	0/-1	0	0	0	0	0	0	0/+1	+1	+1	0	0	+3	+3	+2	+3	10	2	0
Tb	0	0	+1	0	0	0	0	0	0	0	0	+3	+2	0	0	0	0	0	0	0	0	0	0	0	0	0	+3	+3	0/+1	+1	7	0	0
Tc	0	0	0	0	0	0	0	0	0	0	0	+1	+2	0	0	0	0	0	0	0	0	0	0/+1	0/+1	0	0	+3	+3	+3	+3	8	0	0
Td	0	0	0	0	0	0	0	0	0	0	0/+1	0	+1	0	0	0	0	0	0	0	0	0/+1	0/+1	0/+1	0	0	+3	+3	+3	+3	9	0	0
Te	0	0	0	0	0	0	0	0	0	0	0	+1	+2	0	0	0	0	0	0	0	0	0	0/+1	0/+1	0	0	+3	+3	+2	+3	8	0	0
Tf	0	0	0	0	0	0	0	0	0	0	0	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	+3	+3	+1	+2	6	0	0
Tot. n. (+)	18	17	16	13	7	17	19	14	12	4	21	30	30	14	17	26	8	11	8	14	11	19	31	33	14	11	30	15	9	16			
Tot. n. (-)	3	2	4	0	0	0	4	0	0	4	0	0	0	3	8	4	0	3	3	2	0	0	0	0	0	0	7	1	0	2			
Tot. n. (-/+)	0	0	0	0	0	0	1	1	0	2	0	4	0	0	1	1	0	0	0	0	0	2	0	0	0	0	0	1	0	0			

Interaction	Score	Justification
Water Policy Instruments to the Nexus-components Policy Goals		
Wa>W1	+3	The establishment of a national network for monitoring water quality and water quantity is intertwined with the protection and sustainable management of surface water – Measure that supports directly the implementation of the specific policy goal
Wa>W2	+3	The establishment of a national network for monitoring water quality and water quantity is inextricably linked to the protection and sustainable management of groundwater – Measure that supports directly the implementation of the specific policy goal
Wa>W3	+3	The establishment of a national network for monitoring water quality and water quantity is inextricably linked to the protection of aquatic ecosystems and the reduction of pollution as it has to do with monitoring the quality of water in such ecosystems
Wa>W4	+2	The establishment of a national network for monitoring water quality and water quantity reinforces the implementation of the goal for mitigating floods' and drought's effects, especially in the part that has to do with monitoring water quantity and its availability for covering existing and future needs
Wa>W5	+1	The establishment of a national network for monitoring water quality and water quantity enables the regulation of the several water costs (e.g. agricultural cost for water use, industrial cost for water use, etc.) as it has to do with the pressures put on water quality as well as the availability of water resources for covering existing and future needs
Wa>E1	0	There is no significant interaction between the goal and the instrument
Wa>E2	0/+1	The establishment of a national network for monitoring water quality and water quantity may enable electricity production from RES in case where water resources are or may be used for electricity production (hydroelectric power plants)
Wa>E3	0	There is no significant interaction between the goal and the instrument
Wa>E4	0	There is no significant interaction between the goal and the instrument
Wa>E5	0	There is no significant interaction between the goal and the instrument
Wa>E6	0	There is no significant interaction between the goal and the instrument
Wa>L1	0/+1	The establishment of a national monitoring network for water resources may enable the development of a sustainable spatial pattern as it contributes to the protection of biodiversity and natural resources (here: protection and sustainable management of water resources)
Wa>L2	0	There is no significant interaction between the goal and the instrument
Wa>L3	+2	The establishment of a national monitoring network for water resources reinforces the spatial organization of aquaculture as it gives directions for the sustainable management and protection of water resources by the aquaculture sector
Wa>L4	0/+1	The establishment of a national monitoring network for water resources may enable the sustainable spatial organization of the industrial sector as it gives directions for the rational and sustainable use of water resources by the industrial sector
Wa>F1	+2	The establishment of a national monitoring network for water resources reinforces the sustainable development of agriculture as it gives directions for the sustainable management and protection of water resources by the agricultural sector
Wa>F2	0	There is no significant interaction between the goal and the instrument
Wa>F3	0/+1	The establishment of a national monitoring network for water resources may enable the sustainable spatial organization of livestock as it gives directions for the sustainable management and protection of water resources by the sector of livestock
Wa>F4	+1	The establishment of a national monitoring network for water resources enables the use of pesticides as it contributes to the detection of possible misuses, the

		detection of the source of pollution and finally to the confrontation of the problem
Wa>F5	+2	The establishment of a national monitoring network for water resources reinforces the sustainable development of aquaculture as it gives directions towards the sustainable management and protection of water resources by the aquaculture sector
Wa>F6	0	There is no significant interaction between the goal and the instrument
Wa>C1	0	There is no significant interaction between the goal and the instrument
Wa>C2	+2	The establishment of a national monitoring network for water resources reinforces the efforts towards the increase of the country's adaptation ability against climate change as it contributes to proactive planning and the sustainable management of water resources under climate change conditions
Wa>C3	+2	The establishment of a national monitoring network for water resources reinforces the establishment of specific measures for combating climate change with respect to water resources management and sustainable use of water under climate change conditions
Wa>C4	0	There is no significant interaction between the goal and the instrument
Wa>C5	0	There is no significant interaction between the goal and the instrument
Wa>T1	0/+1	The establishment of a national monitoring network for water resources may enable the sustainable development of the tourist sector as it contributes to the sustainable management of water resources by the tourist sector
Wa>T2	0	There is no significant interaction between the goal and the instrument
Wa>T3	0	There is no significant interaction between the goal and the instrument
Wa>T4	0	There is no significant interaction between the goal and the instrument
Wb>W1	+3	The establishment of general rules regulating water uses is inextricably linked to the implementation of the goal towards the sustainable management of surface water as it supports the rational use of water resources in order several needs to be covered
Wb>W2	+3	The establishment of general rules regulating water uses is inextricably linked to the implementation of the goal towards the sustainable management of groundwater as it supports the rational use of water resources in order several needs to be covered
Wb>W3	0	There is no significant interaction between the goal and the instrument
Wb>W4	+2	The establishment of general rules regulating water uses reinforces the goal for mitigating floods' and drought's effects as it has to do with the rational and sustainable use of water resources
Wb>W5	+3	The establishment of general rules regulating water uses is in close and very strong relationship with the establishment of a national water pricing system through which costs for several water uses will be clearly defined
Wb>E1	0	There is no significant interaction between the goal and the instrument
Wb>E2	+1	The establishment of general rules regulating water uses clarifies the conditions under which water resources can be used for electricity production in hydroelectric power plants (e.g. water availability for electricity production)
Wb>E3	0	There is no significant interaction between the goal and the instrument
Wb>E4	0	There is no significant interaction between the goal and the instrument
Wb>E5	0	There is no significant interaction between the goal and the instrument
Wb>E6	0	There is no significant interaction between the goal and the instrument
Wb>L1	0/+1	The establishment of general rules regulating water uses may enable the development of a sustainable spatial pattern as it contributes to the sustainable management of water resources
Wb>L2	0	There is no significant interaction between the goal and the instrument
Wb>L3	+2	The establishment of general rules regulating water uses reinforces the spatial organization of aquaculture activities as it contributes to the identification of areas with available water resources for the development of aquaculture while it also contributes to the rational use of water by the aquaculture sector
Wb>L4	+2	The establishment of general rules regulating water uses reinforces the

		sustainable spatial organization of the industrial sector as it contributes to the rational use of water and the protection of water resources by the industrial sector
Wb>F1	+2	The establishment of general rules regulating water uses reinforces the rational use of water resources by the agricultural sector (irrigation, etc.)
Wb>F2	0	There is no significant interaction between the goal and the instrument
Wb>F3	+2	The establishment of general rules regulating water uses reinforces the rational use of water resources by the sector of livestock (e.g. water used for cleaning livestock infrastructures)
Wb>F4	0	There is no significant interaction between the goal and the instrument
Wb>F5	+2	The establishment of general rules regulating water uses reinforces the rational use of water resources by the aquaculture sector (avoid waste of water, etc.)
Wb>F6	0	There is no significant interaction between the goal and the instrument
Wb>C1	0	There is no significant interaction between the goal and the instrument
Wb>C2	+2	The establishment of general rules regulating water uses reinforces the efforts towards the increase of the country's adaptation ability against climate change as it contributes to the rational use and the sustainable management of water resources by several sectors under climate change conditions
Wb>C3	+2	The establishment of general rules regulating water uses reinforces the establishment of specific measures for combating climate change with respect to the rational use of water resources by several sectors under climate change conditions
Wb>C4	0	There is no significant interaction between the goal and the instrument
Wb>C5	0	There is no significant interaction between the goal and the instrument
Wb>T1	+2	The establishment of general rules regulating water uses reinforces the rational use of water resources by the tourist sector
Wb>T2	0	There is no significant interaction between the goal and the instrument
Wb>T3	0	There is no significant interaction between the goal and the instrument
Wb>T4	0	There is no significant interaction between the goal and the instrument
Wc>W1	+3	The establishment of measures, rules and actions for monitoring water resources pollution is intertwined with the protection of quality of surface water
Wc>W2	+3	The establishment of measures, rules and actions for monitoring water resources pollution is intertwined with the protection of quality of groundwater
Wc>W3	+3	The establishment of measures, rules and actions for monitoring water resources pollution constitutes the main precondition for preventing aquatic ecosystems from further deterioration as it focuses on water quality and its protection by pollution
Wc>W4	0	There is no significant interaction between the goal and the instrument
Wc>W5	0	There is no significant interaction between the goal and the instrument
Wc>E1	0	There is no significant interaction between the goal and the instrument
Wc>E2	-1	The establishment of measures, rules and actions for monitoring water resources pollution puts constraints in case where water resources are exploited for electricity production (hydroelectric power plants) and such activities put pressures on water quality
Wc>E3	0	There is no significant interaction between the goal and the instrument
Wc>E4	0	There is no significant interaction between the goal and the instrument
Wc>E5	0	There is no significant interaction between the goal and the instrument
Wc>E6	0	There is no significant interaction between the goal and the instrument
Wc>L1	0/+1	The establishment of measures, rules and actions for monitoring water resources pollution may enable sustainable spatial development as it contributes to the protection of biodiversity and natural resources (here: protection of water resources)
Wc>L2	0	There is no significant interaction between the goal and the instrument
Wc>L3	-1	The establishment of measures, rules and actions for monitoring water resources pollution puts constraints on the spatial organization of aquaculture sector with

		respect to water resources protection from possible pollution or misuses caused by aquaculture activities
Wc>L4	-1	The establishment of measures, rules and actions for monitoring water resources pollution puts constraints on the spatial organization of the industrial sector with respect to water resources protection from possible pollution or misuses caused by industrial activities
Wc>F1	0/+1	The establishment of measures, rules and actions for monitoring water resources pollution may enable the sustainable development of agriculture and the protection of water resources by the agricultural sector
Wc>F2	0	There is no significant interaction between the goal and the instrument
Wc>F3	-1	The establishment of measures, rules and actions for monitoring water resources pollution puts constraints on the development of livestock activities in case they threat water resources quality
Wc>F4	0/-1	The establishment of measures, rules and actions for monitoring water resources pollution may put constraints on the use of pesticides even in case they are used rationally in case sources of pollution are detected
Wc>F5	0/-1	The establishment of measures, rules and actions for monitoring water resources pollution may put constraints on the development of aquaculture in case aquaculture activities affect the quality of water resources
Wc>F6	0/+1	The establishment of measures, rules and actions for monitoring water resources pollution may contribute to ensuring the quality of food and fodders, especially in case of agricultural products
Wc>C1	0	There is no significant interaction between the goal and the instrument
Wc>C2	+1	The establishment of measures, rules and actions for monitoring water resources pollution enables the efforts towards enhancing the country’s adaptation ability against climate change impacts with respect to water resources protection
Wc>C3	+1	The establishment of measures, rules and actions for monitoring water resources pollution constitutes a group of measures that enable the efforts towards combating climate change impacts on water resources quality
Wc>C4	0	There is no significant interaction between the goal and the instrument
Wc>C5	0	There is no significant interaction between the goal and the instrument
Wc>T1	-1	The establishment of measures, rules and actions for monitoring water resources pollution puts constraints on the development of tourist activities in case they affect water resources quality
Wc>T2	0	There is no significant interaction between the goal and the instrument
Wc>T3	0	There is no significant interaction between the goal and the instrument
Wc>T4	0	There is no significant interaction between the goal and the instrument
Wd>W1	+3	Cost recovery for water services is inextricably linked to the sustainable management of surface water as it has to do with measures and actions regulating the rational use of surface water resources by several sectors
Wd>W2	+3	Cost recovery for water services is inextricably linked to the sustainable management of groundwater as it has to do with measures and actions regulating the rational use of groundwater by several sectors
Wd>W3	+3	Cost recovery for water services is intertwined with the protection of aquatic ecosystems from pollution and deterioration as it takes into account several environmental costs
Wd>W4	+1	Cost recovery for water services enables the achievement of the goal for mitigating floods’ and drought’s effects as it contributes to the sustainable management of water resources (proactive planning for water resources)
Wd>W5	+3	Setting cost recovery for water services is inextricably linked to the establishment of a national water pricing system
Wd>E1	0	There is no significant interaction between the goal and the instrument
Wd>E2	0/-1	Cost recovery for water services may impose constraints in case where water resources are used for electricity production (hydroelectric power plants) in order to protect them by possible misuses or pollution
Wd>E3	0	There is no significant interaction between the goal and the instrument

Wd>E4	0	There is no significant interaction between the goal and the instrument
Wd>E5	0	There is no significant interaction between the goal and the instrument
Wd>E6	0/+1	Cost recovery for water services may enable the achievement of goal for energy saving in special cases such as reduction of energy consumption by the agricultural sector through the respective reduction of water misuse / consumption
Wd>L1	+1	Cost recovery for water services enables the sustainable spatial development as it contributes to the protection of biodiversity and natural resources (here: protection and sustainable management of water resources)
Wd>L2	0	There is no significant interaction between the goal and the instrument
Wd>L3	-1	Cost recovery for water services imposes constraints on water use by the aquaculture sector in order to protect water resources by possible pollution or misuses
Wd>L4	-1	Cost recovery for water services imposes constraints on water use by the industrial sector in order to protect water resources by possible pollution or misuses
Wd>F1	-1	Cost recovery for water services may impose constraints on water use by the agricultural sector in order to limit water misuse by the agricultural sector
Wd>F2	0	There is no significant interaction between the goal and the instrument
Wd>F3	-1	Cost recovery for water services imposes constraints on water use by the sector of livestock in order to protect water resources by possible pollution or misuses
Wd>F4	0	There is no significant interaction between the goal and the instrument
Wd>F5	-1	Cost recovery for water services imposes constraints on water use by the aquaculture sector in order to protect water resources by possible pollution or misuses
Wd>F6	0	There is no significant interaction between the goal and the instrument
Wd>C1	0	There is no significant interaction between the goal and the instrument
Wd>C2	0/+1	Cost recovery for water services may enable the efforts towards increasing the country's adaptation ability against climate change as it contributes to the sustainable and rational use of water resources under climate change conditions
Wd>C3	+1	Cost recovery for water services constitutes a policy measure that enables the goal for combating climate change and boosts the undertaking of relative complementary measures concerning sustainable water resources management under climate change conditions
Wd>C4	0	There is no significant interaction between the goal and the instrument
Wd>C5	0	There is no significant interaction between the goal and the instrument
Wd>T1	-1	Cost recovery for water services imposes constraints on water use by the tourist sector, especially during the peak season in order to protect water resources by possible misuses and pollution
Wd>T2	0	There is no significant interaction between the goal and the instrument
Wd>T3	0	There is no significant interaction between the goal and the instrument
Wd>T4	0	There is no significant interaction between the goal and the instrument
We>W1	+3	Proactive planning for combating floods' and drought's impacts is inextricably linked to the sustainable management of surface water as it contributes to ensuring water availability in the future and also to limit water losses
We>W2	+3	Proactive planning for combating floods' and drought's impacts is inextricably linked to the sustainable management of groundwater as it contributes to ensuring water availability in the future and also to limit water losses
We>W3	0	There is no significant interaction between the goal and the instrument
We>W4	+3	Proactive planning for combating floods' and drought's impacts constitutes the main tool towards the mitigation of floods' and drought's effects
We>W5	0	There is no significant interaction between the goal and the instrument
We>E1	0	There is no significant interaction between the goal and the instrument
We>E2	0/-1	The preparation of a national program concerning flood risk management and management of drought may put constraints on electricity production from RES

		in case where water resources are used for electricity production (hydroelectric power plants) and their availability is under risk
We>E3	0	There is no significant interaction between the goal and the instrument
We>E4	0	There is no significant interaction between the goal and the instrument
We>E5	0	There is no significant interaction between the goal and the instrument
We>E6	0	There is no significant interaction between the goal and the instrument
We>L1	+1	Proactive planning for combating floods' and drought's effects enables sustainable spatial development as it contributes to the sustainable management of natural resources and biodiversity (here: sustainable management of water resources)
We>L2	0	There is no significant interaction between the goal and the instrument
We>L3	0	There is no significant interaction between the goal and the instrument
We>L4	0	There is no significant interaction between the goal and the instrument
We>F1	+1	Proactive planning for combating floods' and drought's effects enables the sustainable development of agriculture as it contributes to the identification of agricultural regions that are vulnerable to floods' and drought's impacts
We>F2	0	There is no significant interaction between the goal and the instrument
We>F3	0/+1	Proactive planning for combating floods' and drought's effects may enable the development and spatial organization of livestock as it contributes to the identification of regions that are vulnerable to floods' and drought's impacts
We>F4	0	There is no significant interaction between the goal and the instrument
We>F5	0	There is no significant interaction between the goal and the instrument
We>F6	0	There is no significant interaction between the goal and the instrument
We>C1	0	There is no significant interaction between the goal and the instrument
We>C2	+3	Proactive planning for combating floods' and drought's effects is intertwined with the increase of the country's adaptation ability against climate change as floods and drought constitute a serious impact of climate change
We>C3	+3	Proactive planning for combating floods' and drought's effects is a basic strategic direction for combating climate change impacts as floods and drought constitute a serious impact of climate change
We>C4	0	There is no significant interaction between the goal and the instrument
We>C5	0	There is no significant interaction between the goal and the instrument
We>T1	+1	Proactive planning for combating floods' and drought's effects enables the sustainable development of tourism as it contributes to the identification of regions that are vulnerable to floods' and drought's impacts
We>T2	0	There is no significant interaction between the goal and the instrument
We>T3	0	There is no significant interaction between the goal and the instrument
We>T4	0	There is no significant interaction between the goal and the instrument
Wf>W3	+3	The creation of a register including water resources and their characteristics is inextricably linked to the sustainable management and protection of surface water as it entails the analytical exploration and description of the available water resources and their specific characteristics
Wf>W2	+3	The creation of a register including water resources and their characteristics is inextricably linked to the sustainable management and protection of groundwater as it entails the analytical exploration and description of the available water resources and their specific characteristics
Wf>W3	+2	The creation of a register including water resources and their characteristics reinforces the protection of aquatic ecosystems from further deterioration and pollution as it includes the specific characteristics of each of them
Wf>W4	0/+1	The creation of a register including water resources and their characteristics may enable actions for mitigating floods' and drought's impacts as it is possible to detect the vulnerability of aquatic ecosystems
Wf>W5	0	There is no significant interaction between the goal and the instrument
Wf>E1	0	There is no significant interaction between the goal and the instrument
Wf>E2	+1	The creation of a register including water resources and their characteristics

		enables electricity production from RES as it contributes to the identification of regions where hydroelectric power plants can be placed
Wf>E3	0	There is no significant interaction between the goal and the instrument
Wf>E4	0	There is no significant interaction between the goal and the instrument
Wf>E5	0	There is no significant interaction between the goal and the instrument
Wf>E6	0	There is no significant interaction between the goal and the instrument
Wf>L1	0/+1	The creation of a register including water resources and their characteristics may enable the sustainable spatial development as it contributes to the sustainable management of natural resources and the protection of biodiversity (here: sustainable management of water resources)
Wf>L2	0	There is no significant interaction between the goal and the instrument
Wf>L3	+1	The creation of a register including water resources and their characteristics enables the sustainable spatial organization of aquaculture as it supports the identification of regions where aquaculture activities can take place
Wf>L4	+1	The creation of a register including water resources and their characteristics enables the sustainable spatial organization of the industrial sector as it supports the identification of regions where industrial activities can take place
Wf>F1	+1	The creation of a register including water resources and their characteristics enables the sustainable development of agriculture as it contributes to the rational use of water resources by the agricultural sector
Wf>F2	0	There is no significant interaction between the goal and the instrument
Wf>F3	+1	The creation of a register including water resources and their characteristics enables the sustainable development of livestock as it contributes to the rational use of water resources by the sector of livestock
Wf>F4	-1	The creation of a register including water resources and their characteristics may put constraints to the use of pesticides, even in case of rational use, depending on the specific characteristics and status of water resources
Wf>F5	+1	The creation of a register including water resources and their characteristics enables the sustainable development of aquaculture as it contributes to the rational use of water resources by the aquaculture sector
Wf>F6	+1	The creation of a register including water resources and their characteristics enables the sustainable development of industrial activities as it contributes to the rational use of water resources by the industrial sector
Wf>C1	0	There is no significant interaction between the goal and the instrument
Wf>C2	+2	The creation of a register including water resources and their characteristics is a first step for reinforcing country's adaptation ability against climate change with respect to water resources sustainable management under climate change conditions
Wf>C3	+2	The creation of a register including water resources and their characteristics is a first step towards the establishment of policy measures, concerning water resources management, for combating climate change
Wf>C4	0	There is no significant interaction between the goal and the instrument
Wf>C5	0	There is no significant interaction between the goal and the instrument
Wf>T1	+1	The creation of a register including water resources and their characteristics enables the sustainable development of tourism as it contributes to the rational use of water resources by the tourist sector
Wf>T2	0	There is no significant interaction between the goal and the instrument
Wf>T3	0	There is no significant interaction between the goal and the instrument
Wf>T4	0	There is no significant interaction between the goal and the instrument
Wg>W1	+3	The establishment of analytical reports for the Greek river basins is intertwined with the protection of surface water as they include analytical information about the characteristics of each river basin and they aim at the protection and sustainable management of water resources
Wg>W2	+3	The establishment of analytical reports for the Greek river basins is inextricably linked to the protection of groundwater as they include analytical information about the characteristics of each river basin and they aim at the protection and

		sustainable management of water resources
Wg>W3	+3	The establishment of analytical reports for the Greek river basins is inextricably linked to the protection of aquatic ecosystems from further deterioration as they include information about water quality and they aim at the protection and sustainable management of water resources
Wg>W4	+3	The establishment of analytical reports for the Greek river basins is inextricably linked to the mitigation of floods' and drought's effects as they include information concerning water quantity and possible risks for flood and drought in each river basin
Wg>W5	+1	The establishment of analytical reports for the Greek river basins enables the establishment of a national water pricing system as such reports include useful information about water quality, water quantity and water demands / needs that should be taken into account when determining water costs
Wg>E1	0	There is no significant interaction between the goal and the instrument
Wg>E2	0/+1	The establishment of analytical reports for the Greek river basins may enable electricity production from RES in case of hydroelectric power plants as they include information concerning the water potential of each region
Wg>E3	0	There is no significant interaction between the goal and the instrument
Wg>E4	0	There is no significant interaction between the goal and the instrument
Wg>E5	0	There is no significant interaction between the goal and the instrument
Wg>E6	0	There is no significant interaction between the goal and the instrument
Wg>L1	0/+1	The establishment of analytical reports for the Greek river basins may enable the sustainable and integrated spatial development as they contribute to the protection of biodiversity and protection of water resources while they also provide information concerning water allocation issues
Wg>L2	0	There is no significant interaction between the goal and the instrument
Wg>L3	+2	The establishment of analytical reports for the Greek river basins reinforces the spatial organization of aquaculture as they contain information about water availability and water quality, parameters that should be taken into account for the spatial distribution of aquaculture activities
Wg>L4	-1	The establishment of analytical reports for the Greek river basins puts constraints on the spatial organization of industry in case where industrial activities entail negative impacts on water resources
Wg>F1	+1	The establishment of analytical reports for the Greek river basins enables the sustainable development of agriculture as they contribute to the better management of water resources by the agricultural sector
Wg>F2	0	There is no significant interaction between the goal and the instrument
Wg>F3	0	There is no significant interaction between the goal and the instrument
Wg>F4	-1	The establishment of analytical reports for the Greek river basins puts constraints on the use of pesticides even it is rational as pesticides affect the quality of water resources
Wg>F5	+2	The establishment of analytical reports for the Greek river basins reinforces the sustainable development of aquaculture as they contain information about water availability and water quality, parameters that should be taken into account for the development of aquaculture activities
Wg>F6	0	There is no significant interaction between the goal and the instrument
Wg>C1	0	There is no significant interaction between the goal and the instrument
Wg>C2	+1	The establishment of analytical reports for the Greek river basins enables the increase of adaptation ability against climate change as they provide information about water availability and water quality that should be taken into consideration in order to achieve a future sustainable management of water resources under climate change conditions
Wg>C3	+1	The establishment of analytical reports for the Greek river basins enables the undertaking of specific measures for combating climate change concerning the future sustainable management of water resources under climate change conditions

Wg>C4	0	There is no significant interaction between the goal and the instrument
Wg>C5	0	There is no significant interaction between the goal and the instrument
Wg>T1	0/+1	The establishment of analytical reports for the Greek river basins may enable the sustainable development of tourism as they support the rational use of water resources by the tourist sector (information on water availability and water quality)
Wg>T2	0	There is no significant interaction between the goal and the instrument
Wg>T3	0	There is no significant interaction between the goal and the instrument
Wg>T4	0	There is no significant interaction between the goal and the instrument
Energy Policy Instruments to the Nexus-components Policy Goals		
Ea>W1	0	There is no significant interaction between the goal and the instrument
Ea>W2	0	There is no significant interaction between the goal and the instrument
Ea>W3	0/-1	The construction of wind parks may have negative impacts on the goal for preventing aquatic ecosystems from further deterioration in case where wind parks are located next to aquatic ecosystems
Ea>W4	0	There is no significant interaction between the goal and the instrument
Ea>W5	0	There is no significant interaction between the goal and the instrument
Ea>E1	+3	The exploitation of wind for energy production and the construction of the relative infrastructures is inextricably linked to the attainment of the national energy goals and the increase of RES sharing in the final gross energy consumption (energy mix)
Ea>E2	+3	The construction of wind parks for energy production goes "hand in hand" with the goal for electricity production from RES as wind is a renewable energy source
Ea>E3	+2	Wind energy can be exploited by cogeneration systems and that it reinforces the promotion and adoption of cogeneration technologies
Ea>E4	+1	The construction of wind parks and the exploitation of wind for energy production is a parameter enabling the establishment of a national energy pricing system in order price of energy produced by wind to be determined
Ea>E5	0	There is no significant interaction between the goal and the instrument
Ea>E6	0/+1	Energy production from wind may enable the goal for energy saving in case the produced energy is stored for future use
Ea>L1	-1/+1	The construction of wind parks doesn't enable the sustainable spatial development in case where it has negative impacts on natural resources / On the other hand it enables the development of a balanced spatial pattern between urban and rural regions as it enriches the "spectrum" of activities taking place in rural regions and support the local income
Ea>L2	+1	Energy production from wind parks constitutes an economic sector that supports national income and contributes to the creation of a balanced economy
Ea>L3	0	There is no significant interaction between the goal and the instrument
Ea>L4	0/-1	The construction of wind parks may put constraints on the spatial organization of industrial sector in case of land use conflicts between the energy and the industrial sector
Ea>F1	0/-1	The construction of wind parks may put constraints on the sustainable development of agricultural sector in case of land use conflicts between the energy and the agricultural sector
Ea>F2	0	There is no significant interaction between the goal and the instrument
Ea>F3	0	There is no significant interaction between the goal and the instrument
Ea>F4	0	There is no significant interaction between the goal and the instrument
Ea>F5	0	There is no significant interaction between the goal and the instrument
Ea>F6	0	There is no significant interaction between the goal and the instrument
Ea>C1	+3	Energy production from wind is inextricably linked to the reduction of GHG emissions as wind is a "clean" energy source
Ea>C2	+3	The construction of wind parks is intertwined with the increase of the country's adaptation ability against climate change as wind is a clean and renewable energy source

Ea>C3	+2	Energy production from wind reinforces the mapping of strategic directions for combating climate change with respect to the further exploitation and development of RES
Ea>C4	+1	The construction of wind parks and their further development helps people understand the importance of climate change impacts and the need for undertaking actions for combating such impacts
Ea>C5	0	There is no significant interaction between the goal and the instrument
Ea>T1	0/-1	The construction of wind parks may put constraints on the development of tourist activities in case of land use conflicts between the tourist sector and the energy sector
Ea>T2	0/-1	The construction of wind parks may put constraints on the development of tourist entrepreneurship in case of "visual disturbance"
Ea>T3	0	There is no significant interaction between the goal and the instrument
Ea>T4	0/-1	The construction of wind parks may put constraints on the quality of Greek tourist product in case of "visual disturbance"
Eb>W1	0/-1	The construction of hydroelectric power plants may have negative impacts on the quality and quantity of surface water (especially in case of big hydroelectric power plants)
Eb>W2	0/+1	The construction of hydroelectric power plants may have positive impacts on groundwater in case it contributes to the increase of groundwater quantity (dams)
Eb>W3	0/-1	The construction of hydroelectric power plants may have negative impacts on aquatic ecosystems (especially in case of big hydroelectric power plants)
Eb>W4	0/+1	The construction of hydroelectric power plants may enable floods' management and mitigation of drought's effects as hydroelectric power plants store water (dams)
Eb>W5	0	There is no significant interaction between the goal and the instrument
Eb>E1	+3	The exploitation of water for energy production and the construction of hydroelectric power plants is inextricably linked to the attainment of the national energy goals and the increase of RES sharing in the final gross energy consumption (energy mix)
Eb>E2	+3	The exploitation of water for energy production and the construction of hydroelectric power plants goes "hand in hand" with the goal for electricity production from RES as water is a renewable energy source
Eb>E3	0	There is no significant interaction between the goal and the instrument
Eb>E4	+1	The construction of hydroelectric power plants and the exploitation of water for energy production is a parameter enabling the establishment of a national energy pricing system in order price of energy produced by water to be determined
Eb>E5	0	There is no significant interaction between the goal and the instrument
Eb>E6	0/+1	The construction of hydroelectric power plants may enable the goal for energy saving as water is stored in reservoirs / dams for future energy production
Eb>L1	-1/+1	The construction of hydroelectric power plants doesn't enable the sustainable spatial development in case it has negative impacts on natural resources / On the other hand it enables the development of a balanced spatial pattern between urban and rural regions as it enriches the "spectrum" of activities taking place in rural regions and support the local income
Eb>L2	+1	Energy production from hydroelectric power plants constitutes an economic sector that supports national income and contributes to the creation of a balanced economy
Eb>L3	+2	The construction of hydroelectric power plants reinforces the spatial organization of the aquaculture sector as aquaculture activities can be developed in reservoirs / dams
Eb>L4	+2	The construction of hydroelectric power plants is a measure that reinforces the development of industrial activities (energy sector) and thus supports the spatial organization of the industrial sector
Eb>F1	+1	The construction of hydroelectric power plants enables the sustainable

		development of agriculture as in many cases the agricultural sector uses water from reservoirs / dams for irrigation purposes
Eb>F2	0	There is no significant interaction between the goal and the instrument
Eb>F3	0	There is no significant interaction between the goal and the instrument
Eb>F4	0	There is no significant interaction between the goal and the instrument
Eb>F5	+2	The construction of hydroelectric power plants reinforces the development of aquaculture activities in the respective reservoirs / dams
Eb>F6	0	There is no significant interaction between the goal and the instrument
Eb>C1	+3	Energy production from hydroelectric power plants is intertwined with the reduction of GHG emissions as water is a “clean” energy source
Eb>C2	+3	The construction of hydroelectric power plants is intertwined with the increase of the country’s adaptation ability against climate change as water is a clean and renewable energy source
Eb>C3	+2	Energy production from water reinforces the mapping of strategic directions for combating climate change with respect to the further exploitation and development of RES
Eb>C4	+1	The construction of hydroelectric power plants and their further development helps people understand the importance of climate change impacts and the need for undertaking actions for combating such impacts
Eb>C5	0	There is no significant interaction between the goal and the instrument
Eb>T1	0/+1	The construction of hydroelectric power plants may enable the sustainable development of tourism as in some cases reservoirs attract tourists’ interest while it also supports the adaptation of the tourist sector to the special characteristics of such regions
Eb>T2	0/+1	The construction of hydroelectric power plants may enable the development of tourist enterprises / infrastructures around the area of the respective reservoirs
Eb>T3	0	There is no significant interaction between the goal and the instrument
Eb>T4	0	There is no significant interaction between the goal and the instrument
Ec>W1	0/-1	The construction of geothermal power plants or biomass processing units may have negative impacts on the quality of surface water in case they are installed next to water resources such as rivers, lakes, etc. (constraining instrument)
Ec>W2	0/-1	The construction of geothermal power plants or biomass processing units may have negative impacts on the quality of groundwater in case they are installed next to groundwater bodies (constraining instrument)
Ec>W3	0/-1	The construction of geothermal power plants or biomass processing units may have negative impacts on the quality of aquatic ecosystems in case they are installed next to them (constraining instrument)
Ec>W4	0	There is no significant interaction between the goal and the instrument
Ec>W5	0	There is no significant interaction between the goal and the instrument
Ec>E1	+3	The exploitation of geothermy and biomass for energy production is inextricably linked to the attainment of the national energy goals and the increase of RES sharing in the final gross energy consumption (energy mix)
Ec>E2	+3	The exploitation of geothermy and biomass for energy production goes “hand in hand” with the goal for electricity production from RES as geothermy and biomass are renewable energy sources
Ec>E3	+2	Geothermy and biomass can be exploited by cogeneration systems so this instrument reinforces the achievement of the goal having to do with the promotion and adoption of cogeneration systems for energy production
Ec>E4	+1	The construction of geothermal power plants and biomass processing units for energy production is a parameter enabling the establishment of a national energy pricing system in order price of energy produced by geothermy and biomass to be determined
Ec>E5	0	There is no significant interaction between the goal and the instrument
Ec>E6	0/+1	The installation of efficient energy systems that use geothermy or biomass for energy production may enable the goal for energy saving
Ec>L1	-1/+1	The construction of geothermal power plants or biomass processing units doesn’t

		enable the sustainable spatial development in case where it has negative impacts on natural resources / On the other hand it enables the development of a balanced spatial pattern between urban and rural regions as it enriches the "spectrum" of activities taking place in rural regions and support the local income
Ec>L2	+1	Energy production from geothermy or biomass constitutes an economic sector that enables national income and contributes to the creation of a balanced economy
Ec>L3	0	There is no significant interaction between the goal and the instrument
Ec>L4	+2	The construction of geothermal power plants or biomass processing units is a measure that reinforces the development of industrial activities (energy sector) and thus supports the spatial organization of the industrial sector
Ec>F1	+2	The exploitation of biomass for energy production reinforces the sustainable development of agriculture as agricultural biomass can be collected and used for energy production purposes
Ec>F2	0	There is no significant interaction between the goal and the instrument
Ec>F3	0	There is no significant interaction between the goal and the instrument
Ec>F4	0	There is no significant interaction between the goal and the instrument
Ec>F5	0	There is no significant interaction between the goal and the instrument
Ec>F6	0	There is no significant interaction between the goal and the instrument
Ec>C1	+3	Energy production from geothermy or biomass is inextricably linked to the reduction of GHG emissions as geothermy and biomass are "clean" energy sources
Ec>C2	+3	The construction of geothermal power plants or biomass processing units is intertwined with the increase of the country's adaptation ability against climate change as geothermy and biomass are clean and renewable energy sources
Ec>C3	+2	Energy production from geothermy or biomass reinforces the mapping of strategic directions for combating climate change with respect to the further exploitation and development of RES
Ec>C4	+1	The construction of geothermal power plants or biomass processing units and their further development helps people understand the importance of climate change impacts and the need for undertaking actions for combating such impacts
Ec>C5	0	There is no significant interaction between the goal and the instrument
Ec>T1	0/+1	The exploitation of geothermy or biomass for energy production may enable the sustainable development of tourism in case the produced energy is used to cover energy needs of the tourist sector
Ec>T2	0	There is no significant interaction between the goal and the instrument
Ec>T3	0	There is no significant interaction between the goal and the instrument
Ec>T4	0	There is no significant interaction between the goal and the instrument
Ed>W1	0	There is no significant interaction between the goal and the instrument
Ed>W2	0	There is no significant interaction between the goal and the instrument
Ed>W3	0	There is no significant interaction between the goal and the instrument
Ed>W4	0	There is no significant interaction between the goal and the instrument
Ed>W5	0	There is no significant interaction between the goal and the instrument
Ed>E1	+3	The exploitation of solar energy for energy production and the installation of photovoltaics are inextricably linked to the attainment of the national energy goals and the increase of RES sharing in the final gross energy consumption (energy mix)
Ed>E2	+3	The exploitation of solar energy and the installation of photovoltaics goes "hand in hand" with the goal for electricity production from RES as solar energy is a renewable energy source
Ed>E3	0	There is no significant interaction between the goal and the instrument
Ed>E4	+1	The exploitation of solar energy for energy production and the installation of photovoltaics is a parameter enabling the establishment of a national energy pricing system in order price of energy produced by photovoltaics to be determined

Ed>E5	0	There is no significant interaction between the goal and the instrument
Ed>E6	0/+1	The broad use of photovoltaics may enable energy saving in buildings. Also, the installation of photovoltaics for energy production may support the goal for energy saving if energy is stored for future use
Ed>L1	-1/+1	The installation of photovoltaics doesn't enable sustainable spatial development in case it has negative impacts on natural resources / On the other hand it enables the development of a balanced spatial pattern between urban and rural regions as it enriches the "spectrum" of activities taking place in rural regions and support the local income
Ed>L2	+1	Energy production from photovoltaics constitutes an economic sector that supports national income and contributes to the creation of a balanced economy
Ed>L3	0	There is no significant interaction between the goal and the instrument
Ed>L4	0/-1	The installation of photovoltaics may have negative impacts on the spatial organization of the industrial sector in case of land use conflicts between the energy and the industrial sector
Ed>F1	0	There is no significant interaction between the goal and the instrument (photovoltaics are installed in barren or low productivity land where agricultural activities cannot take place)
Ed>F2	0	There is no significant interaction between the goal and the instrument
Ed>F3	0	There is no significant interaction between the goal and the instrument
Ed>F4	0	There is no significant interaction between the goal and the instrument
Ed>F5	0	There is no significant interaction between the goal and the instrument
Ed>F6	0	There is no significant interaction between the goal and the instrument
Ed>C1	+3	The exploitation of solar energy for energy production is inextricably linked to the reduction of GHG emissions as solar energy is a "clean" energy source
Ed>C2	+3	The installation of photovoltaics is inextricably linked to the increase of the country's adaptation ability against climate change as solar energy is a "clean" and renewable energy source
Ed>C3	+2	The exploitation of solar energy for energy production reinforces the mapping of strategic directions for combating climate change with respect to the further exploitation and development of RES
Ed>C4	+1	The installation of photovoltaics and their further development helps people understand the importance of climate change impacts and the need for undertaking actions for combating such impacts
Ed>C5	0	There is no significant interaction between the goal and the instrument
Ed>T1	0/+1	The exploitation of solar energy for energy production may enable the sustainable development of tourism in case where solar energy is used to cover energy needs of the tourist sector
Ed>T2	0	There is no significant interaction between the goal and the instrument
Ed>T3	0	There is no significant interaction between the goal and the instrument
Ed>T4	0/-1	The installation of photovoltaics may have negative impacts on the quality of the Greek tourist product in case of "visual disturbance"
Ee>W1	0	There is no significant interaction between the goal and the instrument
Ee>W2	0	There is no significant interaction between the goal and the instrument
Ee>W3	0	There is no significant interaction between the goal and the instrument
Ee>W4	0	There is no significant interaction between the goal and the instrument
Ee>W5	0	There is no significant interaction between the goal and the instrument
Ee>E1	+1	The adoption of cogeneration technologies enables the attainment of the national energy goals in case where RES are used by cogeneration systems – Also cogeneration systems are energy efficient and contribute to energy saving
Ee>E2	+1	The adoption of cogeneration technologies enables electricity production from RES in case RES are used for electricity production by cogeneration systems
Ee>E3	+3	The adoption of cogeneration technologies is intertwined with the goal for cogeneration of high performance electricity and heat and the promotion of energy cogeneration from two or more useful types of energy sources

Ee>E4	+1	The adoption of cogeneration technologies for energy production is a parameter enabling the establishment of a national energy pricing system in order price of energy produced by cogeneration systems to be determined
Ee>E5	+2	The adoption of cogeneration technologies reinforces the establishment of a national system for natural gas management as natural gas is a main energy source used by cogeneration systems
Ee>E6	+2	The adoption of cogeneration technologies reinforces energy saving as it contributes to the increase of energy efficiency
Ee>L1	0	There is no significant interaction between the goal and the instrument
Ee>L2	0	There is no significant interaction between the goal and the instrument
Ee>L3	0	There is no significant interaction between the goal and the instrument
Ee>L4	+1	The adoption of cogeneration technologies enables the sustainable spatial organization of the industrial sector in case where industries are located next to energy resources used by industrial cogeneration systems
Ee>F1	0/+1	The adoption of cogeneration technologies may enable the sustainable development of agriculture in case where cogeneration systems are used for energy production by the agricultural sector
Ee>F2	0	There is no significant interaction between the goal and the instrument
Ee>F3	0	There is no significant interaction between the goal and the instrument
Ee>F4	0	There is no significant interaction between the goal and the instrument
Ee>F5	0	There is no significant interaction between the goal and the instrument
Ee>F6	0	There is no significant interaction between the goal and the instrument
Ee>C1	+3	The adoption of cogeneration technologies is inextricably linked to the reduction of GHG emissions (especially CO_2 emissions) as they are low-emissions technologies
Ee>C2	+3	The adoption of cogeneration technologies is intertwined with the increase of country's adaptation ability against climate change as cogeneration systems contribute to energy saving and the reduction of emissions
Ee>C3	+2	The adoption of cogeneration technologies reinforces the mapping of strategic directions for combating climate change with respect to the further exploitation and development of cogeneration systems in the future
Ee>C4	0	There is no significant interaction between the goal and the instrument
Ee>C5	0	There is no significant interaction between the goal and the instrument
Ee>T1	0/+1	The adoption of cogeneration technologies may enable the sustainable development of tourism in case where cogeneration systems are used for energy production in tourist infrastructures
Ee>T2	0	There is no significant interaction between the goal and the instrument
Ee>T3	0	There is no significant interaction between the goal and the instrument
Ee>T4	0	There is no significant interaction between the goal and the instrument
Ef>W1	0	There is no significant interaction between the goal and the instrument
Ef>W2	0	There is no significant interaction between the goal and the instrument
Ef>W3	0	There is no significant interaction between the goal and the instrument
Ef>W4	0	There is no significant interaction between the goal and the instrument
Ef>W5	0	There is no significant interaction between the goal and the instrument
Ef>E1	+3	The promotion of RES use in buildings is a measure inextricably linked to the attainment of the national energy goals as it contributes to the reduction of emissions and the increase of RES sharing in the gross final energy consumption
Ef>E2	+3	The promotion of RES use in buildings is intertwined with electricity production from RES as it is a measure contributing to electricity production from RES for domestic use, commercial use and public services
Ef>E3	0/+1	The promotion of RES use in buildings may enable electricity production from cogeneration in case where cogeneration systems use RES
Ef>E4	+1	The promotion of RES use in buildings is a parameter enabling the establishment of a national energy pricing system in order price of energy produced by RES in buildings to be determined

Ef>E5	0/-1	The promotion of RES use in buildings may put constraints on the use of natural gas as RES are "cleaner" energy sources
Ef>E6	+2	The promotion of RES use in buildings reinforces the goal for energy saving as the relative technologies contribute to the increase of energy efficiency
Ef>L1	+1	The promotion of RES use in buildings enables the sustainable spatial development as it contributes to the protection of natural resources (here: quality of atmosphere and climate)
Ef>L2	+1	The promotion of RES use in buildings enables the development of new economic activities with respect to energy efficiency in buildings
Ef>L3	0	There is no significant interaction between the goal and the instrument
Ef>L4	0	There is no significant interaction between the goal and the instrument
Ef>F1	0	There is no significant interaction between the goal and the instrument
Ef>F2	0	There is no significant interaction between the goal and the instrument
Ef>F3	0	There is no significant interaction between the goal and the instrument
Ef>F4	0	There is no significant interaction between the goal and the instrument
Ef>F5	0	There is no significant interaction between the goal and the instrument
Ef>F6	0	There is no significant interaction between the goal and the instrument
Ef>C1	+3	The promotion of RES use in buildings is intertwined with the reduction of GHG emissions as RES are "clean" energy sources
Ef>C2	+3	The promotion of RES use in buildings is inextricably linked to the increase of the country's adaptation ability against climate change as RES use in buildings contributes to the increase of energy efficiency in buildings and the reduction of emissions
Ef>C3	+2	The promotion of RES use in buildings reinforces the mapping of strategic directions for combating climate change with respect to energy saving and energy efficiency in buildings
Ef>C4	+2	The promotion of RES use in buildings helps people understand the importance of climate change impacts (e.g. GHG emissions derived from the domestic sector) and the need for undertaking actions for combating such impacts
Ef>C5	0	There is no significant interaction between the goal and the instrument
Ef>T1	+2	The promotion of RES use in buildings reinforces the sustainable development of the tourist sector in case RES are used for energy production in tourist infrastructures
Ef>T2	0	There is no significant interaction between the goal and the instrument
Ef>T3	0	There is no significant interaction between the goal and the instrument
Ef>T4	0/+1	The promotion of RES use in buildings may enable the improvement of quality of the services offered in tourist infrastructures that use RES for energy production
Eg>W1	0	There is no significant interaction between the goal and the instrument
Eg>W2	0	There is no significant interaction between the goal and the instrument
Eg>W3	0	There is no significant interaction between the goal and the instrument
Eg>W4	0	There is no significant interaction between the goal and the instrument
Eg>W5	0	There is no significant interaction between the goal and the instrument
Eg>E1	+1	The promotion of natural gas enables the attainment of the national energy goals as it contributes to the reduction of oil and thus to the relative adaptation of the national energy mix
Eg>E2	0	There is no significant interaction between the goal and the instrument
Eg>E3	+2	The promotion of natural gas reinforces the goal for adopting cogeneration of high performance electricity and heat technologies as it can be used as energy resource by cogeneration systems
Eg>E4	+1	The promotion of natural gas is a parameter enabling the establishment of a national energy pricing system in order price of energy produced by natural gas to be determined
Eg>E5	+3	The promotion of natural gas is intertwined with the establishment of a national natural gas supply and distribution system
Eg>E6	+1	The promotion and use of natural gas enables the goal for energy saving as it is

		more environmental friendly than oil
Eg>L1	0	There is no significant interaction between the goal and the instrument
Eg>L2	+1	The promotion of natural gas enables the development of new economic activities having to do with natural gas management, the installation of systems that use natural gas for energy production, etc.
Eg>L3	0	There is no significant interaction between the goal and the instrument
Eg>L4	+1	The promotion of natural gas enables sustainable spatial organization of the industrial sector as in many cases industrial infrastructures are located next to the available energy resources
Eg>F1	+1	The promotion of natural gas enables the sustainable development of agriculture as it is used by the agricultural sector (e.g. greenhouses) in order to replace oil
Eg>F2	0	There is no significant interaction between the goal and the instrument
Eg>F3	0	There is no significant interaction between the goal and the instrument
Eg>F4	0	There is no significant interaction between the goal and the instrument
Eg>F5	0	There is no significant interaction between the goal and the instrument
Eg>F6	0	There is no significant interaction between the goal and the instrument
Eg>C1	+2	The promotion of natural gas reinforces the reduction of GHG emissions as its use entails less emissions than conventional energy sources such as coal, oil, etc.
Eg>C2	+2	The promotion of natural gas reinforces the increase of the country's adaptation ability against climate change as the use of natural gas contributes to the reduction of emissions
Eg>C3	+2	The promotion of natural gas reinforces the mapping of strategic directions for combating climate change with respect to the reduction of GHG emissions and the adaptation of the national energy mix
Eg>C4	+2	The promotion of natural gas helps people understand the importance of climate change impacts (e.g. GHG emissions derived from the domestic sector) and the need for undertaking actions for combating such impacts
Eg>C5	0	There is no significant interaction between the goal and the instrument
Eg>T1	+2	The promotion of natural gas reinforces the sustainable development of tourist sector in case natural gas is used for covering energy needs in tourist infrastructures
Eg>T2	0	There is no significant interaction between the goal and the instrument
Eg>T3	0	There is no significant interaction between the goal and the instrument
Eg>T4	0/+1	The promotion of natural gas may enable the improvement of "energy services" offered in tourist infrastructures that use natural gas for energy production
Eh>W1	0	There is no significant interaction between the goal and the instrument
Eh>W2	0	There is no significant interaction between the goal and the instrument
Eh>W3	0	There is no significant interaction between the goal and the instrument
Eh>W4	0	There is no significant interaction between the goal and the instrument
Eh>W5	0	There is no significant interaction between the goal and the instrument
Eh>E1	+1	The transparency of the energy pricing system and the availability of relative information enables the attainment of the national energy goals as it has to do with the explicit definition of energy costs for all energy resources
Eh>E2	-1/+1	The transparency of the energy pricing system puts constraints on RES use for energy production in case where RES costs are too high / The transparency of the energy pricing system enables electricity production from RES in case where costs are competitive with the costs of conventional energy sources
Eh>E3	-1/+1	The transparency of the energy pricing system puts constraints on the adoption of cogeneration systems in case where cogeneration costs are too high / The transparency of the energy pricing system enables the adoption of cogeneration systems in case where the relative costs are competitive
Eh>E4	+3	The transparency of the energy pricing system and the availability of relative information is inextricably linked to the establishment of a national energy pricing system
Eh>E5	-1/+1	The transparency of the energy pricing system puts constraints on the use of

		natural gas in case where natural gas costs are too high / The transparency of the energy pricing system enables the use of natural gas in case where costs are competitive
Eh>E6	+2	The transparency of the energy pricing system reinforces energy saving and the reduction of energy consumption
Eh>L1	0	There is no significant interaction between the goal and the instrument
Eh>L2	+2	The transparency of the energy pricing system reinforces the development of a balanced and competitive economy as it explicitly defines the several energy costs
Eh>L3	0	There is no significant interaction between the goal and the instrument
Eh>L4	0	There is no significant interaction between the goal and the instrument
Eh>F1	0/+1	The transparency of the energy pricing system may enable the sustainable use of energy resources by the agricultural sector
Eh>F2	0	There is no significant interaction between the goal and the instrument
Eh>F3	0	There is no significant interaction between the goal and the instrument
Eh>F4	0	There is no significant interaction between the goal and the instrument
Eh>F5	0	There is no significant interaction between the goal and the instrument
Eh>F6	0	There is no significant interaction between the goal and the instrument
Eh>C1	-2/+2	The transparency of the energy pricing system puts constraints to the reduction of GHG emissions in case where "clean" energy sources are more expensive than the conventional energy resources / The transparency of the energy pricing system reinforces the reduction of GHG emissions in case where costs of "clean" energy sources are competitive
Eh>C2	0/+1	The transparency of the energy pricing system may enable relative efforts for increasing the country's adaptation ability against climate change with respect to the sustainable management of energy resources and the reduction of energy consumption (energy saving)
Eh>C3	0/+1	The transparency of the energy pricing system may enable the establishment of policy measures for combating climate change, having to do with the sustainable management of energy resources and the reduction of energy consumption (energy saving)
Eh>C4	0/+1	The transparency of the energy pricing system may help people understand the need for undertaking actions for combating climate change impacts related to energy consumption and the misuse of energy resources
Eh>C5	+2	The transparency of the energy pricing system reinforces the establishment of a national GHG emissions trading system in compliance with the respective EU framework for GHG emissions trading through the definition of the relative energy costs
Eh>T1	0/+1	The transparency of the energy pricing system may enable the sustainable use of energy resources by the tourist sector and the reduction of possible misuses
Eh>T2	0	There is no significant interaction between the goal and the instrument
Eh>T3	0	There is no significant interaction between the goal and the instrument
Eh>T4	0	There is no significant interaction between the goal and the instrument
Ei>W1	0	There is no significant interaction between the goal and the instrument
Ei>W2	0	There is no significant interaction between the goal and the instrument
Ei>W3	0	There is no significant interaction between the goal and the instrument
Ei>W4	0	There is no significant interaction between the goal and the instrument
Ei>W5	0	There is no significant interaction between the goal and the instrument
Ei>E1	0	There is no significant interaction between the goal and the instrument
Ei>E2	0	There is no significant interaction between the goal and the instrument
Ei>E3	0	There is no significant interaction between the goal and the instrument
Ei>E4	0	There is no significant interaction between the goal and the instrument
Ei>E5	0	There is no significant interaction between the goal and the instrument
Ei>E6	+3	The adoption of smart systems for measuring energy consumption is inextricably linked to the goal for energy saving as they monitor possible energy misuses and

		energy losses while they also contribute to the adjustment of energy balance
Ei>L1	0	There is no significant interaction between the goal and the instrument
Ei>L2	0	There is no significant interaction between the goal and the instrument
Ei>L3	0	There is no significant interaction between the goal and the instrument
Ei>L4	0/+1	The adoption of smart systems for measuring energy consumption may enable the sustainable development of the industrial sector with respect to the sustainable use of energy resources and the reduction of emissions
Ei>F1	+1	The adoption of smart systems for measuring energy consumption supports the sustainable development of agriculture with respect to the sustainable management and rational use of energy resources as well as the reduction of emissions by the agricultural sector
Ei>F2	0	There is no significant interaction between the goal and the instrument
Ei>F3	0	There is no significant interaction between the goal and the instrument
Ei>F4	0	There is no significant interaction between the goal and the instrument
Ei>F5	0	There is no significant interaction between the goal and the instrument
Ei>F6	0	There is no significant interaction between the goal and the instrument
Ei>C1	+1	The adoption of smart systems for measuring energy consumption enables the reduction of GHG emissions as they contribute to the limitation of energy consumption and energy misuses
Ei>C2	+1	The adoption of smart systems for measuring energy consumption enables the increase of the country's adaptation ability against climate change as the use of such technologies contributes to the reduction of energy consumption (misuse) and thus the reduction of emissions
Ei>C3	+1	The adoption of smart systems for measuring energy consumption enables the mapping of strategic directions for combating climate change with respect to the reduction of energy consumption (misuse) and GHG emissions
Ei>C4	+1	The adoption of smart systems for measuring energy consumption helps people understand the importance of climate change impacts (e.g. impacts caused by energy misuse) and the need for undertaking actions for combating such impacts
Ei>C5	0/+1	The adoption of smart systems for measuring energy consumption may enable the establishment of a national GHG emissions trading system as it contributes to monitoring energy consumption and energy losses in the industrial sector
Ei>T1	0/+1	The adoption of smart systems for measuring energy consumption may enable the sustainable development of tourism with respect to the sustainable management and rational use of energy resources by the tourist sector
Ei>T2	0	There is no significant interaction between the goal and the instrument
Ei>T3	0	There is no significant interaction between the goal and the instrument
Ei>T4	0	There is no significant interaction between the goal and the instrument
Land Policy Instruments to the Nexus-components Policy Goals		
La>W1	+1	Land use regulation enables the sustainable management of surface water resources from several activities (e.g. agriculture, tourism, etc.) as land uses are explicitly defined and thus water needs of each activity are easier estimated
La>W2	+1	Land use regulation enables the sustainable management of groundwater from several activities (e.g. agriculture, tourism, etc.) as land uses are explicitly defined and thus water needs of each activity are easier estimated
La>W3	+1	Land use regulation enables the prevention of aquatic ecosystems from further deterioration as land uses are defined on the basis of impacts they may have on such ecosystems
La>W4	+1	Land use regulation enables the goal for mitigating floods' and drought's effects as the several land uses are closely related to flood risk and the danger of possible drought
La>W5	+1	Land use regulation enables the establishment of a national water pricing system as it contributes to the clarification of water costs for several uses (e.g. agricultural water, domestic water, etc.)
La>E1	+1	Land use regulation enables the attainment of the national energy goals through the identification of areas where RES activities for energy production can take

		place
La>E2	+1	Land use regulation enables electricity production from RES through the identification of areas where RES activities for electricity production can take place
La>E3	0	There is no significant interaction between the goal and the instrument
La>E4	0	There is no significant interaction between the goal and the instrument
La>E5	-1/+1	Land use regulation may put constraints on the extension of natural gas management and distribution system (e.g. land where natural gas infrastructures may have negative impacts on the environment) / In other cases, where no environmental problems and conflicts exist, it may enable the establishment of the relative infrastructures
La>E6	0	There is no significant interaction between the goal and the instrument
La>L1	+3	Land use regulation is inextricably linked to the development of a sustainable and integrated spatial pattern
La>L2	+2	Land use regulation reinforces the development of a balanced economy and strengthens economic and social cohesion
La>L3	+3	Land use regulation is inextricably linked to the spatial organization of the aquaculture sector as it contributes to the identification of regions that are suitable for the development of aquaculture activities
La>L4	+3	Land use regulation is inextricably linked to the spatial organization of the industrial sector as it contributes to the identification of regions that are suitable for the development of industrial activities
La>F1	+3	Land use regulation is intertwined with the sustainable development of agriculture as it contributes to the identification of regions that are suitable for the development of agricultural activities and the rational use of resources by the agricultural sector
La>F2	0	There is no significant interaction between the goal and the instrument
La>F3	+3	The regulation of land uses is inextricably linked to the sustainable spatial organization of livestock as it contributes to the identification of regions that are suitable for the development of livestock activities (pastures, etc.)
La>F4	+1	The regulation of land uses enables the rational use of pesticides as it contributes to the identification of regions that are “sensitive” to pesticides’ impacts
La>F5	+2	Land use regulation reinforces the sustainable development of aquaculture through the identification of regions that are suitable for the development of aquaculture activities
La>F6	0	There is no significant interaction between the goal and the instrument
La>C1	0/+1	Land use regulation may enable the reduction of GHG emissions as it contributes to the identification of regions that are suitable for the development of RES activities for energy production
La>C2	+1	Land use regulation enables the increase of the country’s adaptation ability against climate change as it contributes to the sustainable management of land and natural resources and the limitation of impacts derived from several activities
La>C3	+1	Land use regulation enables the establishment of policy measures for combating climate change with respect to the several activities that can take place in each region
La>C4	0	There is no significant interaction between the goal and the instrument
La>C5	0	There is no significant interaction between the goal and the instrument
La>T1	+3	Land use regulation is inextricably linked to the sustainable development of tourism as it contributes to the identification of regions that are suitable for the development of tourist activities
La>T2	+1	Land use regulation enables the development of tourist entrepreneurship as it contributes to the identification of regions that are suitable for the construction of tourist infrastructures and the development of relative activities
La>T3	0	There is no significant interaction between the goal and the instrument
La>T4	+1	Land use regulation enables the improvement of the Greek tourist product as it contributes to the upgrading of landscape and also to the improvement of the

		offered tourist services
Lb>W1	0	There is no significant interaction between the goal and the instrument
Lb>W2	0	There is no significant interaction between the goal and the instrument
Lb>W3	0	There is no significant interaction between the goal and the instrument
Lb>W4	0	There is no significant interaction between the goal and the instrument
Lb>W5	0	There is no significant interaction between the goal and the instrument
Lb>E1	0	There is no significant interaction between the goal and the instrument
Lb>E2	0	There is no significant interaction between the goal and the instrument
Lb>E3	0	There is no significant interaction between the goal and the instrument
Lb>E4	0	There is no significant interaction between the goal and the instrument
Lb>E5	0	There is no significant interaction between the goal and the instrument
Lb>E6	0	There is no significant interaction between the goal and the instrument
Lb>L1	+1	The development of synergies that will boost economic activities enables the sustainable spatial development and the establishment of a balanced spatial pattern of development between urban and rural regions
Lb>L2	+3	The development of synergies that will boost economic activities is inextricably linked to the reinforcement of social and economic cohesion and the establishment of a balanced and competitive economy
Lb>L3	0/+1	The development of synergies may enable the establishment of aquaculture infrastructures and the undertaking of relative economic activities
Lb>L4	0/+1	The development of synergies may enable the long-term and sustainable spatial organization of the industrial sector as it boosts the establishment of industrial activities that support national income
Lb>F1	0/+1	The development of economic synergies may enable the sustainable development of agriculture as it boosts the establishment of agricultural activities that support national income
Lb>F2	0	There is no significant interaction between the goal and the instrument
Lb>F3	0	There is no significant interaction between the goal and the instrument
Lb>F4	0	There is no significant interaction between the goal and the instrument
Lb>F5	0/+1	The development of economic synergies may enable the sustainable development of aquaculture activities that support national income
Lb>F6	0	There is no significant interaction between the goal and the instrument
Lb>C1	0	There is no significant interaction between the goal and the instrument
Lb>C2	0	There is no significant interaction between the goal and the instrument
Lb>C3	0	There is no significant interaction between the goal and the instrument
Lb>C4	0	There is no significant interaction between the goal and the instrument
Lb>C5	+1	The development of economic synergies enables the establishment of a GHG emissions trading system according to the respective European policies
Lb>T1	0/+1	The development of economic synergies may enable the sustainable development of tourist activities that support national income
Lb>T2	+2	The development of economic synergies reinforces networking among tourist enterprises and the promotion of tourist entrepreneurship
Lb>T3	0	There is no significant interaction between the goal and the instrument
Lb>T4	+1	The development of synergies enables the improvement of the offered tourist product and services as it boosts the undertaking of relative actions in the tourist sector
Lc>W1	0	There is no significant interaction between the goal and the instrument
Lc>W2	0	There is no significant interaction between the goal and the instrument
Lc>W3	0	There is no significant interaction between the goal and the instrument
Lc>W4	0	There is no significant interaction between the goal and the instrument
Lc>W5	0	There is no significant interaction between the goal and the instrument
Lc>E1	0	There is no significant interaction between the goal and the instrument
Lc>E2	0	There is no significant interaction between the goal and the instrument
Lc>E3	0	There is no significant interaction between the goal and the instrument
Lc>E4	0	There is no significant interaction between the goal and the instrument

Lc>E5	0	There is no significant interaction between the goal and the instrument
Lc>E6	0	There is no significant interaction between the goal and the instrument
Lc>L1	+3	The development of a complementary and balanced spatial pattern between urban and rural regions is inextricably linked to the sustainable and integrated spatial development of Greece
Lc>L2	+3	Increasing complementarity between urban and rural regions is inextricably linked to the development of a balanced national economy as it boosts the economic development of rural regions and the limitation of inequalities between urban and rural regions
Lc>L3	+1	Increasing complementarity between urban and rural regions enables spatial organization of aquaculture as a sector that supports the local income of several regions
Lc>L4	+1	Increasing complementarity between urban and rural regions enables spatial organization of the industrial sector as a sector that supports the local income of several regions
Lc>F1	+1	Increasing complementarity between urban and rural regions enables spatial organization of agriculture as a sector that supports the local income of several regions
Lc>F2	0	There is no significant interaction between the goal and the instrument
Lc>F3	+1	Increasing complementarity between urban and rural regions enables spatial organization of livestock as a sector that supports the local income of several regions
Lc>F4	0	There is no significant interaction between the goal and the instrument
Lc>F5	+1	Increasing complementarity between urban and rural regions enables the sustainable development of aquaculture as an economic activity that supports the local income of several regions
Lc>F6	0	There is no significant interaction between the goal and the instrument
Lc>C1	0	There is no significant interaction between the goal and the instrument
Lc>C1	0	There is no significant interaction between the goal and the instrument
Lc>C2	0	There is no significant interaction between the goal and the instrument
Lc>C3	0	There is no significant interaction between the goal and the instrument
Lc>C4	0	There is no significant interaction between the goal and the instrument
Lc>C5	0	There is no significant interaction between the goal and the instrument
Lc>T1	+1	Increasing complementarity between urban and rural regions enables the sustainable development of tourism as an economic activity that supports the local income of several regions
Lc>T2	+1	Increasing complementarity between urban and rural regions enables the development of tourist entrepreneurship as it supports the local income of tourist regions
Lc>T3	0	There is no significant interaction between the goal and the instrument
Lc>T4	0	There is no significant interaction between the goal and the instrument
Ld>W1	0	There is no significant interaction between the goal and the instrument
Ld>W2	0	There is no significant interaction between the goal and the instrument
Ld>W3	0	There is no significant interaction between the goal and the instrument
Ld>W4	0	There is no significant interaction between the goal and the instrument
Ld>W5	0	There is no significant interaction between the goal and the instrument
Ld>E1	0	There is no significant interaction between the goal and the instrument
Ld>E2	+1	The promotion of entrepreneurship enables the goal for electricity production from RES in case of energy companies that exploit RES for energy production
Ld>E3	0	There is no significant interaction between the goal and the instrument
Ld>E4	0	There is no significant interaction between the goal and the instrument
Ld>E5	0	There is no significant interaction between the goal and the instrument
Ld>E6	0	There is no significant interaction between the goal and the instrument
Ld>L1	+1	The promotion of entrepreneurship enables the sustainable and integrated spatial development as it contributes to the establishment of a balanced spatial

		pattern of development between urban and rural regions
Ld>L2	+3	The promotion of entrepreneurship and the establishment of modern and innovative enterprises is one of the main tools supporting the development of a balanced and competitive economy
Ld>L3	+1	The promotion of entrepreneurship enables the spatial organization of aquaculture as it boosts the development of aquaculture activities
Ld>L4	+1	The promotion of entrepreneurship enables the spatial organization of industrial sector as it boosts the development of industrial activities
Ld>F1	+1	The promotion of entrepreneurship enables the sustainable development of agriculture as it boosts the development of agricultural activities
Ld>F2	+1	The promotion of entrepreneurship enables the preservation of plant genetic resources through the development of the respective enterprises
Ld>F3	+1	The promotion of entrepreneurship enables the spatial organization of livestock as it boosts the development of relative activities
Ld>F4	0	There is no significant interaction between the goal and the instrument
Ld>F5	+1	The promotion of entrepreneurship enables the sustainable development of aquaculture activities contributing to the local income of several regions
Ld>F6	+1	The promotion of entrepreneurship enables the development of food and fodder industry that produces high quality products under the rules of food and fodder security
Ld>C1	0/+1	The promotion of entrepreneurship may enable the establishment of enterprises with limited GHG emissions
Ld>C2	0	There is no significant interaction between the goal and the instrument
Ld>C3	0	There is no significant interaction between the goal and the instrument
Ld>C4	0	There is no significant interaction between the goal and the instrument
Ld>C5	+1	The promotion of entrepreneurship enables the establishment of enterprises operating under the rules that regulate the trade of GHG emissions
Ld>T1	+1	The promotion of entrepreneurship enables the sustainable development of tourism as it boosts the development of tourist activities
Ld>T2	+2	The promotion of entrepreneurship reinforces the development of tourist entrepreneurship that supports national income
Ld>T3	+1	The promotion of entrepreneurship enables tourist training activities for upgrading the quality and modernization of tourist enterprises
Ld>T4	+1	The promotion of entrepreneurship enables the upgrading of the Greek tourist product through the establishment of high quality and modern tourist enterprises
Le>W1	0	There is no significant interaction between the goal and the instrument
Le>W2	0	There is no significant interaction between the goal and the instrument
Le>W3	0	There is no significant interaction between the goal and the instrument
Le>W4	0	There is no significant interaction between the goal and the instrument
Le>W5	0	There is no significant interaction between the goal and the instrument
Le>E1	0	There is no significant interaction between the goal and the instrument
Le>E2	0	There is no significant interaction between the goal and the instrument
Le>E3	0	There is no significant interaction between the goal and the instrument
Le>E4	0	There is no significant interaction between the goal and the instrument
Le>E5	0	There is no significant interaction between the goal and the instrument
Le>E6	0	There is no significant interaction between the goal and the instrument
Le>L1	+2	Strengthening social infrastructures reinforces the sustainable and integrated spatial development as it supports social cohesion
Le>L2	+2	Strengthening social infrastructures reinforces the development of a balanced and competitive economy as it supports social cohesion
Le>L3	0	There is no significant interaction between the goal and the instrument
Le>L4	0	There is no significant interaction between the goal and the instrument
Le>F1	0	There is no significant interaction between the goal and the instrument
Le>F2	0	There is no significant interaction between the goal and the instrument
Le>F3	0	There is no significant interaction between the goal and the instrument

Le>F4	0	There is no significant interaction between the goal and the instrument
Le>F5	0	There is no significant interaction between the goal and the instrument
Le>F6	0	There is no significant interaction between the goal and the instrument
Le>C1	0	There is no significant interaction between the goal and the instrument
Le>C2	0	There is no significant interaction between the goal and the instrument
Le>C3	0	There is no significant interaction between the goal and the instrument
Le>C4	0	There is no significant interaction between the goal and the instrument
Le>C5	0	There is no significant interaction between the goal and the instrument
Le>T1	+1	Strengthening social infrastructures enables the sustainable development of tourism as social infrastructures may cover several needs of tourists
Le>T2	0	There is no significant interaction between the goal and the instrument
Le>T3	0	There is no significant interaction between the goal and the instrument
Le>T4	+1	Strengthening social infrastructures enables the upgrading of the offered tourist services in case they cover several needs of tourists
Lf>W1	0	There is no significant interaction between the goal and the instrument
Lf>W2	0	There is no significant interaction between the goal and the instrument
Lf>W3	0	There is no significant interaction between the goal and the instrument
Lf>W4	0	There is no significant interaction between the goal and the instrument
Lf>W5	0	There is no significant interaction between the goal and the instrument
Lf>E1	+1	The promotion of synergies among the productive sectors and the development of expertise in the energy sector enables the attainment of the national energy goals
Lf>E2	+2	The promotion of synergies among the productive sectors and the development of expertise in the energy sector reinforces the achievement of the goal for electricity production from RES
Lf>E3	+2	The development of expertise in the energy sector reinforces the adoption of cogeneration systems for energy production as the advantages of cogeneration technologies are clarified
Lf>E4	0	There is no significant interaction between the goal and the instrument
Lf>E5	0/+1	The development of expertise in the energy sector may enable the establishment of a modern and innovative natural gas supply and distribution system
Lf>E6	+2	The promotion of synergies among the productive sectors and the development of expertise, specifically in the energy sector, reinforces the goal for energy saving through the diffusion of knowledge and information having to do with energy saving and its contribution to the reduction of climate change impacts
Lf>L1	+1	The promotion of synergies among the productive sectors and the development of expertise enables the establishment of a balanced and sustainable spatial pattern
Lf>L2	+3	The promotion of synergies and the development of expertise is inextricably linked to the development of a balanced and competitive economy (especially between urban and rural regions)
Lf>L3	+1	The promotion of synergies and the development of expertise in the aquaculture sector enables the spatial organization of the relative infrastructures
Lf>L4	+1	The promotion of synergies and the development of expertise in the industrial sector enables the spatial and sustainable organization of several industrial activities
Lf>F1	+2	The promotion of synergies and the development of expertise in the agricultural sector reinforces the sustainable development of agriculture and the adoption of modern agricultural practices and technologies by the agricultural sector
Lf>F2	+2	The promotion of synergies and expertise in the relative sectors reinforces the preservation and sustainable use of plant genetic resources
Lf>F3	+1	The promotion of synergies and expertise in the sector of livestock enables its spatial organization and its sustainable development
Lf>F4	+1	The development of expertise enables the rational use of pesticides and the protection of land and water resources

Lf>F5	+2	The promotion of synergies and the development of expertise in the aquaculture sector reinforces the sustainable development of aquaculture activities (exchange of knowledge and expertise)
Lf>F6	+2	The promotion of synergies and the development of expertise in the food and fodder sector reinforces food and fodder security as it contributes to the production of high quality food products
Lf>C1	+2	The promotion of synergies and the development of expertise in the energy sector reinforces the efforts towards the reduction of GHG emissions
Lf>C2	+2	The promotion of synergies and the development of expertise reinforces the efforts for strengthening country's adaptation ability against climate change
Lf>C3	+2	The promotion of synergies and the development of expertise reinforces the establishment of innovative and effective policy measures for combating climate change through the exchange of knowledge and expertise on climate change issues
Lf>C4	+1	The promotion of synergies for climate enables knowledge diffusion and thus it supports the increase of social awareness with respect to climate change
Lf>C5	+2	The promotion of synergies and the development of expertise reinforces the establishment and implementation of rules concerning the trade of emissions in the energy and industrial sectors
Lf>T1	+2	The promotion of synergies and the development of expertise in the tourist sector reinforces the sustainable development of tourism through the undertaking of coordinated actions and knowledge diffusion
Lf>T2	+2	The promotion of synergies and the development of expertise reinforces the establishment of modern and innovative tourist enterprises
Lf>T3	+2	The promotion of synergies and the development of expertise in the tourist sector reinforces the organization and modernization of tourist training schools and the quality of tourist training in Greece
Lf>T4	+2	The promotion of synergies and the development of expertise in the tourist sector reinforces and entails the offer of high quality tourist products and services
Lg>W1	+1	The identification of land, available for the development of aquaculture activities, enables the protection and sustainable management of surface water as it contributes to the protection and rational use of water resources by the aquaculture sector
Lg>W2	0	There is no significant interaction between the goal and the instrument
Lg>W3	0/+1	The identification of land, available for the development of aquaculture activities, may enable the protection of aquatic ecosystems as it contributes to the spatial organization of aquaculture in a way that limits its impacts to the natural environment
Lg>W4	0	There is no significant interaction between the goal and the instrument
Lg>W5	0	There is no significant interaction between the goal and the instrument
Lg>E1	0	There is no significant interaction between the goal and the instrument
Lg>E2	0	There is no significant interaction between the goal and the instrument
Lg>E3	0	There is no significant interaction between the goal and the instrument
Lg>E4	0	There is no significant interaction between the goal and the instrument
Lg>E5	0	There is no significant interaction between the goal and the instrument
Lg>E6	0	There is no significant interaction between the goal and the instrument
Lg>L1	+2	The identification of land, available for the development of aquaculture activities, reinforces the establishment of a balanced spatial pattern of development between urban and rural regions and the protection of biodiversity and natural resources from the impacts of aquaculture as it contributes to the establishment of spatially organized aquaculture activities
Lg>L2	+1	The identification of land, available for the establishment of aquaculture activities, enables the development of a balanced and competitive economy through the development of aquaculture activities that support national income
Lg>L3	+3	The identification of land, available for the establishment of aquaculture

		activities, is inextricably linked to the spatial organization of aquaculture sector
Lg>L4	0	There is no significant interaction between the goal and the instrument
Lg>F1	0	There is no significant interaction between the goal and the instrument
Lg>F2	0	There is no significant interaction between the goal and the instrument
Lg>F3	0	There is no significant interaction between the goal and the instrument
Lg>F4	0	There is no significant interaction between the goal and the instrument
Lg>F5	+3	The identification of land, available for the establishment of aquaculture activities, is intertwined with the sustainable development of aquaculture sector
Lg>F6	0	There is no significant interaction between the goal and the instrument
Lg>C1	0	There is no significant interaction between the goal and the instrument
Lg>C2	0	There is no significant interaction between the goal and the instrument
Lg>C3	0	There is no significant interaction between the goal and the instrument
Lg>C4	0	There is no significant interaction between the goal and the instrument
Lg>C5	0	There is no significant interaction between the goal and the instrument
Lg>T1	0	There is no significant interaction between the goal and the instrument
Lg>T2	0/+1	The identification of land, available for the establishment of aquaculture activities, may enable the development of tourist entrepreneurship in combination with aquaculture activities
Lg>T3	0	There is no significant interaction between the goal and the instrument
Lg>T4	0	There is no significant interaction between the goal and the instrument
Lh>W1	0/-1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development may have negative impacts on surface water in case where industrial activities are located next to surface water resources
Lh>W2	0/-1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development may have negative impacts on groundwater in case where industrial activities are located next to groundwater resources (repositories)
Lh>W3	0/-1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development may have negative impacts on aquatic ecosystems in case where industrial activities are located next to vulnerable aquatic ecosystems
Lh>W4	0	There is no significant interaction between the goal and the instrument
Lh>W5	0	There is no significant interaction between the goal and the instrument
Lh>E1	+1	Further development of the energy industrial sector and the promotion of a multi-centric pattern of industrial development enable the attainment of the national energy goals especially in case of power plants that exploit RES for energy production
Lh>E2	+1	Further development of the energy industrial sector and the promotion of a multi-centric pattern of industrial development enable electricity production from RES especially in case of power plants that exploit RES for electricity production
Lh>E3	+1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development enable the goal for heat and energy cogeneration in case where industries adopt modern cogeneration systems for energy production
Lh>E4	0	There is no significant interaction between the goal and the instrument
Lh>E5	+1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development enable the establishment of a national system for natural gas management in case we are talking about industries that process natural gas or use natural gas for energy production
Lh>E6	+1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development enable the goal for energy saving as the modernization of the industrial sector entails the increase of energy efficiency and energy saving in industrial infrastructures
Lh>L1	+3	Further development of the industrial sector and the promotion of a multi-centric

		pattern of industrial development are inextricably linked to the establishment of a balanced spatial pattern of development between urban and rural regions as they contribute to the establishment of spatially organized industrial activities
Lh>L2	+2	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development reinforce the development of a balanced and competitive economy as they contribute to the increase of the national income
Lh>L3	0	There is no significant interaction between the goal and the instrument
Lh>L4	+3	Further development of industrial activities and the promotion of a multi-centric pattern of industrial development are inextricably linked to the long-term and sustainable spatial organization of the industrial sector
Lh>F1	0/-1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development may put constraints on the sustainable development of agriculture in case of land use conflicts between the two sectors
Lh>F2	0/+1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development may enable the preservation and sustainable use of plant genetic resources in the case of food industry
Lh>F3	0	There is no significant interaction between the goal and the instrument
Lh>F4	0	There is no significant interaction between the goal and the instrument
Lh>F5	0	There is no significant interaction between the goal and the instrument
Lh>f6	0/+1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development may enable the goal for ensuring food and fodder security in the case of food industry
Lh>C1	-1/+1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development may entail the increase of GHG emissions / May enable the reduction of GHG emissions by increasing energy efficiency and adopting relative technologies (e.g. cogeneration) for energy production
Lh>C2	0	There is no significant interaction between the goal and the instrument
Lh>C3	0	There is no significant interaction between the goal and the instrument
Lh>C4	0	There is no significant interaction between the goal and the instrument
Lh>C5	0	There is no significant interaction between the goal and the instrument
Lh>T1	0/-1	Further development of the industrial sector and the promotion of a multi-centric pattern of industrial development may put constraints on the sustainable development of tourism in case of land use conflicts between the two sectors
Lh>T2	0	There is no significant interaction between the goal and the instrument
Lh>T3	0	There is no significant interaction between the goal and the instrument
Lh>T4	0	There is no significant interaction between the goal and the instrument
Li>W1	+1	The development of spatial plans at all scales enables the protection and sustainable management of surface water as such plans provide analytical information about the special characteristics of each region, the availability of natural resources (including water) as well as the problems related to them
Li>W2	+1	The development of spatial plans at all scales enables the protection and sustainable management of groundwater as such plans provide analytical information about the special characteristics of each region, the availability of natural resources (including groundwater) as well as the problems related to them
Li>W3	+1	The development of spatial plans at all scales enables the protection of aquatic ecosystems from further deterioration as such plans provide analytical information about the conditions characterizing such kind of ecosystems
Li>W4	+2	The development of spatial plans at all scales reinforces mitigation of floods' and drought's effects as they provide information about the vulnerability of each region according to its specific characteristics
Li>W5	0	There is no significant interaction between the goal and the instrument
Li>E1	0	There is no significant interaction between the goal and the instrument
Li>E2	+1	The development of spatial plans at all scales enables the expansion of electricity production from RES as it contributes to the identification of the most suitable areas for the development of infrastructures that exploit RES for energy

		production
Li>E3	0	There is no significant interaction between the goal and the instrument
Li>E4	0	There is no significant interaction between the goal and the instrument
Li>E5	0	There is no significant interaction between the goal and the instrument
Li>E6	0	There is no significant interaction between the goal and the instrument
Li>L1	+3	The development of spatial plans at all scales is inextricably linked to the sustainable and integrated spatial development as it contributes to the identification and exploitation of comparative advantages of each region, the elimination of weaknesses as well as to the protection and sustainable management of the available resources
Li>L2	+2	The development of spatial plans at all scales reinforces the development of a balanced economy as it contributes to the development of economic activities based on the potential and the special characteristics of each region
Li>L3	+3	The development of spatial plans at all scales is intertwined with the spatial organization of aquaculture as such plans support the identification of the most suitable areas for the development of aquaculture activities
Li>L4	+3	The development of spatial plans at all scales is intertwined with the spatial organization of industry as such plans support the identification of the most suitable areas for the development of industrial activities
Li>F1	+3	The development of spatial plans at all scales is inextricably linked to the sustainable development of agriculture as such plans support the identification of the most suitable areas for the development of agricultural activities
Li>F2	0	There is no significant interaction between the goal and the instrument
Li>F3	+3	The development of spatial plans at all scales is inextricably linked to the spatial organization of livestock as they support the identification of the most suitable areas for the development of respective activities
Li>F4	0	There is no significant interaction between the goal and the instrument
Li>F5	+2	The development of spatial plans at all scales reinforces the sustainable development of aquaculture as it supports the identification of areas where aquaculture activities may be developed under the principles of sustainability
Li>F6	0	There is no significant interaction between the goal and the instrument
Li>C1	0	There is no significant interaction between the goal and the instrument
Li>C2	+1	The development of spatial plans at all scales enables the efforts for increasing the country's adaptation ability against climate change as it contributes to the identification of vulnerable regions and their future proactive planning under climate change conditions
Li>C3	+1	The development of spatial plans at all scales enables the establishment of specific policy measures for combating climate change based on the special characteristics and vulnerability of each region
Li>C4	0	There is no significant interaction between the goal and the instrument
Li>C5	0	There is no significant interaction between the goal and the instrument
Li>T1	+3	The development of spatial plans at all scales is intertwined with the sustainable development of tourism as it contributes to the identification of most suitable areas for the development of tourist activities
Li>T2	+1	The development of spatial plans at all scales enables the promotion of tourist entrepreneurship through the identification of areas where tourist enterprises may be founded
Li>T3	0	There is no significant interaction between the goal and the instrument
Li>T4	+1	The development of spatial plans at all scales enables the improvement of the Greek tourist product by placing emphasis on the comparative advantages of each region that may be exploited in order to improve the offered tourist products and services
Agriculture and Food Policy Instruments to the Nexus-components Policy Goals		
Fa>W1	0	There is no significant interaction between the goal and the instrument
Fa>W2	0	There is no significant interaction between the goal and the instrument

Fa>W3	0	There is no significant interaction between the goal and the instrument
Fa>W4	0	There is no significant interaction between the goal and the instrument
Fa>W5	0	There is no significant interaction between the goal and the instrument
Fa>E1	0	There is no significant interaction between the goal and the instrument
Fa>E2	0	There is no significant interaction between the goal and the instrument
Fa>E3	0	There is no significant interaction between the goal and the instrument
Fa>E4	0	There is no significant interaction between the goal and the instrument
Fa>E5	0	There is no significant interaction between the goal and the instrument
Fa>E6	0	There is no significant interaction between the goal and the instrument
Fa>L1	0	There is no significant interaction between the goal and the instrument
Fa>L2	0/+1	The creation of a registry, the collection and protection of plant genetic resources may enable the development of a balanced and competitive economy as it is a measure that supports food industry
Fa>L3	0	There is no significant interaction between the goal and the instrument
Fa>L4	0	There is no significant interaction between the goal and the instrument
Fa>F1	+2	The collection and protection of plant genetic resources reinforce the sustainable development of agriculture through the rational use and preservation of plant genetic resources by the agricultural sector
Fa>F2	+3	The creation of a registry, the collection and protection of plant genetic resources is inextricably linked to the preservation and sustainable use of plant genetic resources by the agricultural and food sectors
Fa>F3	0	There is no significant interaction between the goal and the instrument
Fa>F4	0	There is no significant interaction between the goal and the instrument
Fa>F5	0	There is no significant interaction between the goal and the instrument
Fa>F6	+2	The collection and protection of plant genetic resources reinforce the goal for ensuring food and fodder security
Fa>C1	0	There is no significant interaction between the goal and the instrument
Fa>C2	0	There is no significant interaction between the goal and the instrument
Fa>C3	0/+1	The collection and protection of plant genetic resources may enable the undertaking of measures for combating climate change with respect to the food sector
Fa>C4	0	There is no significant interaction between the goal and the instrument
Fa>C5	0	There is no significant interaction between the goal and the instrument
Fa>T1	0	There is no significant interaction between the goal and the instrument
Fa>T2	0/+1	The collection and protection of plant genetic resources may enable tourist entrepreneurship in case of “gastronomic” tourism
Fa>T3	0	There is no significant interaction between the goal and the instrument
Fa>T4	0	There is no significant interaction between the goal and the instrument
Fb>W1	+2	The adoption of a modern, sustainable and innovative agricultural pattern reinforces the sustainable use of surface water as it places emphasis on the protection of natural resources by the agricultural sector
Fb>W2	+2	The adoption of a modern, sustainable and innovative agricultural pattern reinforces the sustainable use of groundwater as it places emphasis on the protection of natural resources by the agricultural sector
Fb>W3	+1	The adoption of a modern, sustainable and innovative agricultural pattern enables the protection of aquatic ecosystems from the impacts of agricultural sector as it places emphasis on the adaptation of agricultural sector to local conditions
Fb>W4	+1	The adoption of a modern, sustainable and innovative agricultural pattern enables the goal for mitigating floods’ and drought’s impacts as it places emphasis on the adaptation of agricultural sector to local conditions and vulnerability of each region
Fb>W5	0	There is no significant interaction between the goal and the instrument
Fb>E1	0	There is no significant interaction between the goal and the instrument
Fb>E2	0	There is no significant interaction between the goal and the instrument

Fb>E3	0/+1	The adoption of a modern, sustainable and innovative agricultural pattern may enable energy production from cogeneration technologies in case where cogeneration systems are adopted by the agricultural sector
Fb>E4	0	There is no significant interaction between the goal and the instrument
Fb>E5	0	There is no significant interaction between the goal and the instrument
Fb>E6	0/+1	The adoption of a modern, sustainable and innovative agricultural pattern may enable the goal for energy saving in case where energy efficient technologies are used by the agricultural sector
Fb>L1	+2	The adoption of a modern, sustainable and innovative agricultural pattern reinforces the establishment of a sustainable, integrated and balanced spatial pattern between urban and rural regions
Fb>L2	+2	The adoption of a modern, sustainable and innovative agricultural pattern reinforces the development of a balanced and competitive economy as it strengthens rural economy while it also supports national income
Fb>L3	0	There is no significant interaction between the goal and the instrument
Fb>L4	0/-1	The adoption of a modern, sustainable and innovative agricultural pattern may put constraints on the spatial organization of industrial sector in case of land use conflicts between the two sectors
Fb>F1	+3	The adoption of a modern, sustainable and innovative agricultural pattern is intertwined with the sustainable development of agriculture
Fb>F2	+1	The adoption of a modern, sustainable and innovative agricultural pattern enables the preservation of plant genetic resources as it contributes to the promotion of differentiated and locally adapted crops
Fb>F3	0/-1	The adoption of a modern, sustainable and innovative agricultural pattern may put constraints on the spatial organization of livestock in case of land use conflicts between the two sectors
Fb>F4	+2	The adoption of a modern, sustainable and innovative agricultural pattern reinforces the rational use of pesticides as it places emphasis on the development of a more environmental-friendly agricultural pattern and the production of high quality agricultural products
Fb>F5	0	There is no significant interaction between the goal and the instrument
Fb>F6	+2	The adoption of a modern, sustainable and innovative agricultural pattern reinforces the goal for food and fodder security as it places emphasis on the production of high quality agricultural food products
Fb>C1	0	There is no significant interaction between the goal and the instrument
Fb>C2	+1	The adoption of a modern, sustainable and innovative agricultural pattern enables the efforts for reinforcing the country’s adaptation ability against climate change as it promotes differentiated and locally adapted crops and the adoption of differentiated agricultural systems under climate change conditions
Fb>C3	+2	The adoption of a modern, sustainable and innovative agricultural pattern reinforces the establishment of policy measures, concerning agricultural sector and its resilience against climate change
Fb>C4	0	There is no significant interaction between the goal and the instrument
Fb>C5	0	There is no significant interaction between the goal and the instrument
Fb>T1	0/-1	The adoption of a modern, sustainable and innovative agricultural pattern may put constraints on the development of tourism in case of land use conflicts between the two sectors
Fb>T2	0	There is no significant interaction between the goal and the instrument
Fb>T3	0	There is no significant interaction between the goal and the instrument
Fb>T4	0	There is no significant interaction between the goal and the instrument
Fc>W1	+1	The establishment of specific measures for the sustainable development of livestock enables the protection and sustainable management of surface water by the sector of livestock as it places emphasis on the protection of natural resources
Fc>W2	+1	The establishment of specific measures for the sustainable development of livestock enables the protection and sustainable management of groundwater by

		the sector of livestock as it places emphasis on the protection of natural resources
Fc>W3	+1	The determination of suitable locations for the development of livestock enables the protection of aquatic ecosystems from further deterioration as terms and conditions aiming at the protection of natural resources are taken into account
Fc>W4	0	There is no significant interaction between the goal and the instrument
Fc>W5	0	There is no significant interaction between the goal and the instrument
Fc>E1	0	There is no significant interaction between the goal and the instrument
Fc>E2	-1	The determination of suitable locations for the development of livestock may put constraints on electricity production from RES in case of land use conflicts between the energy and livestock sectors
Fc>E3	0/+1	The establishment of specific measures for the development of livestock may enable the adoption of cogeneration technologies in case where cogeneration systems are used for energy production by the sector of livestock
Fc>E4	0	There is no significant interaction between the goal and the instrument
Fc>E5	0	There is no significant interaction between the goal and the instrument
Fc>E6	0/+1	The establishment of specific measures for the development of livestock may enable energy saving in case where energy saving technologies are adopted by the sector of livestock
Fc>L1	+3	The determination of suitable locations for the development of livestock is inextricably linked to the establishment of a balanced and sustainable national spatial pattern of development
Fc>L2	+1	The establishment of specific measures for the development of livestock enables the development of a balanced and competitive economy as the sector of livestock supports national income
Fc>L3	0	There is no significant interaction between the goal and the instrument
Fc>L4	0/-1	The determination of suitable locations for the development of livestock may put constraints on the spatial organization of industrial sector in case of land use conflicts between the two sectors
Fc>F1	-1	The determination of suitable locations for the development of livestock puts constraints on the sustainable development of agriculture as land use conflicts usually exist between the two sectors
Fc>F2	0	There is no significant interaction between the goal and the instrument
Fc>F3	+3	The determination of suitable locations for the development of livestock and the establishment of relative measures are intertwined with the spatial organization of livestock
Fc>F4	0	There is no significant interaction between the goal and the instrument
Fc>F5	0	There is no significant interaction between the goal and the instrument
Fc>F6	+2	The establishment of specific measures for the development of livestock reinforces the goal for ensuring food / fodder safety and protection of citizens' and animals' health
Fc>C1	0	There is no significant interaction between the goal and the instrument
Fc>C2	+1	The determination of suitable locations and the establishment of specific measures for the sustainable development of livestock enable the efforts towards reinforcing the country's adaptation ability against climate change as the conditions for the development of livestock under climate change impacts are set
Fc>C3	+1	The establishment of specific measures for the sustainable development of livestock enables the establishment of policy measures, concerning the sector of livestock and its resilience against climate change
Fc>C4	0	There is no significant interaction between the goal and the instrument
Fc>C5	0	There is no significant interaction between the goal and the instrument
Fc>T1	0/-1	The determination of suitable locations for the development of livestock may put constraints on the sustainable development of tourism in case of land use conflicts between the two sectors
Fc>T2	0	There is no significant interaction between the goal and the instrument

Fc>T3	0	There is no significant interaction between the goal and the instrument
Fc>T4	0	There is no significant interaction between the goal and the instrument
Fd>W1	+2	The adoption of methods and technologies for monitoring the rational use of pesticides reinforces the protection of surface water as it limits the impacts of pesticides on surface water resources
Fd>W2	+2	The adoption of methods and technologies for monitoring the rational use of pesticides reinforces the protection of groundwater as it limits the impacts of pesticides on groundwater
Fd>W3	+2	Monitoring rational use of pesticides reinforces the protection of aquatic ecosystems from deterioration caused by the uncontrolled use of pesticides
Fd>W4	0	There is no significant interaction between the goal and the instrument
Fd>W5	0	There is no significant interaction between the goal and the instrument
Fd>E1	0	There is no significant interaction between the goal and the instrument
Fd>E2	0	There is no significant interaction between the goal and the instrument
Fd>E3	0	There is no significant interaction between the goal and the instrument
Fd>E4	0	There is no significant interaction between the goal and the instrument
Fd>E5	0	There is no significant interaction between the goal and the instrument
Fd>E6	0	There is no significant interaction between the goal and the instrument
Fd>L1	+1	Monitoring rational use of pesticides enables the protection of biodiversity as well as the protection of natural resources because it contributes to the detection of possible sources of pollution and thus to the confrontation of the problem
Fd>L2	0	There is no significant interaction between the goal and the instrument
Fd>L3	0	There is no significant interaction between the goal and the instrument
Fd>L4	0	There is no significant interaction between the goal and the instrument
Fd>F1	+3	Monitoring rational use of pesticides is inextricably linked to the sustainable development of agriculture and the sustainable use and protection of natural resources by the agricultural sector
Fd>F2	0	There is no significant interaction between the goal and the instrument
Fd>F3	0	There is no significant interaction between the goal and the instrument
Fd>F4	+3	The adoption of methods and technologies that monitor the use of pesticides and detect possible misuses is inextricably linked to the goal for achieving rational use of pesticides
Fd>F5	0	There is no significant interaction between the goal and the instrument
Fd>F6	+3	Monitoring rational use of pesticides is intertwined with ensuring food and fodder safety in case of agri-food products
Fd>C1	0	There is no significant interaction between the goal and the instrument
Fd>C2	0	There is no significant interaction between the goal and the instrument
Fd>C3	0	There is no significant interaction between the goal and the instrument
Fd>C4	0	There is no significant interaction between the goal and the instrument
Fd>C5	0	There is no significant interaction between the goal and the instrument
Fd>T1	0	There is no significant interaction between the goal and the instrument
Fd>T2	0	There is no significant interaction between the goal and the instrument
Fd>T3	0	There is no significant interaction between the goal and the instrument
Fd>T4	0	There is no significant interaction between the goal and the instrument
Fe>W1	+1	The establishment of a national program for the development of aquaculture enables the sustainable management of surface water as it takes into account the need for protecting water resources by pressures put by aquaculture activities
Fe>W2	+1	The establishment of a national program for the development of aquaculture enables the sustainable management of groundwater as it takes into account the need for protecting water resources by pressures put by aquaculture activities
Fe>W3	+1	The establishment of a national program for the development of aquaculture enables the protection of aquatic ecosystems and their prevention from further deterioration derived from aquaculture activities
Fe>W4	0	There is no significant interaction between the goal and the instrument

Fe>W5	0	There is no significant interaction between the goal and the instrument
Fe>E1	0	There is no significant interaction between the goal and the instrument
Fe>E2	0	There is no significant interaction between the goal and the instrument
Fe>E3	0	There is no significant interaction between the goal and the instrument
Fe>E4	0	There is no significant interaction between the goal and the instrument
Fe>E5	0	There is no significant interaction between the goal and the instrument
Fe>E6	0	There is no significant interaction between the goal and the instrument
Fe>L1	+2	The establishment of a national program for the development of aquaculture reinforces the creation of an integrated and balanced spatial pattern as it supports the spatial organization of aquaculture and the sustainable management of natural resources by the aquaculture sector
Fe>L2	+1	The establishment of a national program for the development of aquaculture enables the development of a balanced and competitive economy as aquaculture supports national income
Fe>L3	+3	The establishment of a national program for the development of aquaculture is inextricably linked to the spatial organization of the aquaculture sector
Fe>L4	0	There is no significant interaction between the goal and the instrument
Fe>F1	0	There is no significant interaction between the goal and the instrument
Fe>F2	0	There is no significant interaction between the goal and the instrument
Fe>F3	0	There is no significant interaction between the goal and the instrument
Fe>F4	0	There is no significant interaction between the goal and the instrument
Fe>F5	+3	The establishment of a national program for the development of aquaculture is inextricably linked to and also a prerequisite for the sustainable development of aquaculture sector
Fe>F6	+1	The establishment of a national program for the development of aquaculture enables the goal for ensuring food safety in case of aquaculture food products as it gives priority to the production of high quality aquaculture food products
Fe>C1	0	There is no significant interaction between the goal and the instrument
Fe>C2	0	There is no significant interaction between the goal and the instrument
Fe>C3	+1	The establishment of a national program for the development of aquaculture enables the establishment of policy measures, concerning the aquaculture sector and its resilience against climate change
Fe>C4	0	There is no significant interaction between the goal and the instrument
Fe>C5	0	There is no significant interaction between the goal and the instrument
Fe>T1	0/-1	The establishment of a national program for the development of aquaculture may put constraints on the sustainable development of tourism in case of land use conflicts between the two sectors
Fe>T2	0	There is no significant interaction between the goal and the instrument
Fe>T3	0	There is no significant interaction between the goal and the instrument
Fe>T4	0	There is no significant interaction between the goal and the instrument
Ff>W1	0	There is no significant interaction between the goal and the instrument
Ff>W2	0	There is no significant interaction between the goal and the instrument
Ff>W3	0	There is no significant interaction between the goal and the instrument
Ff>W4	0	There is no significant interaction between the goal and the instrument
Ff>W5	0	There is no significant interaction between the goal and the instrument
Ff>E1	0	There is no significant interaction between the goal and the instrument
Ff>E2	0	There is no significant interaction between the goal and the instrument
Ff>E3	0	There is no significant interaction between the goal and the instrument
Ff>E4	0	There is no significant interaction between the goal and the instrument
Ff>E5	0	There is no significant interaction between the goal and the instrument
Ff>E6	0	There is no significant interaction between the goal and the instrument
Ff>L1	0	There is no significant interaction between the goal and the instrument
Ff>L2	+1	Controls in food and fodder industry enable the development of a competitive economy as food industry supports national income
Ff>L3	0	There is no significant interaction between the goal and the instrument

Ff>L4	0	There is no significant interaction between the goal and the instrument
Ff>F1	0/+1	Controls in food and fodder industry may enable the sustainable development of agriculture and the production of high quality agri-food products
Ff>F2	+1	Controls in food and fodder industry is a tool enabling the preservation and sustainable use of plant genetic resources as they place emphasis on the production of high quality food products
Ff>F3	0	There is no significant interaction between the goal and the instrument
Ff>F4	+2	Controls in food and fodder industry reinforce the rational use of pesticides as pesticides affect the quality of agri-food products and are strongly related to their safety
Ff>F5	0	There is no significant interaction between the goal and the instrument
Ff>F6	+3	Controls in food and fodder industry is a measure inextricably linked to the goal for ensuring security in food and fodder sectors
Ff>C1	0	There is no significant interaction between the goal and the instrument
Ff>C2	0	There is no significant interaction between the goal and the instrument
Ff>C3	0	There is no significant interaction between the goal and the instrument
Ff>C4	0	There is no significant interaction between the goal and the instrument
Ff>C5	0	There is no significant interaction between the goal and the instrument
Ff>T1	0	There is no significant interaction between the goal and the instrument
Ff>T2	0	There is no significant interaction between the goal and the instrument
Ff>T3	0	There is no significant interaction between the goal and the instrument
Ff>T4	0	There is no significant interaction between the goal and the instrument
Climate Policy Instruments to the Nexus-components Policy Goals		
Ca>W1	0/+1	Reinforcement of research and technology in the field of RES may enable the sustainable management of surface water in case where surface water resources are used in hydroelectric power plants for energy production
Ca>W2	0	There is no significant interaction between the goal and the instrument
Ca>W3	0	There is no significant interaction between the goal and the instrument
Ca>W4	0	There is no significant interaction between the goal and the instrument
Ca>W5	0	There is no significant interaction between the goal and the instrument
Ca>E1	+3	Reinforcing research and technology in the field of RES is inextricably linked to the attainment of the national energy goals and the increase of RES sharing in the final gross energy production
Ca>E2	+3	Reinforcing research and technology in the field of RES is inextricably linked to the exploitation of RES for energy production as it enriches the relative knowledge background and it contributes to the development and the broad adoption of relative technologies
Ca>E3	+3	Reinforcing research and technology in the field of RES is inextricably linked to the exploitation of RES for energy production by cogeneration technologies
Ca>E4	+1	Reinforcing research and technology in the field of RES enables the determination of costs related to the exploitation of RES for energy production
Ca>E5	0	There is no significant interaction between the goal and the instrument
Ca>E6	+3	Reinforcing research and technology in the field of RES is inextricably linked to the efforts for energy saving as it promotes the use of cleaner and more efficient energy resources
Ca>L1	0	There is no significant interaction between the goal and the instrument
Ca>L2	0/+1	Reinforcing research and technology in the field of RES has the potential to boost national economy with respect to the energy sector
Ca>L3	0	There is no significant interaction between the goal and the instrument
Ca>L4	0/+1	Research and technology in the field of RES may enable the spatial organization of the industrial sector in terms of the availability and potential exploitation of renewable energy resources for energy production
Ca>F1	0	There is no significant interaction between the goal and the instrument
Ca>F2	0	There is no significant interaction between the goal and the instrument
Ca>F3	0	There is no significant interaction between the goal and the instrument

Ca>F4	0	There is no significant interaction between the goal and the instrument
Ca>F5	0	There is no significant interaction between the goal and the instrument
Ca>F6	0	There is no significant interaction between the goal and the instrument
Ca>C1	+3	Reinforcing research and technology in the field of RES is inextricably linked to the development, adoption and promotion of RES which consequently entails the reduction of GHG emissions
Ca>C2	+3	Reinforcing research and technology in the field of RES is intertwined with the efforts towards the adaptation and resilience against climate change impacts as it strengthens the use of RES in the energy sector
Ca>C3	+3	Research and technology in the field of RES is intertwined with the undertaking of measures and the design of strategic directions against climate change in the energy sector
Ca>C4	+2	Research and technology in the field of RES reinforces the increase of public awareness concerning climate change by supporting participatory actions against climate change
Ca>C5	+1	Research and technology in the field of RES enables the establishment of rules regulating GHG emissions derived from the energy and industrial sectors
Ca>T1	+1	Research and technology in the field of RES enables the sustainable development of tourism by encouraging the adoption of RES by the tourist sector
Ca>T2	0	There is no significant interaction between the goal and the instrument
Ca>T3	0	There is no significant interaction between the goal and the instrument
Ca>T4	0	There is no significant interaction between the goal and the instrument
Cb>W1	0	There is no significant interaction between the goal and the instrument
Cb>W2	0	There is no significant interaction between the goal and the instrument
Cb>W3	0	There is no significant interaction between the goal and the instrument
Cb>W4	0	There is no significant interaction between the goal and the instrument
Cb>W5	0	There is no significant interaction between the goal and the instrument
Cb>E1	+3	The use of technologies that capture CO_2 emissions is inextricably linked to the attainment of the national energy goals and the reduction of emissions
Cb>E2	0	There is no significant interaction between the goal and the instrument
Cb>E3	0	There is no significant interaction between the goal and the instrument
Cb>E4	0	There is no significant interaction between the goal and the instrument
Cb>E5	0	There is no significant interaction between the goal and the instrument
Cb>E6	+1	The use of technologies that capture CO_2 emissions enables the achievement of the goal for energy saving
Cb>L1	0/+1	The use of technologies that capture CO_2 emissions may enable the sustainable spatial development as such technologies contribute to the protection of biodiversity and natural resources (especially climate and atmosphere quality)
Cb>L2	0	There is no significant interaction between the goal and the instrument
Cb>L3	0	There is no significant interaction between the goal and the instrument
Cb>L4	0	There is no significant interaction between the goal and the instrument
Cb>F1	+1	The use of technologies that capture CO_2 emissions enables the sustainable development of agriculture as it results in the better management of emissions derived from the agricultural sector
Cb>F2	0	There is no significant interaction between the goal and the instrument
Cb>F3	0	There is no significant interaction between the goal and the instrument
Cb>F4	0	There is no significant interaction between the goal and the instrument
Cb>F5	0	There is no significant interaction between the goal and the instrument
Cb>F6	0	There is no significant interaction between the goal and the instrument
Cb>C1	+3	The use of technologies that capture CO_2 emissions is inextricably linked to the reduction of GHG emissions
Cb>C2	+3	The use of technologies that capture CO_2 emissions is inextricably linked to the adaptation ability and resilience against climate change as it concerns environmental friendly technologies that contribute to the reduction of emissions
Cb>C3	+3	The use of technologies that capture CO_2 emissions is a basic policy measure,

		inextricably linked to and in line with strategies against climate change
Cb>C4	0	There is no significant interaction between the goal and the instrument
Cb>C5	+3	The use of technologies that capture CO_2 emissions is intertwined with the establishment of a national GHG emissions trading system aiming at the better management of emissions from the energy and industrial sectors
Cb>T1	0	There is no significant interaction between the goal and the instrument
Cb>T2	0	There is no significant interaction between the goal and the instrument
Cb>T3	0	There is no significant interaction between the goal and the instrument
Cb>T4	0	There is no significant interaction between the goal and the instrument
Cc>W1	0	There is no significant interaction between the goal and the instrument
Cc>W2	0	There is no significant interaction between the goal and the instrument
Cc>W3	0	There is no significant interaction between the goal and the instrument
Cc>W4	0	There is no significant interaction between the goal and the instrument
Cc>W5	0	There is no significant interaction between the goal and the instrument
Cc>E1	+3	The adoption of technologies for reducing methane emissions is inextricably linked to the attainment of the national energy goals and the reduction of GHG emissions
Cc>E2	0	There is no significant interaction between the goal and the instrument
Cc>E3	+1	The adoption of technologies for reducing methane emissions enables the promotion and adoption of cogeneration systems that are more “clear”, more efficient energy technologies and with lower emissions
Cc>E4	0	There is no significant interaction between the goal and the instrument
Cc>E5	0	There is no significant interaction between the goal and the instrument
Cc>E6	0	There is no significant interaction between the goal and the instrument
Cc>L1	0/+1	The adoption of technologies for reducing methane emissions may enable sustainable spatial development as it contributes to the protection of biodiversity and natural resources (especially climate and atmosphere quality)
Cc>L2	0	There is no significant interaction between the goal and the instrument
Cc>L3	0	There is no significant interaction between the goal and the instrument
Cc>L4	0	There is no significant interaction between the goal and the instrument
Cc>F1	+1	The adoption of technologies for reducing methane emissions enables the sustainable development of agriculture as it results in the better management of emissions derived from the agricultural sector
Cc>F2	0	There is no significant interaction between the goal and the instrument
Cc>F3	0	There is no significant interaction between the goal and the instrument
Cc>F4	0	There is no significant interaction between the goal and the instrument
Cc>F5	0	There is no significant interaction between the goal and the instrument
Cc>F6	0	There is no significant interaction between the goal and the instrument
Cc>C1	+3	The adoption of technologies for reducing methane emissions is inextricably linked to the limitation of GHG emissions
Cc>C2	+3	The adoption of technologies for reducing methane emissions is inextricably linked to the goal for increasing the country’s adaptation ability against climate change with respect to climate issues and quality of atmosphere
Cc>C3	+3	The adoption of technologies for reducing methane emissions is intertwined with the establishment of specific measures through which national strategies for combating climate change can be implemented
Cc>C4	+1	The diffusion of practices through which methane emissions can be reduced enables the goal for increasing social awareness with respect to climate change issues as diffusion entails broad adoption of such practices
Cc>C5	+3	The adoption of technologies for reducing methane emissions is inextricably linked to the establishment of rules regulating GHG emissions derived from the energy and industrial sectors
Cc>T1	0	There is no significant interaction between the goal and the instrument
Cc>T2	0	There is no significant interaction between the goal and the instrument
Cc>T3	0	There is no significant interaction between the goal and the instrument

Cc>T4	0	There is no significant interaction between the goal and the instrument
Cd>W1	+3	The use of indicators, methods and techniques for assessing climate change impacts and the respective susceptibility is inextricably linked to the protection and sustainable management of surface water as it contributes to the detection of climate change impacts on surface water resources
Cd>W2	+3	The use of indicators, methods and techniques for assessing climate change impacts and the respective susceptibility is inextricably linked to the protection and sustainable management of groundwater as it contributes to the detection of climate change impacts on groundwater
Cd>W3	+2	The assessment of climate change impacts and the respective susceptibility reinforces the protection of aquatic ecosystems from further deterioration derived from climate change impacts
Cd>W4	+3	The assessment of climate change impacts and the respective susceptibility is inextricably linked to the goal for mitigating floods' and drought's effects as it contributes to the proactive management of flood risk and drought which are main impacts of climate change
Cd>W5	+2	The assessment of climate change impacts and the respective susceptibility reinforces the establishment of a national water pricing system as it contributes to the identification of possible future water needs and the consequent sustainable management of water resources through the establishment of water costs
Cd>E1	+3	The assessment of climate change impacts is intertwined with the attainment of the national energy goals by indicating the need to limit emissions and increase RES sharing in the energy market in order to reduce climate change impacts
Cd>E2	+3	The assessment of climate change impacts is intertwined with electricity production from RES as a means for mitigating such impacts
Cd>E3	+2	The assessment of climate change impacts reinforces the adoption of cogeneration technologies as more "energy efficient" technologies, also contributing to the limitation of emissions
Cd>E4	+2	The assessment of climate change impacts reinforces the establishment of a national energy pricing system that regulates energy costs for all possible energy sources while it also contributes to the better management of energy sources
Cd>E5	-1	The assessment of climate change impacts puts constraints on the promotion of natural gas technologies as natural gas contributes to the increase of the overheating of planet
Cd>E6	+2	The assessment of climate change impacts reinforces the goal for energy saving by indicating the need for limiting emissions and using energy efficient technologies in order to mitigate climate change impacts
Cd>L1	+2	The assessment of climate change impacts and the respective susceptibility reinforces the sustainable and integrated spatial development, the protection of biodiversity and the sustainable use of natural resources especially under climate change conditions
Cd>L2	+1	The assessment of climate change impacts and the respective susceptibility enables the development of a low-carbon, environmental friendly and competitive economy
Cd>L3	0/+1	The assessment of climate change impacts may enable the spatial organization of aquaculture sector as it contributes to the identification of suitable areas for the development of aquaculture activities under climate change impacts
Cd>L4	-1/+1	The assessment of climate change impacts puts constraints on the industrial sector in case where industrial activities have negative impacts on climate and natural resources (quality of atmosphere, water resources, etc.) / Enables the spatial organization of industrial sector as it contributes to the sustainable management of the sector under climate change conditions
Cd>F1	-1/+1	The assessment of climate change impacts puts constraints on the agricultural sector in case where agricultural activities have negative impacts on climate and natural resources (quality of atmosphere, water resources, etc.) / Enables the

		sustainable development of agriculture under climate change conditions
Cd>F2	+1	The adoption of indicators, methods and techniques for assessing climate change impacts enables the preservation and sustainable use of plant genetic resources as it contributes to the identification of plant resources already been or expected to be under extinction due to climate change
Cd>F3	+1	The assessment of climate change impacts enables the spatial organization of livestock under climate change conditions
Cd>F4	+1	The assessment of climate change impacts enables the goal aiming at the rational use of pesticides as it places emphasis on the protection of land and water resources
Cd>F5	+1	The assessment of climate change impacts enables the sustainable development of aquaculture activities under climate change conditions
Cd>F6	0	There is no significant interaction between the goal and the instrument
Cd>C1	+3	The assessment of climate change impacts through the use of relative indicators and methods is a main “driving tool” towards the reduction of GHG emissions
Cd>C2	+3	The assessment of climate change impacts is inherently linked to the increase of the country’s adaptation ability as it sets the directions upon which future sustainable development should be based on by taking into consideration climate change impacts
Cd>C3	+3	The assessment of climate change impacts is intertwined with the establishment of policy measures for combating climate change as it sets the directions upon which the design and implementation of future strategies against climate change should be based on
Cd>C4	+2	The assessment of climate change impacts reinforces participatory actions against climate change as it contributes to the diffusion of relative knowledge and the dissemination of data concerning climate change impacts
Cd>C5	+2	The assessment of climate change impacts reinforces the establishment of a national GHG emissions trading system as it offers data and information upon which such a system should be based on
Cd>T1	+2	The assessment of climate change impacts reinforces the sustainable development of the tourist sector under climate change conditions as it provides information about the most suitable areas for the development of tourist activities or the need for the sector’s adaptation to the new conditions created by climate change
Cd>T2	-1/+1	The assessment of climate change impacts puts constraints to the development of tourist entrepreneurship in case where tourist activities entail negative impacts on the environment and climate / Enables the development of tourist entrepreneurship under climate change conditions
Cd>T3	0/+1	The assessment of climate change impacts may enable tourist training activities with respect to the management of the tourist sector under climate change conditions
Cd>T4	+1	The assessment of climate change impacts enables the improvement of the Greek tourist product through the adaptation of the tourist sector to the new conditions caused by climate change
Ce>W1	0/+1	The undertaking of participatory actions against climate change may enable the goal for sustainable management and protection of surface water through the dissemination of knowledge having to do with climate change impacts on surface water resources
Ce>W2	0/+1	The undertaking of participatory actions against climate change may enable the goal for sustainable management and protection of groundwater through the dissemination of knowledge having to do with climate change impacts on groundwater
Ce>W3	0/+1	The undertaking of participatory actions against climate change may enable the goal for sustainable management and protection of aquatic ecosystems from further deterioration through the dissemination of knowledge having to do with climate change impacts on aquatic ecosystems

Ce>W4	+1	The undertaking of participatory actions against climate change enables the mitigation of floods' and drought's effects as it supports the involvement of citizens to the whole effort
Ce>W5	+1	The undertaking of participatory actions against climate change enables the establishment of a national water pricing system as it supports the diffusion of information having to do with the rational use of water resources under climate change conditions
Ce>E1	+3	The undertaking of participatory actions against climate change is inextricably linked to the attainment of the national energy goals as it supports public awareness actions having to do with energy saving and the increase of RES sharing in the final gross energy consumption
Ce>E2	+3	The undertaking of participatory actions against climate change is inextricably linked to the attainment of the goal for electricity production from RES as it supports public awareness actions having to do with the increase of RES for electricity production purposes
Ce>E3	+2	The undertaking of participatory actions against climate change reinforces the promotion of cogeneration technologies as it supports the diffusion of knowledge having to do with the limited emissions and the effectiveness of cogeneration systems
Ce>E4	+1	The undertaking of participatory actions against climate change enables the establishment of a national energy pricing system as it supports public awareness activities having to do with energy and emissions costs
Ce>E5	-1	The undertaking of participatory actions against climate change puts constraints on the promotion of natural gas as it contributes to the overheating of planet
Ce>E6	+2	The undertaking of participatory actions against climate change reinforces the goal for energy efficiency and saving as it supports the diffusion of information having to do with energy consumption and the rational use of energy resources under climate change conditions
Ce>L1	+2	The undertaking of participatory actions against climate change reinforces the sustainable and integrated spatial development as it promotes the creation of a balanced spatial pattern and the protection of biodiversity and natural resources
Ce>L2	0	There is no significant interaction between the goal and the instrument
Ce>L3	0	There is no significant interaction between the goal and the instrument
Ce>L4	0	There is no significant interaction between the goal and the instrument
Ce>F1	0/+1	The undertaking of participatory actions against climate change may enable the sustainable development of agriculture by increasing awareness with respect to climate change impacts derived from agricultural activities
Ce>F2	0/+1	The undertaking of participatory actions against climate change may enable the preservation of plant genetic resources by emphasizing (to the public) the importance to preserve them under climate change conditions
Ce>F3	0	There is no significant interaction between the goal and the instrument
Ce>F4	0/+1	The undertaking of participatory actions against climate change may enable the rational use of pesticides by emphasizing (to the public) the need for protecting land and water resources from pesticides
Ce>F5	0	There is no significant interaction between the goal and the instrument
Ce>F6	0	There is no significant interaction between the goal and the instrument
Ce>C1	+3	The undertaking of participatory actions against climate change is inextricably linked to the reduction of GHG emissions through the broad diffusion of knowledge and information regarding the negative impacts of emissions on climate and atmosphere quality
Ce>C2	+3	The undertaking of participatory actions against climate change is inextricably linked to the goal for reinforcing the country's adaptation ability against climate change impacts through the diffusion of knowledge having to do with the need for increasing resilience under climate change conditions
Ce>C3	+3	The undertaking of participatory actions against climate change is intertwined with the need for adopting specific measures for combating climate change by

		emphasizing the need to follow relative strategic directions for the sustainable future development under climate change conditions
Ce>C4	+3	The undertaking of participatory actions against climate change is intertwined with increasing social awareness and involving citizens in actions having to do with climate change confrontation
Ce>C5	+2	The undertaking of participatory actions against climate change reinforces the establishment of a national GHG emissions trading system through the diffusion of knowledge having to do with the sustainable management of GHG emissions
Ce>T1	0/+1	The undertaking of participatory actions against climate change may enable the sustainable development of tourism by increasing awareness with respect to climate change impacts derived from tourist activities
Ce>T2	0	There is no significant interaction between the goal and the instrument
Ce>T3	0	There is no significant interaction between the goal and the instrument
Ce>T4	0/+1	The undertaking of participatory actions against climate change may enable the improvement of the Greek tourist product through the adaptation of the tourist sector to the new conditions imposed by climate change
Cf>W1	0/+1	The organized management of GHG emissions may enable the protection of surface water as it reduces the negative impacts of atmosphere / climate on surface water resources
Cf>W2	0/+1	The organized management of GHG emissions may enable the protection of groundwater as it reduces the negative impacts of atmosphere / climate on groundwater
Cf>W3	0/+1	The organized management of GHG emissions may enable the protection of aquatic ecosystems as it reduces the negative impacts of atmosphere / climate on aquatic ecosystems
Cf>W4	0/+1	The organized management of GHG emissions may enable the mitigation of floods' and drought's effects as it contributes to the limitation of climate change impacts causing floods and drought
Cf>W5	0	There is no significant interaction between the goal and the instrument
Cf>E1	+3	The organized management of GHG emissions is inextricably linked to the attainment of the national energy goals
Cf>E2	+2	The organized management of GHG emissions reinforces the increase of RES sharing for electricity production as the use of RES entails less emissions
Cf>E3	+2	The organized management of GHG emissions reinforces the adoption of cogeneration technologies that produce less emissions
Cf>E4	+2	The undertaking of specific measures aiming at the management of emissions reinforces the establishment of a national energy pricing system that regulates energy and emissions costs
Cf>E5	-1	The organized management of emissions puts constraints on the promotion of natural gas as natural gas contributes to the overheating of planet through the emissions it releases
Cf>E6	+3	The organized management of emissions is inextricably linked to the goal for energy saving
Cf>L1	0	There is no significant interaction between the goal and the instrument
Cf>L2	0/+1	The organized management of emissions may enable the development of a competitive and low-carbon economy
Cf>L3	0	There is no significant interaction between the goal and the instrument
Cf>L4	0/+1	The organized management of emissions may enable the sustainable spatial organization of the industrial sector by regulating the management of industrial emissions
Cf>F1	0/+1	The organized management of emissions may enable the sustainable development of agriculture by regulating the emissions derived from the agricultural sector
Cf>F2	0	There is no significant interaction between the goal and the instrument
Cf>F3	0	There is no significant interaction between the goal and the instrument
Cf>F4	0	There is no significant interaction between the goal and the instrument

Cf>F5	0	There is no significant interaction between the goal and the instrument
Cf>F6	0	There is no significant interaction between the goal and the instrument
Cf>C1	+3	The organized management of emissions is intertwined with the reduction of GHG emissions
Cf>C2	+3	The organized management of emissions is intertwined with the increase of the country's adaptation ability against climate change impacts
Cf>C3	+3	The organized management of emissions is inextricably linked to the adoption of strategic directions aiming at combating climate change
Cf>C4	+1	The organized management of emissions enables the goal for increasing awareness against climate change as it mobilizes the undertaking of relative participatory actions
Cf>C5	+3	The establishment of specific measures for the organized management of emissions is inextricably linked to the establishment of a national GHG emissions trading system
Cf>T1	0/+1	The organized management of emissions may enable the sustainable development of tourism by regulating the emissions derived from the tourist sector
Cf>T2	0	There is no significant interaction between the goal and the instrument
Cf>T3	0	There is no significant interaction between the goal and the instrument
Cf>T4	0	There is no significant interaction between the goal and the instrument
Tourism Policy Instruments to the Nexus-components Policy Goals		
Ta>W1	0	There is no significant interaction between the goal and the instrument
Ta>W2	0	There is no significant interaction between the goal and the instrument
Ta>W3	0	There is no significant interaction between the goal and the instrument
Ta>W4	0	There is no significant interaction between the goal and the instrument
Ta>W5	0	There is no significant interaction between the goal and the instrument
Ta>E1	0	There is no significant interaction between the goal and the instrument
Ta>E2	0	There is no significant interaction between the goal and the instrument
Ta>E3	0	There is no significant interaction between the goal and the instrument
Ta>E4	0	There is no significant interaction between the goal and the instrument
Ta>E5	0	There is no significant interaction between the goal and the instrument
Ta>E6	0/+1	The promotion of organized and sophisticated tourist investments may enable the goal for energy saving through the adoption of relative technologies by the tourist sector
Ta>L1	+1	The promotion of organized and sophisticated tourist investments enables the goal for the establishment of a sustainable and balanced spatial pattern between urban and rural regions
Ta>L2	+2	The promotion of organized and sophisticated tourist investments reinforces the development of a balanced and competitive economy as the tourist sector is one of the main sectors contributing to the national income
Ta>L3	0/-1	The promotion of organized and sophisticated tourist investments may put constraints on the spatial organization of the aquaculture sector in case where land use conflicts exist between the two sectors
Ta>L4	0/-1	The promotion of organized and sophisticated tourist investments may put constraints on the spatial organization of the industrial sector in case where land use conflicts exist between the two sectors
Ta>F1	0	There is no significant interaction between the goal and the instrument
Ta>F2	0	There is no significant interaction between the goal and the instrument
Ta>F3	0	There is no significant interaction between the goal and the instrument
Ta>F4	0	There is no significant interaction between the goal and the instrument
Ta>F5	0	There is no significant interaction between the goal and the instrument
Ta>F6	0	There is no significant interaction between the goal and the instrument
Ta>C1	0/+1	The promotion of organized and sophisticated tourist investments may enable the reduction of GHG emissions in case where tourist infrastructures are equipped by low-emission / energy saving technologies

Ta>C2	+1	The promotion of organized and sophisticated tourist investments enables the goal for increasing adaptation ability against climate change through the consequent adaptation of tourist activities to the new conditions imposed by climate change
Ta>C3	+1	The promotion of organized and sophisticated tourist investments enables the goal for mapping out national strategic directions against climate change through the adoption of relative specific policy measures concerning the development of the tourist sector under climate change conditions
Ta>C4	0	There is no significant interaction between the goal and the instrument
Ta>C5	0	There is no significant interaction between the goal and the instrument
Ta>T1	+3	The promotion of organized and sophisticated tourist investments is inherently linked to the sustainable development of the tourist sector
Ta>T2	+3	The promotion of organized and sophisticated tourist investments is inherently linked to the development of tourist entrepreneurship and the construction of relative tourist infrastructures
Ta>T3	+2	The promotion of organized and sophisticated tourist investments reinforces the development of tourist training activities focusing on the management of such investments
Ta>T4	+3	The promotion of organized and sophisticated tourist investments is intertwined with the improvement of the Greek tourist product and the offered tourist services
Tb>W1	0	There is no significant interaction between the goal and the instrument
Tb>W2	0	There is no significant interaction between the goal and the instrument
Tb>W3	+1	The establishment of specific land use regulations for the development of tourist activities enables the protection of aquatic ecosystems from further deterioration in case where tourist activities are developed next to aquatic ecosystems
Tb>w4	0	There is no significant interaction between the goal and the instrument
Tb>W5	0	There is no significant interaction between the goal and the instrument
Tb>E1	0	There is no significant interaction between the goal and the instrument
Tb>E2	0	There is no significant interaction between the goal and the instrument
Tb>E3	0	There is no significant interaction between the goal and the instrument
Tb>E4	0	There is no significant interaction between the goal and the instrument
Tb>E5	0	There is no significant interaction between the goal and the instrument
Tb>E6	0	There is no significant interaction between the goal and the instrument
Tb>L1	+3	The establishment of land use regulations for the development of tourist activities is inextricably linked to the sustainable, integrated and balanced spatial development
Tb>L2	+2	The organized spatial development of tourist activities reinforces the development of a balanced and competitive economy as tourism is one of the main sectors supporting national income
Tb>L3	0	There is no significant interaction between the goal and the instrument
Tb>L4	0	There is no significant interaction between the goal and the instrument
Tb>F1	0	There is no significant interaction between the goal and the instrument
Tb>F2	0	There is no significant interaction between the goal and the instrument
Tb>F3	0	There is no significant interaction between the goal and the instrument
Tb>F4	0	There is no significant interaction between the goal and the instrument
Tb>F5	0	There is no significant interaction between the goal and the instrument
Tb>F6	0	There is no significant interaction between the goal and the instrument
Tb>C1	0	There is no significant interaction between the goal and the instrument
Tb>C2	0	There is no significant interaction between the goal and the instrument
Tb>C3	0	There is no significant interaction between the goal and the instrument
Tb>C4	0	There is no significant interaction between the goal and the instrument
Tb>C5	0	There is no significant interaction between the goal and the instrument
Tb>T1	+3	The establishment of land use regulations for the development of tourist activities is inextricably linked to the sustainable development of tourism as it

		contributes to the identification of the most suitable areas for the development of tourist activities
Tb>T2	+3	The establishment of land use regulations for the development of tourist activities is intertwined with the development of tourist entrepreneurship through the identification of areas that are suitable for the development of tourist enterprises and tourist infrastructures
Tb>T3	0/+1	The establishment of land use regulations may enable tourist training regarding issues having to do with land use management by the tourist sector
Tb>T4	+1	The establishment of land use regulations for the development of tourist activities enables the improvement of the Greek tourist product and the offered tourist services
Tc>W1	0	There is no significant interaction between the goal and the instrument
Tc>W2	0	There is no significant interaction between the goal and the instrument
Tc>W3	0	There is no significant interaction between the goal and the instrument
Tc>W4	0	There is no significant interaction between the goal and the instrument
Tc>W5	0	There is no significant interaction between the goal and the instrument
Tc>E1	0	There is no significant interaction between the goal and the instrument
Tc>E2	0	There is no significant interaction between the goal and the instrument
Tc>E3	0	There is no significant interaction between the goal and the instrument
Tc>E4	0	There is no significant interaction between the goal and the instrument
Tc>E5	0	There is no significant interaction between the goal and the instrument
Tc>E6	0	There is no significant interaction between the goal and the instrument
Tc>L1	+1	The establishment of a tourist observatory enables the integrated and balanced spatial development between urban and rural regions through the equal promotion and distribution of tourist activities
Tc>L2	+2	The establishment of a tourist observatory reinforces the establishment of a balanced and competitive economy as tourism is one of the main sectors that support national income
Tc>L3	0	There is no significant interaction between the goal and the instrument
Tc>L4	0	There is no significant interaction between the goal and the instrument
Tc>F1	0	There is no significant interaction between the goal and the instrument
Tc>F2	0	There is no significant interaction between the goal and the instrument
Tc>F3	0	There is no significant interaction between the goal and the instrument
Tc>F4	0	There is no significant interaction between the goal and the instrument
Tc>F5	0	There is no significant interaction between the goal and the instrument
Tc>F6	0	There is no significant interaction between the goal and the instrument
Tc>C1	0	There is no significant interaction between the goal and the instrument
Tc>C2	0/+1	The establishment of a tourist observatory may enable the adaptation of the tourist sector to the new conditions imposed by climate change based on the needs and preferences of tourists
Tc>C3	0/+1	The establishment of a tourist observatory may enable the establishment of specific policy measures for combating climate change regarding the tourist sector
Tc>C4	0	There is no significant interaction between the goal and the instrument
Tc>C5	0	There is no significant interaction between the goal and the instrument
Tc>T1	+3	The establishment of a tourist observatory is inextricably linked to the sustainable development of the tourist sector as it promotes the Greek tourist product, it reveals the current tourist trends and it supports the needs of tourists
Tc>T2	+3	The establishment of a tourist observatory is inextricably linked to the development of tourist entrepreneurship by providing valuable information about the tourist trends, the preferences of tourists, etc.
Tc>T3	+3	The establishment of a tourist observatory is inextricably linked to the development of tourist training activities as it provides useful information supporting the development and modernization of the Greek tourism
Tc>T4	+3	The establishment of a tourist observatory is inherently linked to the

		improvement of the Greek tourist product through the diffusion of relative information (tourist trends, etc.)
Td>W1	0	There is no significant interaction between the goal and the instrument
Td>W2	0	There is no significant interaction between the goal and the instrument
Td>W3	0	There is no significant interaction between the goal and the instrument
Td>W4	0	There is no significant interaction between the goal and the instrument
Td>W5	0	There is no significant interaction between the goal and the instrument
Td>E1	0	There is no significant interaction between the goal and the instrument
Td>E2	0	There is no significant interaction between the goal and the instrument
Td>E3	0	There is no significant interaction between the goal and the instrument
Td>E4	0	There is no significant interaction between the goal and the instrument
Td>E5	0	There is no significant interaction between the goal and the instrument
Td>E6	+1	The enhancement and organization of tourist training activities enable energy saving by promoting the adoption of relative practices by the tourist sector
Td>L1	0	There is no significant interaction between the goal and the instrument
Td>L2	+1	The enhancement and organization of tourist training activities enable the development of a balanced and competitive economy through the improvement and modernization of the tourist sector
Td>L3	0	There is no significant interaction between the goal and the instrument
Td>L4	0	There is no significant interaction between the goal and the instrument
Td>F1	0	There is no significant interaction between the goal and the instrument
Td>F2	0	There is no significant interaction between the goal and the instrument
Td>F3	0	There is no significant interaction between the goal and the instrument
Td>F4	0	There is no significant interaction between the goal and the instrument
Td>F5	0	There is no significant interaction between the goal and the instrument
Td>F6	0	There is no significant interaction between the goal and the instrument
Td>C1	0/+1	The enhancement and organization of tourist training activities may enable the reduction of emissions derived from the tourist sector by promoting the adoption of relative practices
Td>C2	0/+1	The enhancement and organization of tourist training activities may enable the adaptation of the tourist sector and its future development under climate change conditions
Td>C3	0/+1	The enhancement and organization of tourist training activities may enable the establishment of strategic directions regarding the development of tourist sector under climate change conditions
Td>C4	0	There is no significant interaction between the goal and the instrument
Td>C5	0	There is no significant interaction between the goal and the instrument
Td>T1	+3	The enhancement and organization of tourist training activities is inextricably linked to the sustainable development of tourism and the exploration of its future perspectives
Td>T2	+3	The enhancement and organization of tourist training activities is inextricably linked to the development of tourist entrepreneurship and the establishment of modern tourist enterprises
Td>T3	+3	The organization of tourist schools, seminar courses and tourist educational centers is intertwined with the development of tourist training
Td>T4	+3	The organization of tourist training activities is inextricably linked to the improvement of the Greek tourist product and its future perspectives
Te>W1	0	There is no significant interaction between the goal and the instrument
Te>W2	0	There is no significant interaction between the goal and the instrument
Te>W3	0	There is no significant interaction between the goal and the instrument
Te>W4	0	There is no significant interaction between the goal and the instrument
Te>W5	0	There is no significant interaction between the goal and the instrument
Te>E1	0	There is no significant interaction between the goal and the instrument
Te>E2	0	There is no significant interaction between the goal and the instrument
Te>E3	0	There is no significant interaction between the goal and the instrument

Te>E4	0	There is no significant interaction between the goal and the instrument
Te>E5	0	There is no significant interaction between the goal and the instrument
Te>E6	0	There is no significant interaction between the goal and the instrument
Te>L1	+1	The differentiation of tourist activities according to the specific characteristics of each region enables the establishment of a sustainable and balanced spatial pattern of development between urban and rural regions as it broadens the spectrum of the possible tourist activities that can be developed in each region
Te>L2	+2	The differentiation of tourist activities according to the specific characteristics of each region reinforces the development of a balanced and competitive economy as the tourist sector supports national income
Te>L3	0	There is no significant interaction between the goal and the instrument
Te>L4	0	There is no significant interaction between the goal and the instrument
Te>F1	0	There is no significant interaction between the goal and the instrument
Te>F2	0	There is no significant interaction between the goal and the instrument
Te>F3	0	There is no significant interaction between the goal and the instrument
Te>F4	0	There is no significant interaction between the goal and the instrument
Te>F5	0	There is no significant interaction between the goal and the instrument
Te>F6	0	There is no significant interaction between the goal and the instrument
Te>C1	0	There is no significant interaction between the goal and the instrument
Te>C2	0/+1	The differentiation of tourist activities according to the specific characteristics of each region may enable the adaptation of the tourist sector to the new conditions imposed by climate change
Te>C3	0/+1	The differentiation of tourist activities according to the specific characteristics of each region may enable the establishment of strategic directions regarding the development of tourist sector under climate change conditions
Te>C4	0	There is no significant interaction between the goal and the instrument
Te>C5	0	There is no significant interaction between the goal and the instrument
Te>T1	+3	The differentiation of tourist activities according to the specific characteristics of each region strongly is inextricably linked to the sustainable development of the tourist sector through its adaptation to the comparative advantages and peculiarities of each region
Te>T2	+3	The differentiation of tourist activities according to the specific characteristics of each region strongly is intertwined with the development of tourist entrepreneurship by boosting the establishment of tourist enterprises and infrastructures serving the needs of the respective tourist activities
Te>T3	+2	The differentiation of tourist activities according to the specific characteristics of each region reinforces the establishment of training activities focusing on the promotion and management of differentiated tourist activities
Te>T4	+3	The differentiation of tourist activities according to the specific characteristics of each region strongly is inextricably linked to the improvement of the Greek tourist product by broadening the spectrum of possible tourist activities and also by promoting a more environmental friendly pattern of tourist development
Tf>W1	0	There is no significant interaction between the goal and the instrument
Tf>W2	0	There is no significant interaction between the goal and the instrument
Tf>W3	0	There is no significant interaction between the goal and the instrument
Tf>W4	0	There is no significant interaction between the goal and the instrument
Tf>W5	0	There is no significant interaction between the goal and the instrument
Tf>E1	0	There is no significant interaction between the goal and the instrument
Tf>E2	0	There is no significant interaction between the goal and the instrument
Tf>E3	0	There is no significant interaction between the goal and the instrument
Tf>E4	0	There is no significant interaction between the goal and the instrument
Tf>E5	0	There is no significant interaction between the goal and the instrument
Tf>E6	0	There is no significant interaction between the goal and the instrument
Tf>L1	+1	Networking among tourist firms enables the establishment of a balanced spatial pattern of development between urban and rural regions through the exchange

		of information
Tf>L2	+1	Networking among tourist firms enables the development of a balanced national economy as it contributes to the upgrading of the tourist sector
Tf>L3	0	There is no significant interaction between the goal and the instrument
Tf>L4	0	There is no significant interaction between the goal and the instrument
Tf>F1	0	There is no significant interaction between the goal and the instrument
Tf>F2	0	There is no significant interaction between the goal and the instrument
Tf>F3	0	There is no significant interaction between the goal and the instrument
Tf>F4	0	There is no significant interaction between the goal and the instrument
Tf>F5	0	There is no significant interaction between the goal and the instrument
Tf>F6	0	There is no significant interaction between the goal and the instrument
Tf>C1	0	There is no significant interaction between the goal and the instrument
Tf>C2	0	There is no significant interaction between the goal and the instrument
Tf>C3	0	There is no significant interaction between the goal and the instrument
Tf>C4	0	There is no significant interaction between the goal and the instrument
Tf>C5	0	There is no significant interaction between the goal and the instrument
Tf>T1	+3	Networking among tourist firms is inherently linked to the sustainable development and upgrading of the tourist sector as it contributes to the diffusion of knowledge and the establishment of synergies
Tf>T2	+3	Networking among tourist firms is inextricably linked to the development and modernization of tourist entrepreneurship while it promotes cooperation among tourist enterprises
Tf>T3	+1	Networking among tourist firms enables the development of tourist training activities having to do with tourist entrepreneurship and the creation of synergies among tourist businesses
Tf>T4	+2	Networking among tourist firms reinforces the improvement of the Greek tourist product through the cooperation and the creation of synergies among tourist enterprises

The assessment of interactions between the nexus critical instruments and objectives indicates that instruments and objectives referring to the same nexus sector are fully combined with each other. For example, policy instruments concerning the protection and management of water resources fully support the achievement of the respective "water objectives". Also, instruments concerning the energy sector contribute critically to the achievement of "climate objectives" and vice versa ("climate instruments" → "energy objectives"), instruments concerning water contribute to the achievement of goals related to the sustainable development of agriculture and the country's adaptation to climate change impacts, "land use instruments" are combined harmonically with goals concerning the sustainable development of agriculture and tourism while instruments referring to the rational use of resources by the agricultural sector support the achievement of "water goals".

On the other hand, the main conflicts exist between "water instruments" and goals having to do with the exploitation of water for energy production, irrigation, aquaculture and industrial activities. This is fully justified as according to the literature and also the opinions of stakeholders, water allocation/use and protection of water quality are among the basic factors creating conflicts during the policy implementation phase. Also, "energy instruments" concerning the development of RES infrastructures may not support "land goals" in case they entail negative impacts on landscape, biodiversity and natural environment (e.g. protected areas).

The instrument effectively combined with the majority of nexus critical objectives is (Cd): "Assessment of climate change impacts and the respective susceptibility" (total number of "+":25). This instrument focuses on the adoption of indicators, measures and techniques for the assessment of climate change impacts and it supports the sustainable management and future development of all nexus sectors under the conditions imposed by climate change. Instruments (Lf): “Promotion of specialization and complementarity among productive sectors” (total number of “+”:24), (La): “Land use regulation” (total number of “+”:21) and (Ce): “Initiatives to increase public awareness on climate change” (total number of “+”:21) follow. Regarding the instruments that put constraints to the majority of the nexus critical objectives, these are: instrument (Wc): “Monitoring water pollution by each region” (total number of “-“:7) and instrument (Wd): “Cost recovery for water services” (total number of “-“:7). This is more or less predictable as the development of all nexus sectors presupposes the use of water that entails pressures on water resources and impacts on their quality. Instruments (Ea): “Construction of wind parks – Identification of suitable and non-suitable areas” (total number of “-“:6) and (Lh): “Promotion of a multi-centric pattern of industrial development – Decentralization of the industrial sector” (total number of “-“:5) follow.

Finally, the majority of the nexus critical instruments support the achievement of goal (C3): “Mapping out national strategic directions against climate change” (total number of “+“:33). This goal focuses on the establishment of specific policy measures for combating climate change. Goals (C2): “Increase the adaptation ability and resilience against climate change” (total number of “+“:31), (T1): “Sustainable development of the tourist sector” (total number of “+”:30), (L1): “Sustainable and integrated spatial development” (total number of “+”:30) and (L2): “Development of a balanced and competitive economy” (total number of “+”:30) follow. The least supported goals are: (L4): “Improve spatial organization of industrial sector” (total number of “-“:8) and (E5): “Establishment of a national system for natural gas management” (total number of “+”:4 and total number of “-“:4).

The general conclusion is that most policy priorities focus on the development of a low-carbon economy and the sustainable development of all nexus sectors under climate change impacts.

5.3. Assessment of vertical interactions between policies

This section focuses on the assessment of policy interactions across scales and how these interactions affect the achievement of the Nexus Critical Objectives (NCOs). In case of the Greek case study interactions between EU and national policies, in the relevant nexus sectors, were investigated. Global policies (mainly climate policies) adopted by EU and Greece have been also taken into consideration. The assessment was based on the literature and the interviews with stakeholders.

More specifically, the key questions upon which this analysis was based on are:

- To what extent higher level policies (objectives and instruments) are incorporated and implemented at lower level and why?
- Which are the factors that support or hinder the implementation of higher level policies at lower level?
- To what extent lower level policies (objectives and instruments) are supported or hindered by higher level policies and why?

At this point, it should be mentioned that harmonization of the Greek policy framework with the global and European policy framework is either obligatory (e.g. adoption of European Directives) or optional. However, the creation of broad synergies, in the policy level among EU countries, supports the undertaking of common actions and strategies that reinforce the achievement of common goals. It also promotes the creation of large funding schemes. Greece fully reconciles its legislative framework with the respective European policies as a member of EU. EU supports Greece in the implementation of policies having to do with the sustainable and effective management of resources.

The results of this analysis are presented in a table format that summarizes the vertical interactions. In Table 31, information about the successful/unsuccessful implementation of higher level policies in the national scale and also the successful/unsuccessful support of national policies by higher level policies is included.

Table 31: Vertical interactions among policies

HIGHER>LOWER	
Higher level policies successfully implemented at lower scale	
Policy	*Description of reason and how NCOs are influenced*
Kyoto Protocol	Ratified and fully adopted in Greece (Law 3017/2002) for the protection of climate. It supports the attainment of national goals having to do with climate and atmosphere quality through the: reduction of emissions, advancement of sustainable development, limitation of GHG emissions not monitored by the Protocol of Montreal and energy efficiency.
Doha amendment of the Kyoto Protocol	Ratified and fully adopted in Greece (Law 4345/2015) for the protection of climate. It supports the undertaking of efforts aiming at the reduction of emissions in Greece (quantitative commitments).
Paris Convention	Ratified and fully adopted in Greece (Law 4426/2016) for the protection of climate. It supports goals aiming at combating climate change and increase of global temperature through the reduction of GHG emissions, the assessment of climate change impacts and the improvement of socioeconomic and ecological systems' resilience.
Directive 2003/87/EC	Ratified and fully adopted in Greece [Common Ministerial Decisions 54409/2632(2004) and 57495/2959/E103(2010)] for the protection of climate. It supports the establishment of a national GHG emissions trading system, the inclusion of the air transport in the GHG emissions trading system and the limitation of GHG emissions in a cost-effective and economic-efficient way.
Directive 2000/60/EC	Ratified and fully adopted in Greece (Law 3199/2003 and Presidential Decree 51/2007) for the protection of water resources. It supports goals having to do with the sustainable management of surface water and groundwater, the quality of water resources, the establishment of analytical reports for the Greek river basins, the recovery of costs for water services, the development of a monitoring network for water resources, etc.
International Convention on plant genetic resources for food and agriculture	Ratified and adopted in Greece (Law 3165/2003) for the sustainable development of agriculture and food sector. It supports goals having to do with the preservation and sustainable use of plant genetic resources for food and agriculture as well as the equitable sharing of benefits derived from the use of plant genetic resources.
Higher level policies only partly implemented at lower scale	
Policy	*Description of reason and how NCOs are influenced*
None	None
Higher level policies poorly implemented at lower scale	
Policy	*Description of reason and how NCOs are influenced*
None	None
LOWER>HIGHER	
Lower level policies fully supported by higher level policies	
Policy	*Description of reason and how NCOs are influenced*
National programme for the reduction of emissions	Adopted in 2003 and verified by the Council of Ministers for the protection of climate and atmosphere quality. Fully supported by higher (Global and European) level policies concerning the reduction of GHG

	emissions, the promotion of RES, energy saving in building, use of biofuels, etc. (Kyoto Protocol, 2002/358/EC Decision of the Council).
National strategic plan for climate change adaptation	Adopted in 2016 and aims at combating climate change in Greece. Fully supported by higher (European) level policies. It concerns the reinforcement of the country's adaptation ability and resilience against climate change impacts (adaptation of biodiversity, agricultural sector, forest ecosystems, etc.) (EC Green Paper COM2007, EC White Paper COM2009, Directive 2007/60/EC).
Decision 39626/2208/E130 (2009)	Adopted in 2009 for the protection of groundwater. Fully supported by higher (European) level policies. It focuses on the establishment of proactive measures for monitoring pollution and deterioration of groundwater and the assessment of the chemical status of groundwater (Directive 2006/118/EC).
Common Ministerial Decision 31822/1542/E103(2010)	Adopted in 2010 for the assessment of flood risk. Fully supported by higher (European) level policies. It concerns the assessment of flood risk and the limitation of floods' effects on: human health, natural environment, cultural heritage and several economic activities (Directive 2007/60/EC).
Common Ministerial Decision 135275(2017)	Adopted in 2017 for the sustainable management of water resources. Fully supported by higher (European) level policies. It focuses on the establishment of a national water pricing system, the determination of water prices for water services and the determination of costs for water services (Directive 2000/60/EC).
Law 4036/2012	Adopted in 2012 for the sustainable development of agriculture. Fully supported by higher (European) level policies. It concerns the establishment of rules regulating pesticides' market and the rational / sustainable use of pesticides (Directive 2009/128/EC, Regulation 1107/2009/EC, Regulation 396/2005/EC).
Law 4235/2014	Adopted in 2014 for the sustainable development of food sector. It is supported by higher (European) level policies. It concerns the achievement of goals having to do with food and fodder security through the establishment of strict controls and penalties in food and fodder industry (Regulation 178/2002/EC, Regulation 882/2004/EC).
Law 3734/2009	Adopted in 2009 for the sustainable development of energy sector. It is supported by higher (European) level policies. It focuses on the promotion of cogeneration from two or more types of energy in the internal energy market (Directive 2004/8/EC).
Law 3851/2010	Adopted in 2010 for the sustainable development of energy sector and the protection of climate. Fully supported by higher (European) level policies. It focuses on the attainment of the national energy goals for the year 2020 and the acceleration of RES development for combating climate change (Directive 2009/28/EC, European Energy Strategy for the year 2020).
Law 4001/2011	Adopted in 2011 for the sustainable development of energy sector. Fully supported by higher (European) level policies. It concerns the operation of electricity and natural gas markets as well as research, production and transmission networks for hydrocarbons (Directive 2009/72/EC, Directive 2009/73/EC).
Law 4414/2016	Adopted in 2016 for the sustainable development of energy sector. Fully supported by higher (European) level policies. It focuses on electricity production from RES and the adoption of cogeneration technologies (Directive 2004/8/EC).
Lower level policies only partly supported by higher level policies	
Policy	*Description of reason and how NCOs are influenced*
Law 3468/2006	Adopted in 2006 for the sustainable development of energy sector. Partially supported by higher (European) level policies. It concerns

	electricity production from RES and cogeneration of high performance electricity and heat in the internal market (Directive 2001/77/EC).
Decision 6876/481-2008	Adopted in 2008 for the sustainable spatial development, the protection of biodiversity and natural resources. It is partially supported by higher (Global and European) level policies as some provisions have to do with the protection of climate, the reduction of GHG emissions, the adoption of climate change adaptation strategies, the mitigation of climate change impacts and the confrontation of natural disasters (Kyoto Protocol).
Decision 31722-2011	Adopted in 2011 for the spatial organization and sustainable development of aquaculture sector. It is partially supported by higher (European) level policies as some provisions have to do with the sustainable management of water resources and rules regulating fishery (Directive 2000/60/EC, Common EU Policy Framework for Fishery).
Lower level policies hindered/disrupted by higher level policies	
Policy	*Description of reason and how NCOs are influenced*
None	None

As mentioned above, vertical interactions may either hamper or support the achievement of the Nexus Critical Objectives. Regarding the Greek case study and the policy issues analyzed in this report, there are no higher level policies that hamper the implementation of national scale policies. The majority of the nexus-related policies are fully or partially supported by EU policies as they concern common goals and policy priorities between EU and Greece. On the other hand, Greece adopts EU policies and incorporates the respective goals and instruments in the national legislative framework. As a result broad cooperations have been created working towards the achievement of common goals, e.g.: reduction of GHG emissions, development of a low-carbon economy, promotion of RES, sustainable management of water resources, food safety, etc.

It should be mentioned that in case of lower level policies which are partly supported by higher level policies, the achievement of the Nexus Critical Objectives is not hampered. These policies have been classified in such a way because the respective national policy papers include also other (more specific and more local scale) policies, not contained in the relevant EU documents. In other words, we are talking about national policy papers designed in a national level and regulating issues that refer basically to local and not national scale (NUTS2, NUTS3 or even smaller scale – Additional information not included in EU policy documents). However, they also include more generic information (national level) which is too close with several policy priorities put by EU.

5.4. Formal and informal arrangements adopted to address conflicts, negotiate trade-offs and exploit synergies

In this section, the management of problems arising during the policy implementation phase is investigated. Conflicts, opportunities, trade-offs and synergies are analyzed in order to have a better understanding on the issues concerning policy implementation. Formal and informal arrangements, formal and informal rules/practices as well as enabling and hindering factors are explored, based on the literature and the opinions of stakeholders. Of crucial importance is how such rules, practices and arrangements affect the achievement of the Nexus Critical Objectives.

It should be mentioned that as the focus is on a more practical level, the experience of stakeholders and their expertise was the main source of information reported in this section. Stakeholders identified conflicts and synergies not included in the relevant policy papers and helped us gaining a deeper understanding of the real problems that usually exist when a policy goal or policy instrument is implemented. They also offered information about the establishment of arrangements in order to manage the respective problems and the way such arrangements deal with each of the problems.

The formal and informal arrangements, the type and description of each arrangement, its function, the enabling and limiting factors related to each arrangement as well as the effects of the arrangement for the achievement of the nexus critical objectives are analytically described in Table 32.

Table 32: Formal and informal arrangements

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision making, knowledge sharing, etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of nexus critical objectives
Formal	Collaboration committee between the Ministry of Environment and Energy and the School of Chemical Engineering (NTUA).	Consultation and knowledge sharing concerning the establishment of regional (NUTS2 level) plans for combating climate change impacts.	The committee works effectively during the policy design process on the basis of knowledge exchange (consultation process). There are common goals and interests. Its members cooperate in order to establish policy papers that will turn into implemented policies (transparent government rules). There is a high level of trust among the members of the committee.	This arrangement supports the goals for combating climate change, protecting the quality of atmosphere and increasing the country's adaptation ability against climate change impacts.
	Collaboration between the Athens Labor Unions Organization with several Ministries.	Consultation and knowledge sharing on issues having to do with environmental impacts on employees and laborers (urban environment) – Environmental impacts on working conditions.	The committee works effectively during the policy design process or the assessment of already implemented policies (knowledge exchange / consultation). There is trust among its members who are working towards	This arrangement supports the goals concerning the protection of urban environment, the confrontation of climate change impacts, the protection of atmosphere, the sustainable use of water resources, land use regulations and

			the achievement of common goals. One of its basic missions is the elaboration of transparent policy directions.	energy saving.
	Collaboration committee between the Ministry of Environment and Energy and the Directorate of International Energy Issues (Ministry of Foreign Affairs).	Coordinate decisions and knowledge sharing on issues having to do with the international/ bilateral cooperation of Greece in the energy sector (international energy issues).	The committee is working effectively; it takes serious decisions concerning the design and implementation of energy policies. Common goals, common interests and confidence characterize such cooperation. Exchange of knowledge and expertise on energy issues.	The arrangement supports the goals for energy saving and climate change adaptation.
	Inter-ministerial committee between the Ministry of Environment and Energy, the Ministry of Rural Development and Food and the Ministry of Tourism.	Coordinate decisions and knowledge sharing about land use regulations, infrastructures with visual disturbance in tourist regions and the management of geothermal springs.	The committee is working effectively; it takes serious decisions during the policy design process and aims at the successful implementation of the respective policies (transparent government rules). The cooperation is based on common interests and common perspectives. It aims at the exchange of knowledge and experience. Its members trust each other.	The arrangement supports the goals having to do with the sustainable development of tourism, the development of alternative tourist activities, the sustainable development of agriculture, the establishment of a balanced spatial pattern of development, the regulation of land uses and the sustainable management of natural resources.
	Collaboration committee between the Ministry of Environment and Energy and the	Coordinate decisions and knowledge sharing on issues concerning the management of	The committee is working effectively during the policy design process (exchange of knowledge and	This arrangement supports the goals having to do with the sustainable management of energy resources

	Hellenic Public Power Corporation S.A.	energy resources, the production of electricity and environmental management.	expertise). Sometimes conflicts arise concerning the content of policy documents and the role (responsibilities) of HPPC as a national energy provider but usually a compromise decision is taken as there are common interests and common goals.	and the protection of natural environment.
	Collaboration of the Greek Ombudsman with several public authorities (cross-sectoral arrangement).	Coordinate decisions concerning policy implementation and relative conflicts.	Effective collaboration during the assessment of policy implementation. The collaboration is mainly based on problems reported by citizens during policy implementation. It aims at improving policies that do not “work well”. This refers to possible policy gaps, unexpected results, etc. Knowledge and experience are exploited in order to improve current policies and their implementation.	This arrangement supports the goals having to do with the effective implementation of the nexus-related policies and the problems/conflicts arise during their implementation.
	Collaboration of the School of Mechanical Engineering (NTUA) with the National Council of Energy Strategy.	Coordinate decisions and knowledge sharing on issues having to do with energy policy.	Effective collaboration during the policy design process (knowledge exchange – consultation). Serious decisions are taken and turn into implemented policies	This arrangement supports the goals having to do with the attainment of the national energy goals, the promotion of RES and energy saving.

			(transparent government rules). There are common interests, common goals and trust among the members of the committee.	
	Collaboration of the National Documentation Centre (National H2020 contact point on energy issues) with the General Secretariat of Research and Technology.	Coordinate decisions and knowledge sharing on issues having to do with research and policies in the energy sector.	Effective collaboration concerning energy issues (exchange of experience and expertise). Feedback and knowledge exchange, dissemination of knowledge and results from research programmes and establishment of business and research partnerships. Common interests, common goals and trust among the members of the committee.	This arrangement supports the promotion of energy saving, the promotion of RES and the attainment of the national energy goals.
	Collaboration of the National Cadastre and Mapping Agency S.A. with the Ministry of Environment and Energy.	The National Cadastre and Mapping Agency S.A. has a supportive role (consultant) during the design of land policies.	Effective collaboration. Consultancy and supply of geo-data and geo-information. Trust among the members of the committee.	This arrangement supports the goals having to do with the establishment of a balanced spatial pattern of development and the regulation of land uses.
Informal	Collaboration of the Ministry of Environment and Energy with the Hellenic Association of Photovoltaic Energy Producers (consultant).	Coordinate decisions concerning environmental, financial and legal issues having to do with energy production from PVs.	The coordination is working effectively during the energy policy design process, aiming at the effective implementation of the designed policies. Sometimes conflicts arise (e.g. management	This arrangement supports the achievement of goals for energy production from PVs through the promotion of PVs and the increase of their sharing in the final energy mix. It also supports the goals for combating

			of the amount of electricity produced from PVs) but compromise solutions are found. The committee has common interests and common goals.	climate change.
	Collaboration between Piraeus Bank (consultant) and private individuals (agricultural and energy investors/private initiatives).	Coordinate actions having to do with consultation and funding of agricultural and energy investments.	The coordination works effectively in case the Bank and the investors have the same interests. It fails to work in case of conflicting interests between the two sides.	This arrangement supports the achievement of goals having to do with the sustainable development of agricultural sector, the promotion of RES and energy saving.
	Cooperation among farmers.	Actions having to do with the adopted cultivation practices, certification of agricultural products, funding opportunities, trade of agricultural products, training activities, land use conflicts and water allocation.	Cooperation work effectively in case where farmers trust each other and follow the rules having informally (not mandatory by law) agreed among them. In some cases cooperation don't work because farmers are not willing to follow the "rules" or conflicting interests (e.g. water allocation for irrigation) exist among them.	This arrangement supports the sustainable development of agriculture and the rational use of resources by the agricultural sector.
	Cooperation among the members of the Hellenic Association for Cogeneration of Heat and Power.	Actions having to do with feedback exchange in the sector of cogeneration, scientific and technical support, diffusion of knowledge and expertise.	Cooperation work effectively towards the implementation of policies concerning cogeneration of electricity and heat. Common interests, common goals and trust exist among the	This arrangement supports the goal having to do with the promotion of cogeneration technologies and the adoption of cogeneration systems for the production of electricity and heat.

			members of the committee.	
	Collaboration of Mills of Crete enterprise with farmers and food producers.	Actions having to do with the further development of agricultural and food sectors.	Effective cooperation in the context of policy implementation (agricultural and food policies). Exchange of knowledge and expertise – Consultancy. Common interests and perspectives.	This arrangement supports the goals concerning the sustainable development of agriculture and the safety of food and fodders.
	Cooperation of WWF Greece with several Ministries (Ministry of Environment and Energy, Ministry of Rural Development and Food, etc.).	WWF Greece acts as lobbyist and exerts pressure during the policy design and policy implementation processes. It submits proposals having to do with biodiversity, climate change, Common Agricultural Policy, water policy, land use policies, etc.	Sometimes the cooperation work effectively and the two sides have common interests and common perspectives. Some other times conflicts arise between the two sides and the cooperation meets a dead end.	This arrangement supports the goals having to do with the protection, sustainable management and effective use of all the nexus components.
	Cooperation of Greenpeace Greece with several Ministries (Ministry of Environment and Energy, Ministry of Rural Development and Food, etc.) and municipalities.	Greenpeace Greece acts as lobbyist (campaign group) and exerts pressure during the policy design and policy implementation processes. It submits proposals having to do with energy, agriculture and fishery.	Sometimes the cooperation work effectively and the two sides have common interests and common perspectives. Some other times conflicts arise between the two sides and the cooperation meets a dead end.	This arrangement supports the goals having to do with the promotion of RES, the attainment of the national energy goals, the promotion of energy saving, the sustainable development of agriculture, the protection of plant genetic resources, the rational use of pesticides and the safety of food and fodders.

Based on the information presented in Table 32, we conclude that several collaborations and cooperation have been formed among public organizations, businesses, NGOs, scientific associations and research institutes in order to deal with conflicts, trade-offs and synergies during the policy implementation phase. Several committees promote coordinate actions aiming at confronting problems that arise in a practical level, limiting divergent interests and finding compromising solutions. In some cases the cooperation work effectively and meet success; in some other cases they don't work successfully due to uncompromising discrepancies.

Under the framework of such committees, stakeholders act as consultants, lobbyists or decision makers, depending on their official status and their interests. In this way participative actions are strongly encouraged while, consultancy and transparency during the decision making process are reinforced. Among the practices adopted by the respective committees are: the exploration and use of scientific results, the exchange of knowledge and expertise, the evaluation of policy implementation, the exertion of pressure, the establishment of campaign groups and the development of advocacy.

The enabling and hindering factors that support or hamper the successful outcome of each arrangement are:

- Common/conflicting ends and plans [e.g. between the Ministry of Environment and Energy and the School of Mechanical Engineering (NTUA) there are common ends such as: improving the quality of atmosphere, reducing emissions, promote energy saving, adoption of energy efficient systems, etc.]
- Common/conflicting goals and perspectives (e.g. among farmers usually exist conflicting goals having to do with water allocation issues for covering irrigation needs)
- Common/conflicting needs and interests (e.g. farmers and agri-business have common interests concerning the production of high quality agri-food products)
- Common/conflicting profits (e.g. Piraeus Bank and investors may have bilateral profits through the implementation of sophisticated investments in agricultural and energy / RES sectors)
- Exchange of experience and expertise (in all types of arrangements the exchange of experience and expertise can lead to fruitful discussions and the exploration of compromised solutions)
- Knowledge diffusion (in all types of arrangements knowledge diffusion can reveal new future perspectives and lead to the design of robust policy options)

5.5. Success stories and failures

This section concerns the exploration of success stories and failures regarding the nexus-related policies. Based on the issues studied so far, the literature and the outcomes of the interviews with stakeholders, success stories and failures have been investigated with respect to policy design and policy implementation stages.

Success stories and failures are strongly linked to the arrangements (see section 5.4.) dealing with conflicts and synergies that may be created in a practical level. Also, the factors affecting the outcomes of the respective arrangements are of exceptional importance. From a nexus perspective, most success stories exist among policies referring to the same sector or complementary sectors. On the other hand, failures are detected mainly during the policy implementation stage and concern diverging interests and conflicting goals. Thus, success stories are related to respective success factors while failures are related to failure factors.

In case of the Greek case study, the success stories and failures are briefly presented in Table 33.

Table 33: Success stories and failures

Type of successful policy arrangement	Description	Factors of success, do's
Design of regional plans and regional policies for climate change adaptation: Ministry of Environment and Energy – School of Chemical Engineering (NTUA). The arrangement aims at the exchange of knowledge and expertise. NTUA offers scientific expertise on issues concerning climate change and the Ministry tries to incorporate such expertise in the respective regional plans (expected to be ready in 2018).	Successful formal collaboration for the establishment of regional (NUTS2 level) plans concerning climate change adaptation of the 13 Greek regions, the increase of their resilience against climate change and the adoption of relative mitigation strategies. Emphasis is placed on the exploration of local climate conditions and the vulnerability of each region in order specific policy measures to be taken based on the specific local conditions.	• Sharing of knowledge and expertise • Common interests • Common goals • Trust • Ministry: recognized authority • NTUA: recognized academic and research institute
Arrangements having to do with policies for the protection of urban environment: Several Ministries (mainly the Ministry of Environment and Energy) – Athens Labor Unions Organization (EKA). These arrangements concern the exploration and management of environmental impacts on working conditions in Athens. EKA acts as a consultant on issues having to do with: the impacts of climate change on employees, waste management, quality of atmosphere, land uses, etc. The Ministries try to incorporate such knowledge in the relative policy papers	Successful formal collaboration for the protection of urban environment and the limitation of environmental impacts on employees and laborers (quality of atmosphere, waste management, land uses, water resources management, etc.).	• Sharing of knowledge and expertise • Common interests • Common goals • Trust • Transparent agreements • Relationship having been built over time
Arrangements having to do with the energy sector and especially the coverage of energy needs in Greece: Directorate of International Energy Issues (Ministry of Foreign Affairs) – Ministry of Environment and Energy. This arrangement concerns the management of international energy issues, the management of transboundary energy infrastructures and energy imports in Greece. The two sides co-design relative policies.	Successful formal collaboration focusing on the availability of energy stock, the transboundary energy infrastructures and the management of energy imports.	• Sharing of knowledge and expertise • Common interests • Trust • Leadership and recognized authority • Transparent agreements • Relationship having been built over time
Arrangements having to do with land use policies and	Successful formal collaboration concerning land use by	• Sharing of knowledge and expertise

regulation of land use conflicts: Ministry of Environment and Energy – Ministry of Rural Development and Food – Ministry of Tourism. This arrangement focuses on the management of land use conflicts among the several productive sectors (mainly: agriculture-livestock-tourism-energy). Its main mission is the formal distribution of land and the definition of activities that can be developed in each case.	agricultural, energy and tourist sectors. Also, they focus on the management of protected areas and the management of 'visual disturbances' (landscape).	• Discussing trade-offs in case of conflicting interests • Common interests • Trust • Recognized authorities • Relationship having been built over time
Energy policies having to do with the exploitation of RES for electricity production and the protection of environment: Ministry of Environment and Energy – Hellenic Public Power Corporation S.A.	Successful formal collaboration concerning the involvement of the Hellenic Public Power Corporation S.A. (PPC) in efforts having to do with electricity production from RES (PPC Renewables).	• Sharing of knowledge and expertise • Common interests • Common goals • Recognized authorities
Policies having to do with the attainment of the national energy goals, the promotion of RES and energy saving: School of Mechanical Engineering (NTUA) – National Council of Energy Strategy.	Successful formal collaboration concerning the design of energy-effective policies and the establishment of a more environmental-friendly energy mix. It places emphasis on the promotion of plans and the design of regulations having to do with energy saving in buildings.	• Sharing of knowledge and expertise • Common interests • Common goals • Recognized authorities • Trust
Policies focusing on research issues for the energy sector: National Documentation Centre (National H2020 contact point on energy issues) – General Secretariat of Research and Technology.	Successful formal collaboration on issues having to do with policies concerning the future of the energy sector and the dissemination of relative research results. Its main scope is to disseminate knowledge and research outcomes concerning the energy sector.	• Sharing of knowledge and expertise • Common interests • Common goals • Trust • Recognized authorities • Relationship having been built over time
Land use policies in relation to the development of the national Cadastre: Ministry of Environment and Energy – National Cadastre and Mapping Agency S.A.	Successful formal collaboration focusing on consultancy actions and supply of geo-data and geo-information.	• Sharing of knowledge and expertise • Common interests • Trust • Ministry: recognized authority • National Cadastre and Mapping Agency: reputable public authority, responsible for the development of the Greek Cadastre
Policies concerning the promotion and development of PVs: Ministry of Environment and Energy – Hellenic Association of	Successful informal collaboration on policy issues having to do with energy production from PVs, the management of the produced	• Sharing of knowledge and expertise • Common interests • Discussing trade-offs in case of conflicting interests

Photovoltaic Energy Producers.	amount of energy and its diffusion to the national electricity distribution system. The association has proposed specific methodologies for estimating the amounts of electricity produced by PVs and their possible uses.	
Policy implementation concerning investments in agricultural and energy sectors: Piraeus Bank – Private individuals. Economic arrangements having to do with the implementation of investments on the basis of existing policies.	Successful informal collaboration concerning the implementation of agricultural and energy policies for making investments in the agricultural and energy sectors.	• Sharing of knowledge and expertise • Common interests • Common goals • Trust • Piraeus Bank: one of the leading banks in Greece
Implementation of agricultural policies having to do with water allocation, agricultural training, certification and trade of agricultural products: Arrangements among farmers.	Successful informal collaboration among farmers concerning either the implementation of the formal agricultural policy or agreements among them.	• Common interests • Common goals • Common perspectives
Implementation of policies having to do with cogeneration: members of the Hellenic Association for Cogeneration of Heat and Power. Arrangement for the promotion of cogeneration and the adoption of cogeneration systems for energy production by the several productive sectors.	Successful informal collaboration having to do with the promotion and use of cogeneration technologies for energy production (mainly from the industrial and tertiary sector).	• Sharing of knowledge and expertise • Common interests • Common goals • Trust
Implementation of agricultural policy and policy concerning food and fodder security: Mills of Crete – Farmers. Arrangements having to do with the processing and quality of agri-food products.	Successful informal collaboration focusing on the production of safe, high quality and certified agricultural products.	• Sharing of knowledge and expertise • Common interests • Common goals • Relationship having been built over time
Design of policies concerning the protection of biodiversity and wetlands: Ministry of Environment and Energy – WWF Greece.	Successful informal collaboration focusing on the protection of biodiversity and wetlands. Indicative examples: Participation in the consultation for the management of Greek river basins, cooperation during the design of law for the protection of biodiversity and the Presidential Decree for the management of wetlands.	• Sharing of knowledge and expertise • Common interests • Common goals • Ministry: recognized authority • WWF Greece: recognized NGO
Design of policies concerning the establishment of energy communities: Ministry of Environment and Energy –	Successful informal collaboration on issues focusing on energy saving, energy production and energy	• Sharing of knowledge and expertise • Common interests • Common goals

Greenpeace Greece.	consumption in small communities.	• Ministry: recognized authority • Greenpeace Greece: recognized NGO
Implementation of policies concerning the production of high quality fodders and the protection of fisheries: Greenpeace Greece – Farmers/Fishermen.	Successful informal collaboration concerning the cultivation of traditional fodders and the development of sustainable fishery for the protection of sea populations.	• Sharing of knowledge and expertise • Common interests • Common goals • Ministry: recognized authority • Greenpeace Greece: recognized NGO
Type of unsuccessful policy arrangement	**Description**	**Factors of failure, don'ts**
Energy policies having to do with electricity production from conventional energy sources (mainly lignite) and the management of lignite mines: Ministry of Environment and Energy – Hellenic Public Power Corporation S.A.	Unsuccessful formal collaboration as, the two sides don't agree in several issues about the share of lignite in the internal electricity market and the management of mines. Discussions are in progress in order to explore compromise solutions.	• Conflicting interests • Conflicting perspectives • Divergences concerning the expecting profits
Policy implementation concerning investments in agricultural and energy sectors: Piraeus Bank – Private individuals.	Unsuccessful informal collaborations in case where the two sides have not common perspectives or doesn't agree in the framework of a funding scheme.	• Conflicting interests • Conflicting goals • Divergences concerning the expecting profits
Water allocation policies: Farmers.	Unsuccessful informal collaboration on issues concerning water allocation for irrigation purposes. As a result there are problems with water availability and some farmers do not have available amounts of water in order to cover irrigation needs.	• Conflicting interests • Conflicting profits
Land use regulation policies: Farmers – Shepherds.	Unsuccessful informal collaboration on issues concerning land uses by the agricultural sector and the sector of livestock. As a result, in some cases agricultural land is used as pasture and crops are destroyed.	• Conflicting interests • Conflicting goals
Design of several environmental policies concerning the nexus components: Ministry of Environment and Energy – WWF Greece.	Unsuccessful informal collaboration having to do with the sustainable management of natural resources and the protection of natural environment.	• Conflicting interests • Conflicting goals • Conflicting perspectives
Design of several environmental policies concerning the nexus components: Ministry of Environment and Energy – Greenpeace Greece.	Unsuccessful informal collaboration having to do with the sustainable management of natural resources and the protection of natural environment.	• Conflicting interests • Conflicting goals • Conflicting perspectives

Installation of PVs on high productivity agricultural land: Ministry of Environment and Energy – Farmers.	Unsuccessful informal collaboration as, farmers are willing to re-activate a previous law (already abolished) that permitted the installation of PVs in 1% of the total high productivity agricultural land. Farmers want to use such percent of land for energy production but the Ministry disagrees. Discussions are in progress in order to find a compromise solution.	• Conflicting interests • Conflicting goals • Conflicting perspectives
Policies concerning the exploitation and management of geothermal springs: Ministry of Environment and Energy – Ministry of Tourism.	Although the exploitation of geothermal springs (e.g. energy production, alternative tourism) depends on the enthalpy, the two Ministries do not agree on the management of geothermal springs. Discussions are in progress in order to find a solution based on the possible exploitation of geothermal springs according to the enthalpy.	• Conflicting interests • Conflicting goals
Water allocation for irrigation and energy production: Farmers – Hellenic Public Power Corporation S.A. (PPC).	Unsuccessful informal collaboration on water allocation issues. Farmers need water for irrigation purposes and PPC needs water for electricity production. The problem has not been addressed yet (deadlock).	• Conflicting interests • Conflicting goals • Conflicting perspectives
Implementation of policies regulating the use of pesticides: Ministry of Environment and Energy - Farmers.	Unsuccessful informal collaboration as, farmers use pesticides in order to protect cultivations from insects and weeds as well as to increase productivity. On the other side, the Ministry of Environment and Energy places emphasis on the protection of water resources and soil from pesticides. The problem has not been addressed yet as it is difficult to monitor the effects of pesticides. However, efforts for detecting possible sources of pollution are in progress.	• Conflicting interests • Conflicting goals • Conflicting perspectives

In Table 33, a representative number of successful and unsuccessful outcomes and policy arrangements have been described.
Success stories have to do mainly with:

- The establishment of regional plans (NUTS 2 level) that will support the country's adaptation ability and resilience against climate change. Specific characteristics of each region as well as its vulnerability and its particular climate conditions are explored in order specific policy measures for each NUTS2 region to be defined. Such regional plans are expected to be completed by the end of 2018.

- The protection of urban environment and the limitation of environmental impacts on employees. The Athens Labor Unions Organization has established synergies with several Ministries trying to incorporate issues related to environmental impacts on working conditions into the respective policy documents.
- The availability of energy stock and issues related to energy imports. Transboundary energy infrastructures serving energy imports are under construction and successful arrangements between the Ministry of Environment and Energy and the Ministry of Foreign Affairs have been done towards this direction.
- Land use regulations between the agricultural and tourist sectors. Progress has already been done but the implementation of the national Cadastre will contribute decisively to the management of conflicts between the two sectors.
- Electricity production from RES and RES increase in the national energy mix. Greece is very close to the attainment of the national energy goals as RES are constantly adopted for electricity production. Especially in case of PVs the goals have already been achieved.
- Design and implementation of investments in the energy and agricultural sectors. Piraeus Bank is a leading Greek bank that funds such kind of investments and gives priority to green banking, agricultural innovation and exploitation of RES for energy production.
- Production, processing and trade of high quality / certified agricultural products. Agri-businesses in cooperation with farmers place emphasis on food and fodder safety and promote Greek agricultural products. A remarkable number of producers export their products (e.g. olive oil) in international markets.
- Promotion of cogeneration technologies. Cogeneration technologies have not been broadly adopted in Greece. However, it is a main policy goal to be achieved in the future. The Ministry of Environment and Energy as well as the Hellenic Association for Cogeneration of Heat and Power (HACHP) are working towards this direction. Especially the HACHP provides knowledge; expertise; technical, financial, legal and environmental information.
- Protection of biodiversity and wetlands. Apart from the Ministry of Environment and Energy, WWF Greece had an active role during the design of policies for the sustainable management of biodiversity and wetlands. Moreover, the WFD 2000/60/EC is fully implemented in Greece and consequently the respective regulations concerning the protection of aquatic ecosystems.
- Energy saving, energy production and energy consumption in small communities (energy communities). Greenpeace Greece together with the Ministry of Environment and Energy designed policies regarding the creation of "energy communities". The relative law was published about a month ago and it promotes energy autonomy based on RES in small communities.
- Cultivation of traditional fodders. The cultivation of traditional crops and the production of traditional agri-food products constitute a dominant trend in Greece. Farmers together with Greenpeace Greece promote the production of traditional agri-foods and fodders.
- Sustainable fishery / Protection of sea populations. The development of sustainable fishery for the protection of sea populations is one of the main priorities of Greenpeace Greece which works towards this direction with the fishermen of the Aegean islands.

The success of the aforementioned policy arrangements is mainly based on factors having to do with the perspectives of the involved stakeholders. Such factors are: sharing of knowledge and expertise, common interests, common goals, discussion of trade-offs in case where

conflicts exist, bilateral trust, recognition and reputation of the respective organizations and common future perspectives.
Regarding failures, they have to do with:
- The share of lignite in the internal electricity market and the management of lignite mines. A basic conflict between the Ministry of Environment and Energy and the PPC concerns the management of lignite mines and the production of electricity from both conventional and renewable energy sources. PPC has profits through the exploitation of lignite mines and the processing of lignite and coal for electricity production. On the other hand, the Ministry of Environment and Energy promotes policies having to do with electricity production from RES and the reduction of GHG emissions.
- Unsuccessful investments in the agricultural and energy sectors.
- Water allocation (irrigation / domestic use / energy production / environmental flow). Farmers, PPC, municipalities and the Ministry of Environment and Energy are involved in conflicts concerning water allocation for covering water needs in several regions in Greece.
- Land use conflicts between the agricultural sector and the sector of livestock. Such land use conflicts exist because of the lack of land use regulations. As a result, in many cases there are no explicit boundaries between pastures and agricultural land.
- Installation of PVs in high-productivity agricultural land. Farmers are willing to combine their agricultural activities with activities having to do with energy production from PVs. Thus, they ask for the re-activation of an abolished law that permitted the installation of PVs in high-productivity agricultural land (max: 1% of the total area). The Ministry of Environment and Energy and the Ministry of Agriculture and Food provide several ambiguities in order to protect agricultural land and agricultural production.
- Management of geothermal springs. The Ministry of Tourism wants to exploit geothermal springs for the development of touristic activities while the Ministry of Environment and Energy wants to exploit such springs for energy production. As the possible exploitation of geothermal springs depends on the enthalpy, the issue is under discussion in order a compromised decision to be taken.
- Impacts of pesticides on water quality and quality of soil. Efforts for detecting possible sources of pollution are in progress but conflicts between farmers and the Ministry of Environment and Energy exist with respect to the rational use of pesticides.
- Lack of synergies between land policies (policies having mainly to do with spatial planning) and economic-developmental policies. The absence of land use regulations is linked to the relative policy gaps between spatial planning and the distribution of economic activities in space. As a consequence, there is not a land use policy framework regulating the development and spatial distribution of the several economic activities. National Cadastre will set the base for solving such problems.

The main factors that led to such failures are: several conflicting interests, conflicting future perspectives, divergences concerning the expecting profits, conflicting goals and the absence of a common end.

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Latvian case study
Policy analysis

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Contents

Executive summary

Low-carbon development is the key focus of the Latvia case study. According to the goals and priorities set by national policy documents, Latvia is seeking for possibilities to increase sustainable use of renewable energy sources, reduce energy dependency from imported fuels, and ensure economic development while reducing greenhouse gas emissions. Energy, climate, agriculture & food production, forestry, land use, water along with environmental/nature protection are the key policy sectors of concern in this case study.

This paper gives an overview on main socio-economic context and provides a description of main stakeholders, indicating their role, power, and interest structure per each relevant policy sector. The paper summarises the key policy objectives, specific policy instruments and reference documents (national laws and Cabinet of Ministers regulations) in each policy sector. The paper presents the assessment of policy coherence as well as formal and informal arrangements established to address conflicts, negotiate trade-offs, and exploit synergies. It also gives a brief overview on success stories and failures in relation to policy implementation in practice.

Acronyms

AIEA	Auctioning Instrument of Emission Allowances
BEF	Association "Baltic Environmental Forum-Latvia"
CCFI	Climate Change Financial Instrument
CHP	Combined Heat and Power
CSB	Central Statistical Bureau
CSCC	Cross-Sectoral Coordination Centre
EAB	Environmental Advisory Board
EAFRD	European Agricultural Fund for Rural Development
ETS	Emission Trading System
EU	European Union
FP	Association "Farmers Parliament"
GDP	Gross domestic product
GHG	Greenhouse gasses
GL	Association "Green Liberty"
HPP	Hydropower Plant
IARE	Institute of Agricultural Resources and Economics
IDAL	Investment and Development Agency of Latvia

IPE	Institute of Physical Energetics
LALRG	Latvian Association of Local and Regional Government
Latvenergo	JSC "Latvenergo"
LCCI	Latvian Chamber of Commerce and Industry
LCS	Latvian Council of Science
LEGMC	Latvian Environment, Geology, and Meteorology Centre
LFN	Association "Latvian Fund for Nature"
LREF	Latvian Renewable Energy Federation
LSF	JSC "Latvia's State Forests"
LU	University of Latvia
LUA	**Latvia University of Life Sciences and Technologies** (previously known as Latvia University of Agriculture)
LULUCF	Land use, land-use change, and forestry
MEPRD	Ministry of Environmental Protection and Regional Development
MK	Regulations of the Cabinet of Ministers
MoAgriculture	Ministry of Agriculture
MoEconomics	Ministry of Economics
NCA	Nature Conservation Agency
NCOs	Nexus Critical Objectives
NGO	Non-governmental Organisation
NRDP	National Rural Development Program
R&D	Research and Development
R&D	Research and development
RES	Renewable energy sources
RSS	Rural Support Service
RTU	Riga Technical University
SES	State Environmental Service
SFS	State Forest Service
Silava	Latvian State Forestry Research Institute "Silava"
SMEs	Small and Medium Enterprises
SRDA	State Regional Development Agency

Introduction

The Latvia case study is focusing on low-carbon development of the country, considering interlinkages with the Nexus components - climate, water, energy, land use, and food. In Latvia, low carbon development is getting an increasing attention on various policy levels along with elaboration of the "National strategy on low-carbon development 2050" (due for the end of 2018). Low carbon development calls for reduction of greenhouse gas (particularly CO_2) emissions as well as maintaining or even increasing CO_2 sequestration at the same time having positive environmental, economic, and social impacts. Potential directions of low-carbon development in Latvia comprise sustainable energy, comprehensive energy efficiency; resource efficient and environmentally friendly transport; sustainable land management, consumption, and production; research and innovation on low carbon technologies[1].

Latvia has a high potential for renewable energy but remains largely dependent on imported fossil fuels and electricity. Thus, energy security is of a key concern and ensuring the energy supply, competitiveness, energy efficiency and the use of renewable energy is the target set for 2030. At the same time along with significant reduction of total GHG emissions since 1995, the current level of GHG emissions in Latvia remains high (539 890 $tCO_{2\ eq}$/billion EUR in 2014) and is between the highest values in the European Union. The current policy sets the national target to limit total GHG emissions to 12.19 Mt $CO_{2\ eq}$ in 2020[2]. The new policy goal for the national economy to be reached already by 2030 is increasing the GDP at the same time reducing or not increasing GHG emissions. The envisaged target for Latvia to be reached by 2050 is reduction of GHG emissions for at least 80% in comparison to 1990. The intermediate target to be reached by 2040 is increasing the carbon sequestration fully covering the total amount of anthropogenic GHG emissions of the country and achieving the carbon neutrality[3].

Acknowledging the need to increase the use of natural resources, a draft national strategy "Bio-economy strategy 2030" has been elaborated and submitted to Cabinet of Ministers on 3 August 2017. According to the strategy, the priority directions comprise promotion and maintenance of employment level in the branches of bioeconomy (e.g., agriculture, forestry, fishery, food production), increasing the added value of products of bioeconomy, increasing the export value of products of bioeconomy branches. Substitution of fossil fuels with bio-resources is one of the main goals of the strategy.

Increasing the use of bio-resources and renewable energy sources (RES) in general rises several questions of concern e.g., harvesting of biomass puts a pressure on forestry and growing energy plants compete with crops and food production. Growing energy plants require large amounts of fertilizers resulting in a negative impact on water quality and causing eutrophication of water bodies thus posing a risk to climate change adaptation. Climate change has an impact on water resources e.g., increasing autumn and winter precipitation generates higher flood risks. During these periods soils in Latvia suffer from excessive moisture. On the other hand, periods of droughts in summer have an impact on use of

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[1] http://ilgtspejigaattistiba.saeima.lv/attachments/article/719/2017-03-28_OMAstratUnPielagStrat_IPruse.pdf
[2] The Guidelines for the Development of Energy Sector for 2016-2020
[3] I. Prūse (2017), Presentation on developments related to low carbon development strategy 2050 and climate change adaptation strategy 2030 (in Latvian), http://ilgtspejigaattistiba.saeima.lv/attachments/article/719/2017-03-28_OMAstratUnPielagStrat_IPruse.pdf

hydropower, particularly for small scale applications, as well as on agriculture. Thus, preparedness to resist climate change and reduce adverse effects is becoming of high importance for national economy.

The Latvia case study covers mainly four sectors of the national economy – energy, agriculture, forestry, and industry. Along with reduction of GHG emissions and increase of economic development of the country the case study will take into consideration the impacts on biodiversity, land use and water resources.

The case study will seek to develop the pathways for:

- increasing the use of renewable energy sources for electricity and heat production in centralized systems;
- increasing the production and application of biofuels;
- widening the production of electricity, heat, and biofuels in decentralized installations;
- optimizing climate change adaptation measures with respect to fluctuations of precipitation and water regime.

The key research questions of the case study are:

- is it possible to enlarge energy self-supply, by widening the use of renewable energy sources in the country?
- which trade-offs would be acceptable and what are the possible solutions towards low carbon economy?

The case study will also seek for solutions helping the decision makers to decide on climate change adaptation measures dealing with impacts caused by seasonal increase of precipitation and fluctuation of water regime.

1. Socio-economic context

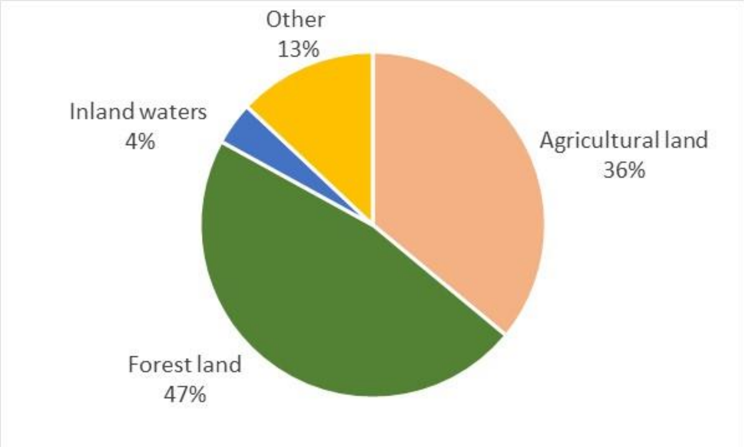
The Republic of Latvia lies in Northern Europe, on the eastern shores of the Baltic Sea. It is bordering with Estonia (to the north), Russian Federation (to the east), Belarus (to the southeast) and with Lithuania (to the south). The total length of its maritime boundary is 498 km. Most of Latvia's territory is less than 100 m above sea level.

Land coverage

Latvia covers the area of 64 573 sq.km - agricultural land constitutes 23 358 sq.km, forest land is 30 662 sq.km, and inland waters – 2460 sq.km (Figure 1.1.). Nationally protected areas cover 12790 sq.km[4] (19.8% of the whole country).

[4] Central Statistical Bureau of Latvia

Figure 1.1. Territorial coverage of Latvia by type of land use (%)



Population

According to the national statistics referring to the year 2015, during the last five years, demographic indicators are improving slightly (the total population in 2015 has reached 1 986 096 people), the unemployment rate has fallen below 10 %, the average gross wages and salaries in Latvia reach EUR 829. It has been evaluated that due to lack of well paid jobs the emigration level between the years 2000 and 2016 has reached 270 000 inhabitants[5] (mostly young adults) thus putting additional stress on social development of the country.

National economy

The total gross domestic product (GDP), official exchange rate in 2015 was ca. 24 billion euro; and ca, 12 thousand euro, per capita.[6] The economic structure of Latvia is based on services, providing the biggest contribution to the national GDP, industry, and agriculture. Exports contribute to more than half of GDP. In 2015 Latvia mostly exported wood and wood products, wood charcoal, electrical machinery, and equipment, as well as mineral products. Due to its geographical location, transit services are highly-developed, along with timber and wood-processing, agriculture and food products, and manufacturing of machinery and electronics industries[7]. During the year 2015 the largest growth in manufacturing was recorded in manufacture of basic metals, computer, electronic and optical products, in manufacture of furniture and in wood processing. Latvia joined the World Trade Organization in 1999, the euro zone in 2014 and the OECD in 2016.

Energy

Latvia is not rich in local energy sources and is dependent on imported energy. Nevertheless, the dependence on imported energy resources reduced from 63.9% in 2005 to 40.6 % in 2014 due to the

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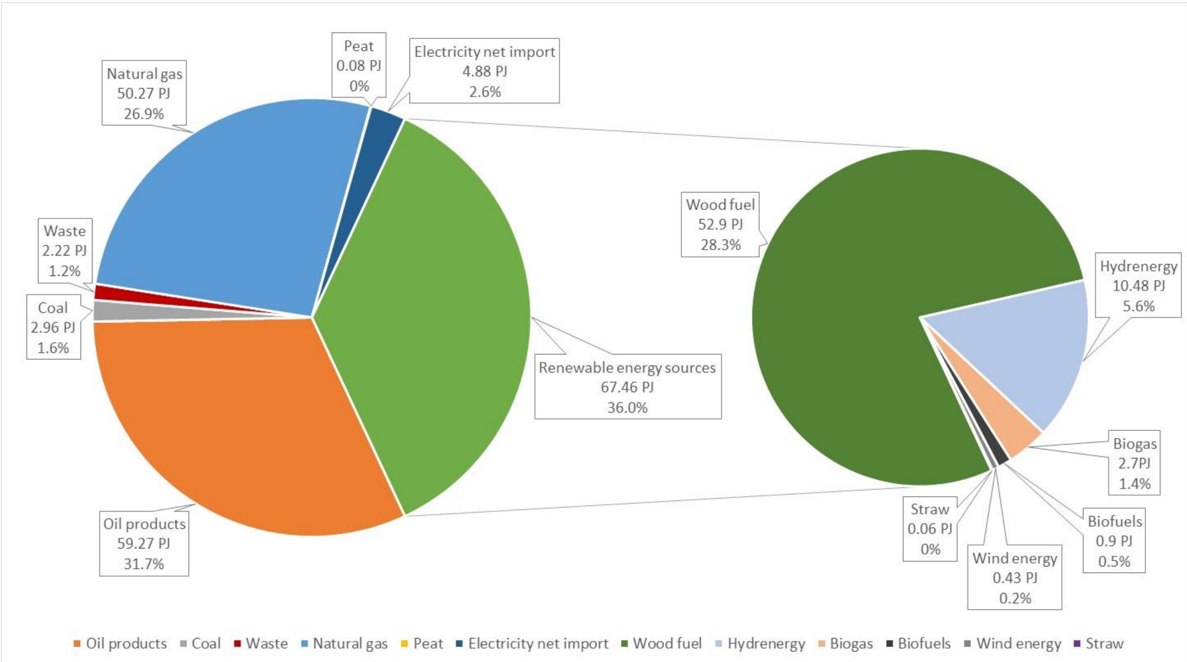
[5] Central Statistical Bureau of Latvia (IBG01. Long term migration of inhabitants)
[6] Central Statistical Bureau of Latvia
[7] IndexMundi, Latvia Economy Profile 2017, www.indexmundi.com/latvia/economy_profile.html

increased gross consumption of renewable energy sources. Renewable energy sources (RES), particularly wood fuels and hydro energy, along with the oil products and natural gas imported from various countries play the most important role in energy balance of Latvia. The remaining share in the primary energy structure of Latvia is comprised by electricity import, peat, coal, and waste (Figure 1.2.).

Latvia has the second highest share of RES in the energy consumption in the EU; in 2014 Latvian indicator constituted 38.7 % (EU average – 16.0 %)[8]. Latvia is rich in forests (forests[9] covered 3260 th. ha in 2014)[10] and respectively wood fuel is an important local fuel used in centralized, local, and individual heat supply, as well as in co-generation. It is estimated that the amount of biomass used in energy sector will increase, although in general, significant changes in primary energy structure are not envisaged until 2020[11].

Figure 1.2. Consumption of primary energy sources In Latvia in 2013 (PJ, %)[12]



Latvia has suitable circumstances for use of hydropower. The biggest share of electricity is produced in 3 hydropower plants (HPPs) installed on the Daugava River (HPPs ensure ca. 40% of electricity consumption). During the recent years, installed electrical capacity of hydropower plants has

[8] http://www.csb.gov.lv/en/notikumi/consumption-renewable-energy-resources-2015-44050.html
[9] Forest: An ecosystem in all stages of its development, dominated by trees, the height of which at the location may reach at least five metres and the present or potential tree crown cover accounts for at least 20% of the stand area.
[10] Central Statistical Bureau of Latvia
[11] The Guidelines for the Development of Energy Sector for 2016-2020
[12] The Guidelines for the Development of Energy Sector for 2016-2020

not changed significantly while wind power plants and combined heat and power (CHP) plants using renewable resources has increased notably.13 The share of solar power in the total energy balance is negligible mostly due to high initial investment costs in technologies. The total share of RES is increasing, nevertheless is has been estimated that further efforts are required to achieve the target of 40% set by the Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC14.

[13] http://www.csb.gov.lv/en/notikumi/consumption-renewable-energy-resources-2015-44050.html
[14] Ecologic Institute, Eclareon (2013), Assessment of Climate change policies in the context of the European semester. Country report: Latvia, https://ec.europa.eu/clima/sites/clima/files/strategies/progress/reporting/docs/lv_2014_en.pdf

2. Mapping of stakeholders

This chapter includes description of stakeholders, their role, power, and interest structure per each relevant policy sector – Energy, Climate, Agriculture, Forestry, Land use, Water, Environmental/Nature protection, and Food production (see Tables 2.1 – 2.8). The chapter also provides a map of relevant stakeholders and relationships.

Table 2.1. The role, power and interest of the Ministry of Environmental Protection and Regional Development of the Republic of Latvia and its supervised institutions

Ministry of Environmental Protection and Regional Development of the Republic of Latvia (MEPRD)		
Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder. MEPRD is responsible for implementing policy in three areas: protection of environment, regional development, and information and information and communication technologies. In environmental protection, the Ministry deals with establishment of prerequisites and conditions for nature conservation, clean environment and ensures that natural resources are used effectively and in sustainable manner.
Stakeholders' power and its source	Formal power	Design of policy on environmental protection, incl., improvement of environmental quality, nature protection, preservation and prudent use of natural resources, climate policy, environmental investments, hydrometeorology, use of subterranean depth; regional development; development of municipality system; spatial development planning, incl., landscape planning; land management. MEPRD supervised institutions: • State Environmental Service (SES) - to ensure compliance of implementation of legislation framework in environmental protection and natural resources • Administration of Latvian Environmental Protection Fund – supervises and administrates the expenditure of the state budget program funding; resources are comprised by a set allocation from the general revenue of the main state budget stipulated by the law "On natural resource tax" (since 14.09.1995). • Environment State Bureau – carries out EIA of proposed activities and planning documents, revises claim and complains and takes decision in the cases referred to in the environmental legislation • Nature Conservation Agency (NCA) – ensures implementation of unified nature protection policy in Latvia • Latvian Institute of Aquatic Ecology –small scientific institute dedicated to basic and applied research on ecology and environmental problems in the Baltic Sea.

		• **State Regional Development Agency** (SRDA) – a national regulatory authority promoting regional development. MEPRD supervised companies: • **State limited liability company "Latvian Environment, Geology and Meteorology Centre"** (LEGMC) – to collect and process environmental information, monitoring programs, implement the State policy in domains of geology, meteorology, climatology, hydrology, air quality (incl., cross-border air pollution) • Limited liability company "State Enterprise Latvian Environmental Investment Fund" – to attract domestic and foreign funding and grant loans to municipal and private entities to implement environmental protection projects
	Informal power	Consultancy on cross-sectoral policy designation and shared responsibility implementation (e.g., agricultural pollution of soil and water resources with nitrates, energy policy). Provides information to public on sectoral policy, consultancy with NGOs in the decision-making process, promotes social dialogue and promotes participation of stakeholders.
	Source of power	Legal public authority (Institution of Direct Administration, Provisions by CM Regulations Nr.233, 29.03.2011).
Stakeholders' interests		✓ Water policy (very strong interest): Policy maker on water resources, protection ✓ Energy policies (strong interest): Limited on issues concerning emission ceilings, emission targets ✓ Agriculture and food policies (strong interest): On issues concerning pollution, nature protection ✓ Land use policies (very strong interest): Policy maker on land use regulations, regional development ✓ Climate policy (very strong interest): Policy maker on climate change mitigation and adaptation, and emission trading ✓ Forestry policy (strong interest): On issues concerning CO_2 sequestration, nature protection ✓ Nature policy (very strong interest): Policy maker on protection of species and habitats, nature territories

Table 2.2. The role, power, and interest of the of Economics of the Republic of Latvia and its supervised institutions

Ministry of Economics of the Republic of Latvia (MoEconomics)		
Dimensions	Sub-dimension	Description

Stakeholders' role		Public stakeholder: leading state administrative institution in the field of economic policy formation in Latvia. MoEconomics is responsible for development and implementation of economic structural policy, industrial policy, energy policy, foreign economic policy, domestic market (goods and services) policy, commercial activity, competitiveness and technology development policy, consumers' rights protection policy, building and housing policy.
Stakeholders' power and its source	Formal power	Design of economic policy, design and implementation of policy in these sectors: industry, tourism, energy, building/ construction, and trade. MoEconomics supervised institutions: • Investment and Development Agency of Latvia (IDAL) • Central Statistical Bureau (CSB) • Consumer Rights Protection Centre Joint stock companies: • Privatization Agency • JSC "Latvenergo" • Latvian Guarantee Agency • SC "Latvijas gaze" • SC "Rīgas siltums"
	Informal power	Provides information to public on sectoral policy, consultancy with NGOs in the decision-making process, promotes social dialogue and promotes participation of stakeholders.
	Source of power	Legal public authority (Institution of Direct Administration, Provisions by CM Regulations Nr.271, 23.03.2010).
Stakeholders' interests		✓ Water policy (weak interest) ✓ Energy policies (very strong interest): Policy maker on energy production, biofuels, renewable energy ✓ Agriculture and food (some interest): Limited to availability of resources to industry ✓ Land use policies (some interest): Limited to siting of industrial production units ✓ Climate policy (some interest): Limited to investment support for RES ✓ Forestry policy (some interest): Limited to availability of resources for industry ✓ Nature protection policy (weak interest)

Table 2.3. The role, power and interest of the Ministry of Agriculture and its supervised institutions

Ministry of Agriculture (MoAgriculture)

Dimensions	Sub-dimension	Description
Stakeholders' role		Public stakeholder: responsible for Latvia`s agriculture, forestry, fisheries, and rural development.
Stakeholders' power and its source	Formal power	Design of agricultural, forestry and fisheries policy. Organize and coordinate policy implementation in sectors of agriculture, forestry, and fisheries. Institutions subordinate to the MoAgriculture: • Rural Support Service (RSS) • Food and Veterinary Service • State Plant Protection Service • State Forestry Service (SFS) • Agricultural Data Center • State Technical Monitoring Agency • Latvia University of Agriculture (LUA) • Latvian State Institute of Agrarian Economics (IARE) • Latvian State Forestry Research Institute "Silava" (Silava) • National Research Institute of "Food Safety, Animal Health and Environment" MoAgriculture is a public shareholder in companies: • State Joint Stock Company "Latvian State Forests" (LSF) • State limited company "Ministry of Agriculture, Real Estate" • State limited company "Meliorprojekts" • Public limited company "Latvian Rural Advisory and Training Centre"
	Informal power	According to competencies participate in development of cross-sectoral policy (e.g., climate change and LULUCF, sustainable use of renewable energy sources (biomass from forestry and agriculture), management policy of forestry and agricultural land (incl., melioration)). Provides information to public on sectoral policy, consultancy with NGOs in the decision making process, promotes social dialogue and promotes participation of stakeholders.
	Source of power	Legal public authority (Institution of Direct Administration, Provisions by CM Regulations Nr.245, 29.04.2003).
Stakeholders' interests		✓ Water policy (some interest): In context of pollution from agriculture, forests ✓ Energy policies (some interest): In context of biomass as an energy source ✓ Agriculture and food (very strong interest): Policy maker ✓ Land use policies (some interest): In context of rural development ✓ Climate policy (strong interest): In context of LULUCF and CO_2

		sequestration ✓ Forestry policy (very strong interest): Policy maker ✓ Nature protection policy (strong interest): In context to maintenance of semi-natural grasslands

Table 2.4. The role, power, and interest of the Latvian Association of Local and Regional Government

Latvian Association of Local and Regional Government (LALRG)		
Dimensions	Sub-dimension	Description
Stakeholders' role		A public organization associating local governments of the Republic of Latvia on voluntary basis; functions as a representative, advocate and advisor of the local governments in Latvia and Europe.
Stakeholders' power and its source	Formal power	Represent interests of LALRG and its members and to protect their rights at the State authority and central government; to develop the position LALRG on Latvian local government policy in accordance with suggestions from local governments, their associations and unions. Developing policies and drafting opinions by the permanent committees: • Finance and Economy – issues on municipal development • Education and Culture • Social and Health issues • Regional development and cooperation • Technical issues
	Informal power	Implemented the principle of collegial management - to strengthen local democracy and the administrative capacity of local governments. Consultation of lobbyist to understand needs of local governments; promote cooperation, provide information, organize training for local governments.
	Source of power	Based on the law "On Self-Governments" (Art.96), the LALRG has authority to represent local governments in negotiations with the Cabinet of Ministers (as the LALRG associates more than a half of all types of local governments (118 are members out of 119 Local governments in Latvia).
Stakeholders' interests		✓ Water policy (strong interest): In context of municipal development ✓ Energy policies (strong interest): In context of municipal development ✓ Agriculture and food (strong interest): In context of municipal development ✓ Land use policies (strong interest): In context of municipal development

		✓ Climate policy (some interest): In context of municipal development ✓ Forestry policy (strong interest): In context of municipal development ✓ Nature protection policy (some interest): In context of municipal development

Table 2.5. The role, power and interest of the Latvian Chamber of Commerce and Industry

Latvian Chamber of Commerce and Industry (LCCI)		
Dimensions	Sub-dimension	Description
Stakeholders' role		A voluntary, politically independent organization uniting micro, small, medium and large-sized companies from all regions an all economic sectors in Latvia. Represents the interests of entrepreneurs in state and regional institutions, and offers services so as to ensure Latvia has excellent companies in an excellent business environment. Work in three areas: business environment, competitiveness of the companies, and export.
Stakeholders' power and its source	Formal power	Organized lobby group for representation of interests of LCCI members in public and municipal institutions: participates in development of policy planning documents and legal acts, and in discussions on their objectives and contexts. Participates and represent interest of LCCI at: (i) meeting of the Cabinet and Parliament committees, (ii) Prime Ministers Consultative Council, (iii) the National Economy Council.
	Informal power	Summarizes information provided by members and assess their needs; organizes meetings with politicians and officials; organizes public relations campaigns, in order to achieve objectives defined in LCCI Policy guidelines. LCCI is governments partner in economic matters.
	Source of power	LCCI is the largest non-governmental organization of businessmen, uniting individual companies, industry associations, city business clubs, and other businessmen unions.
Stakeholders' interests		✓ Water policy (weak interest) ✓ Energy policies (strong interest): On energy production, economically reasonable energy efficiency, sustainable energy costs (promoting competitiveness of entrepreneurs), use of local resources in energy production ✓ Agriculture and food (some interest): Limited to use of agricultural land as a valuable resource ✓ Land use policies (some interest): Limited to issues concerning

		availability of territories for industry, ✓ Climate policy (weak interest) ✓ Forestry policies (some interest): Limited to availability of local resources for industry ✓ Nature protection policy (weak interest)

Table 2.6. The role, power, and interest of the Cross-Sectoral Coordination Centre Republic of Latvia

Cross-Sectoral Coordination Centre Republic of Latvia (CSCC)		
Dimensions	Sub-dimension	Description
Stakeholders' role		CSCC is the leading institution in national development planning and coordination in Latvia. It is responsible for developing and monitoring the national development planning documents, and implementation of such documents in relation to the EU. CSCC performs analytical tasks assigned by the Prime Minister and Prime Minister`s Office, and monitoring of sectoral policies.
Stakeholders' power and its source	Formal power	CSCC is under direct authority of the Prime Minister of the Republic of Latvia.
	Informal power	Sees essential to provide opportunity for stakeholders (incl., NGOs, institutions, community groups) to participate in the policy-making process. Open for cooperation with wide range of stakeholders, encourages to participate in the policy making process. Informs the society and proactively explains development planning process. Interests related to SDG and Governments priorities.
	Source of power	Institution of Direct Administration, Provisions by CM Regulations Nr.815, 19.10.2011.
Stakeholders' interests		Interests related to SDG; Government`s priorities, inter alia, strengthening the economy, raising quality of life ✓ Water policy (strong interest): substantiated by development priorities ✓ Energy policies (strong interest): substantiated by development priorities ✓ Agriculture and food (strong interest): substantiated by development priorities ✓ Land use policies (strong interest): substantiated by development priorities

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		✓ Climate policy (strong interest): substantiated by development priorities ✓ Forestry policies (strong interest): substantiated by development priorities ✓ Nature protection policy (strong interest): substantiated by development priorities

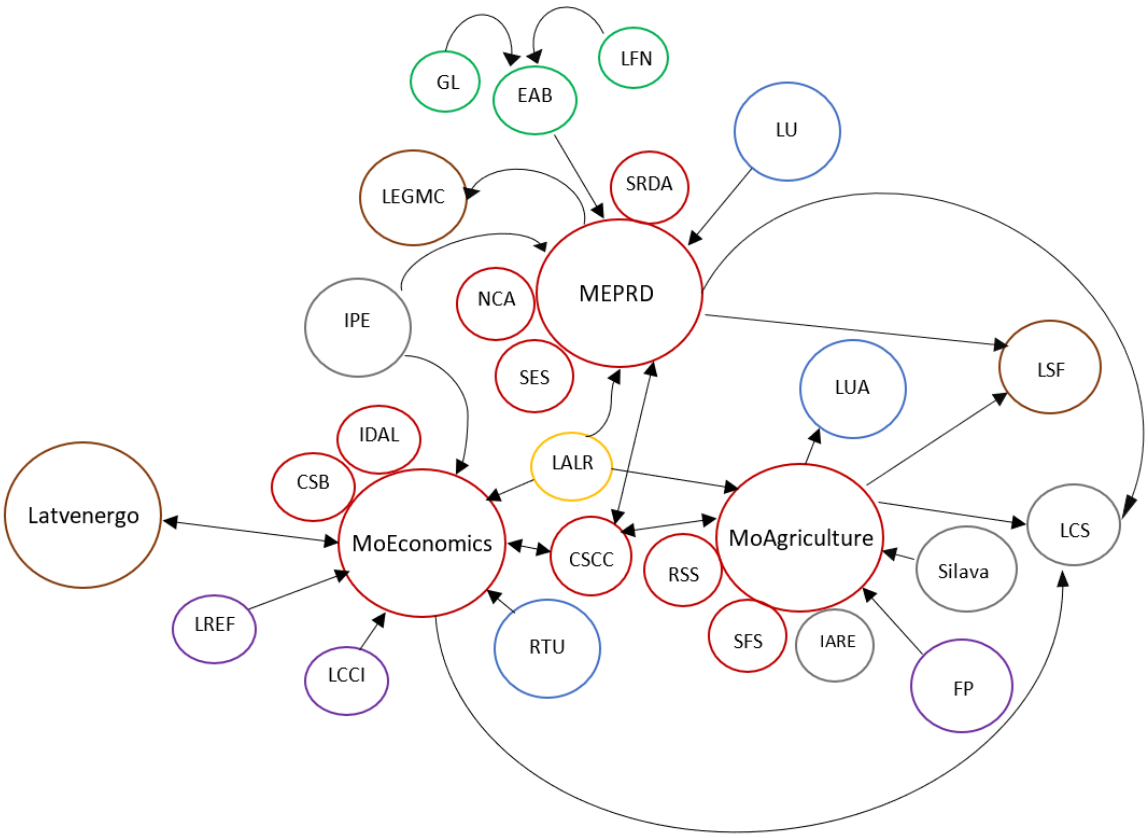
Table 2.7. The role, power, and interest of the Latvian Council of Science

Latvian Council of Science (LCS)		
Dimensions	Sub-dimension	Description
Stakeholders' role		The Council is a counsellor of the Latvian Government on research and researchers training issues. It advises on the formulation and implementation of science, higher education and R&D policy.
Stakeholders' power and its source	Formal power	The Council takes active part in project based competitive R&D funding; promotes the development of Latvian researcher resources
	Informal power	Fosters the international scientific cooperation.
	Source of power	The Latvian Council of Science is a collegiate institution of scientists established as a direct administrative institution under the supervision of the Ministry of Education and Science (in accordance with the Law of Scientific Activity (2007), Section 14). The Latvian Council of Science was established in 1991.
Stakeholders' interests		✓ Water policy (some interest): to develop research ✓ Energy policies (strong interest): substantiated by development priorities ✓ Agriculture and food (strong interest): substantiated by development priorities ✓ Land use policies (strong interest): substantiated by development priorities ✓ Climate policy (strong interest): substantiated by development priorities ✓ Forestry policies (strong interest): substantiated by development priorities ✓ Nature protection policy (some interest): to develop research

Table 2.8. The role, power, and interest of the Environmental Advisory Board

Environmental Advisory Board (EAB)		
Dimensions	Sub-dimension	Description
Stakeholders' role		EAB prepares and provides proposals to the Ministry (MEPRD) on legislation and planning documents in environmental policy, informs society on environmental aspects and promotes integration of environmental issues in sectoral policy.
Stakeholders' power and its source	Formal power	Assigned functions of the EAB are (i) to foster preparation of legal acts and policy planning documents in relation to environmental aspects, and (ii) to promote cooperation and information exchange among personal views and society, and public authorities and municipalities.
	Informal power	Spectrum of environmental interests is wide by representation of non-governmental organizations in this Board. Every year 20 NGOs are elected as members. Key representatives: • Association "Baltic Environmental Forum" • Association "Green Liberty" (GL) • Foundation "Latvian Fund for Nature" (LFN) • Association "Latvian Ornithological Society" • WWF Latvia • Association "homo ecos" • Association of Latvian Organic Agriculture • Waste Management Association of Latvia – a professional, voluntary, non-governmental organization
	Source of power	EAB is a consultative coordination institution with an aim to promote public participation in development and implementation of environmental policy. Provisions by CM Regulations Nr.209, 27.03.2007. NGOs are participants and members in a range of other working groups and consultative boards.
Stakeholders' interests		✓ Water policy (strong interest): to environmental issues ✓ Energy policies (some interest): limited to environmental issues ✓ Agriculture and food (some interest): limited to environmental issues ✓ Land use policies (strong interest): to environmental issues ✓ Climate policy (strong interest): to environmental issues ✓ Forestry policies (strong interest): in context to environmental issues ✓ Nature protection policy (very strong interest): focus of work

Figure 2.1. Map of relevant stakeholders and relationships



Legend:

national governmental organization	research
business	municipalities
education	Trade union
	NGO

Abbreviations:

MEPRD	Ministry of Environmental Protection and Regional Development	IARE	Institute of Agricultural Resources and Economics
MoAgriculture	Ministry of Agriculture	Silava	Latvian State Forestry Research Institute “Silava”
MoEconomics	Ministry of Economics	LCS	Latvian Council of Science
IDAL	Investment and Development Agency of Latvia	IPE	Institute of Physical Energetics

CSB	Central Statistical Bureau	LALRG	Latvian Association of Local and Regional Government
CSCC	Cross-Sectoral Coordination Centre	LCCI	Latvian Chamber of Commerce and Industry
SES	State Environmental Service	FP	Association "Farmers Parliament"
NCA	Nature Conservation Agency	LREF	Latvian Renewable Energy Federation
SRDA	State Regional Development Agency	EAB	Environmental Advisory Board
SFS	State Forest Service	GL	Association "Green Liberty"
RSS	Rural Support Service	LFN	Foundation "Latvian Fund for Nature"
LEGMC	Latvian Environment, Geology, and Meteorology Centre		
Latvenergo	JSC "Latvenergo"		
LSF	JSC "Latvia's State Forests"		
LU	University of Latvia		
LUA	**Latvia University of Life Sciences and Technologies** (previously known as Latvia University of Agriculture)		
RTU	Riga Technical University		

The following figures highlight the power/interest grid of the stakeholders on energy, water, agriculture and food, land use, climate, forestry, and nature protection issues (see Figures 2.2. – 2.8.).

Figure 2.2. Power and interest of stakeholders on Energy issues

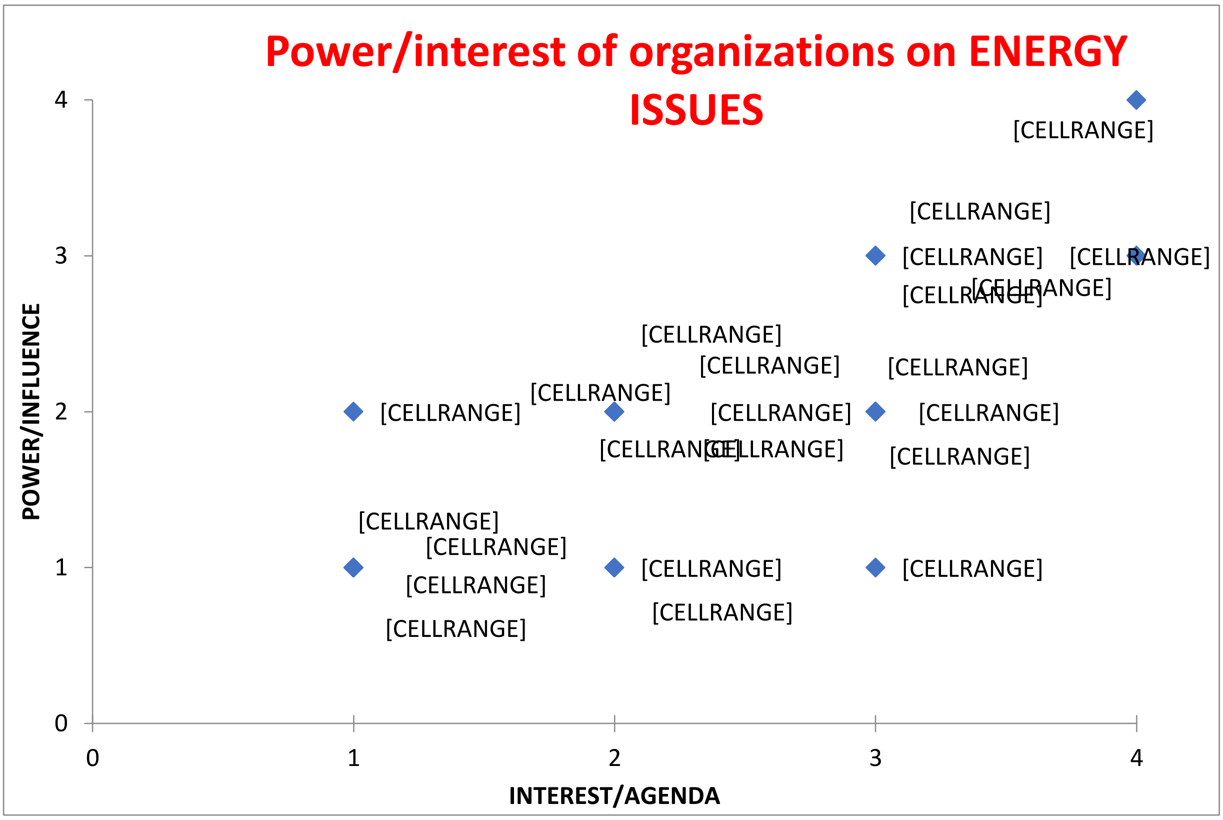


Figure 2.3. Power and interest of stakeholders on Water issues

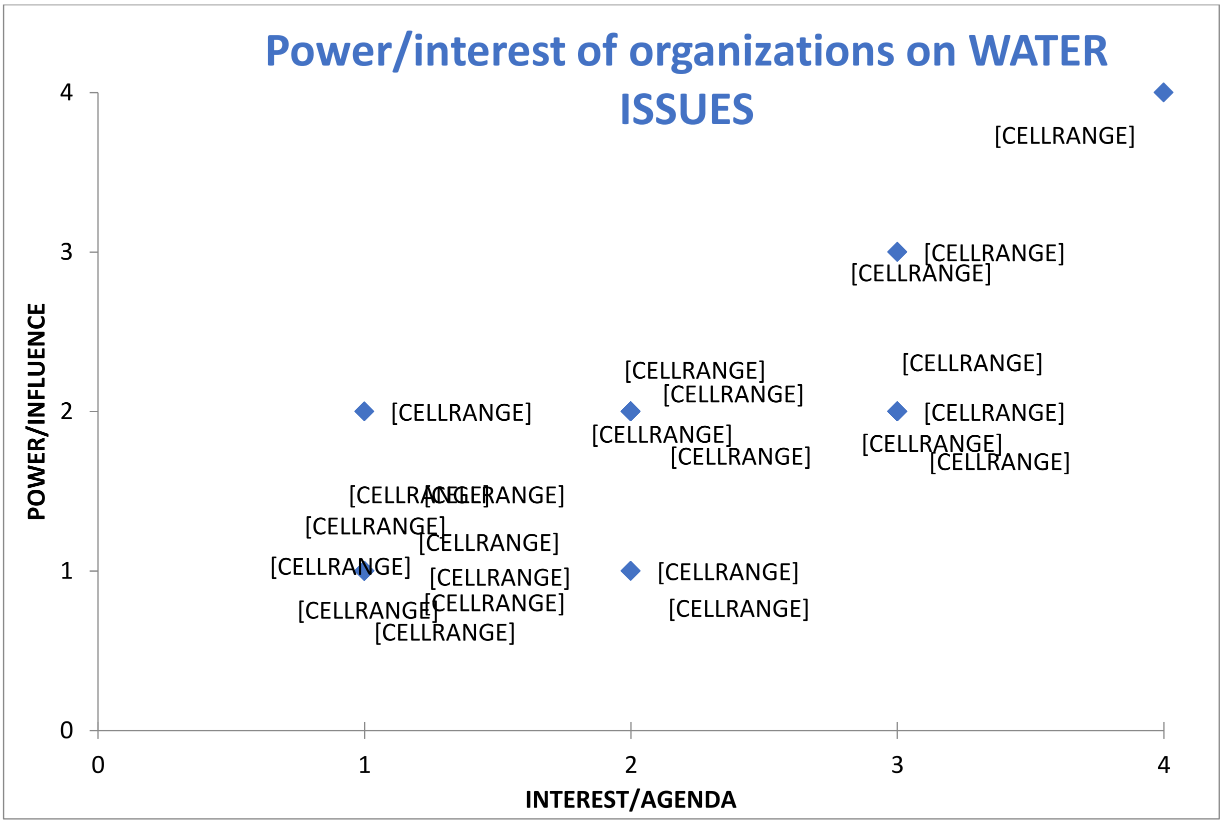


Figure 2.4. Power and interest of stakeholders on Agriculture and Food issues

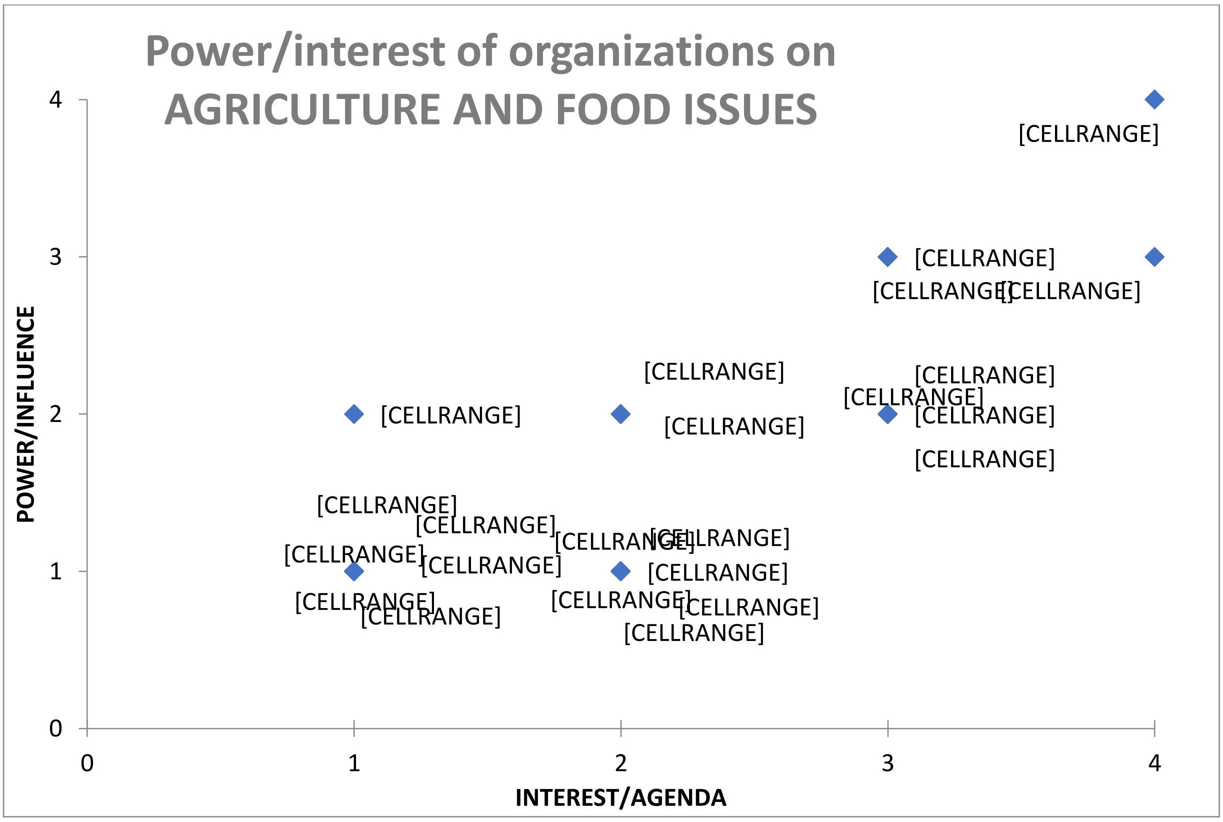


Figure 2.5. Power and interest of stakeholders on Land use issues

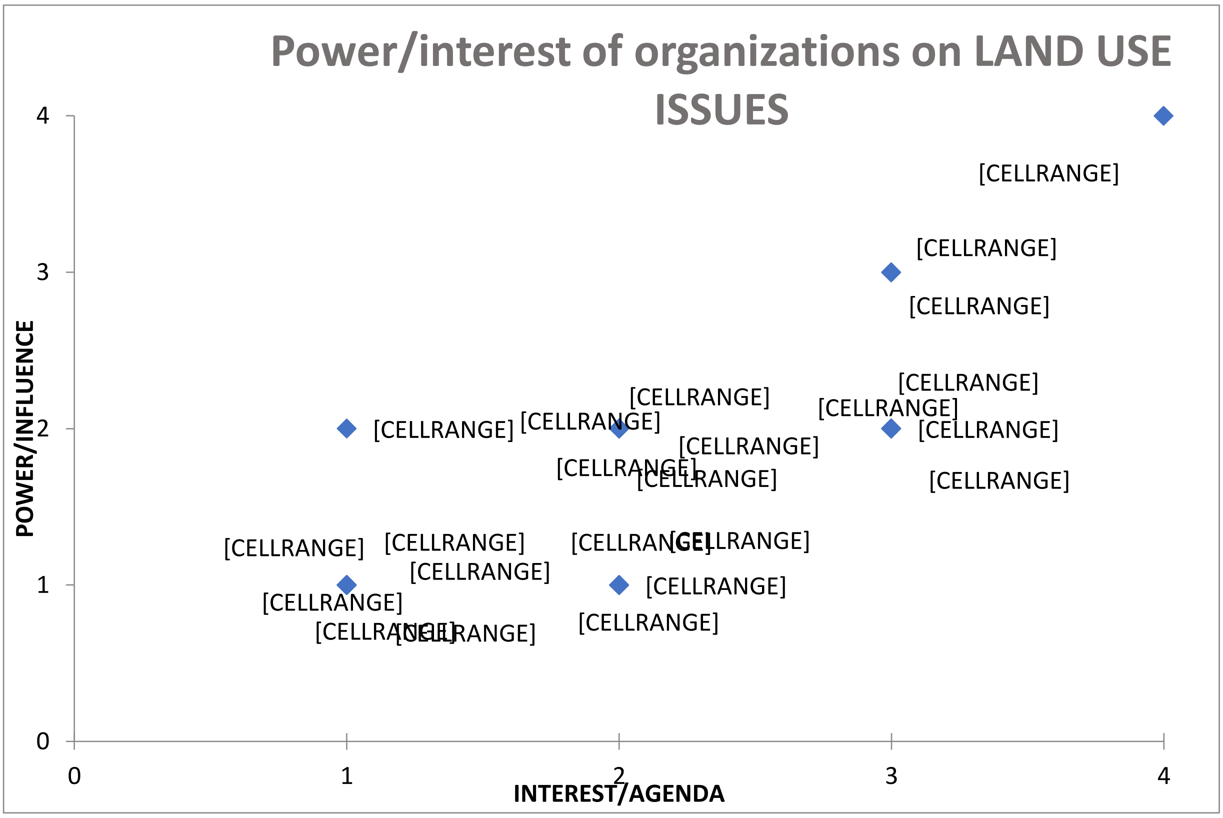


Figure 2.6. Power and interest of stakeholders on Climate issues

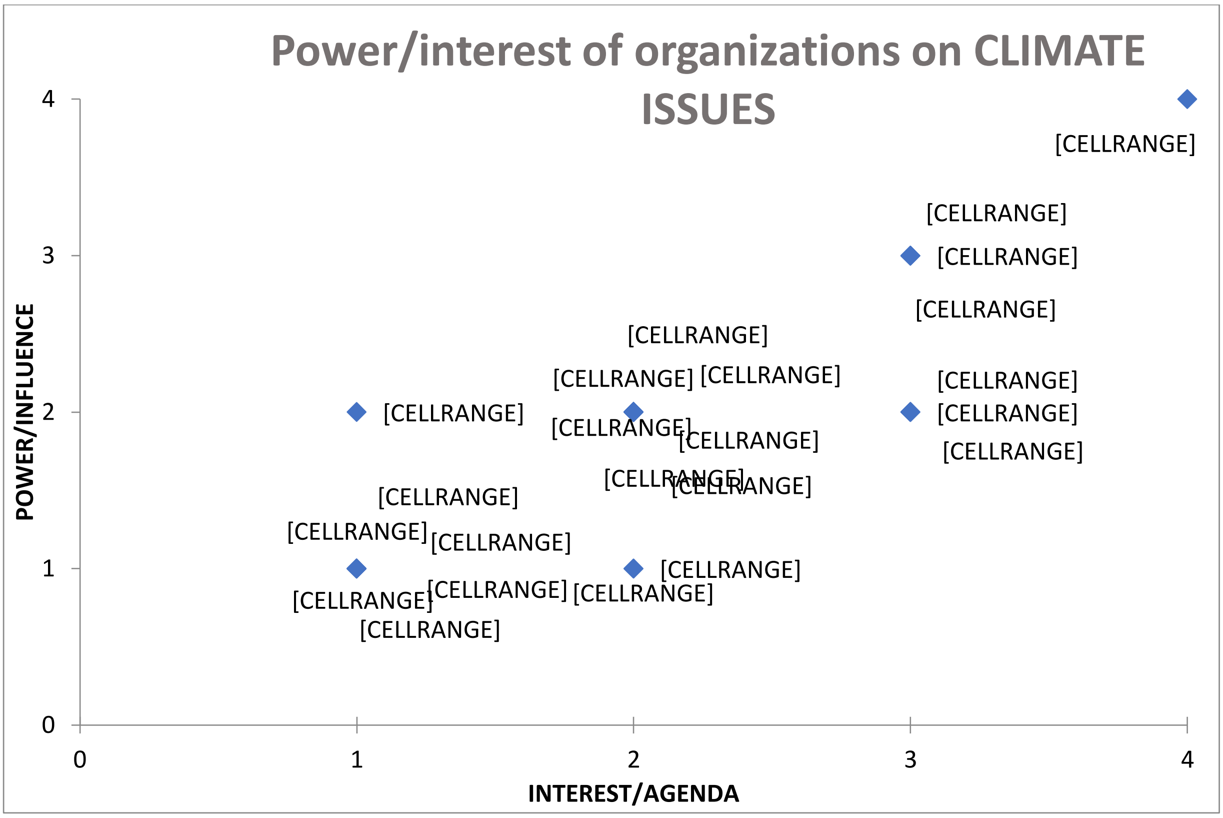


Figure 2.7. Power and interest of stakeholders on Forestry issues

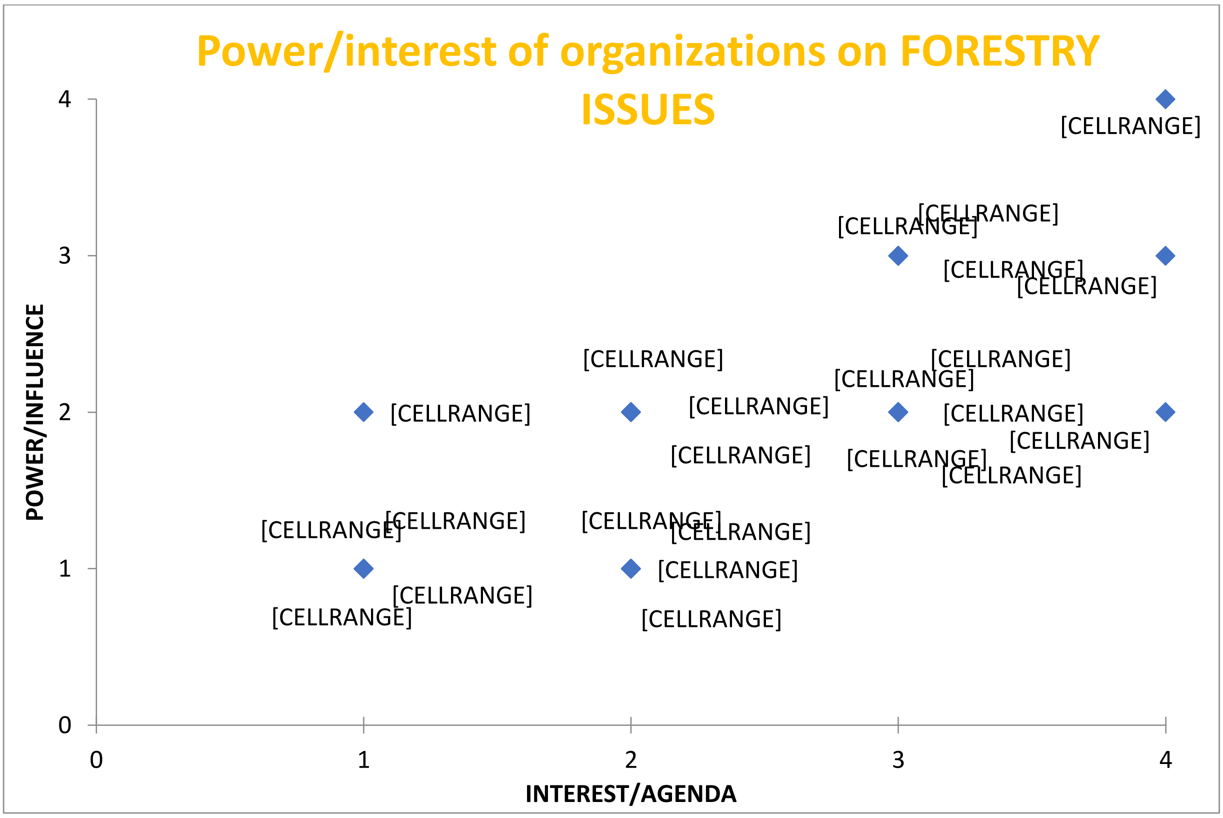
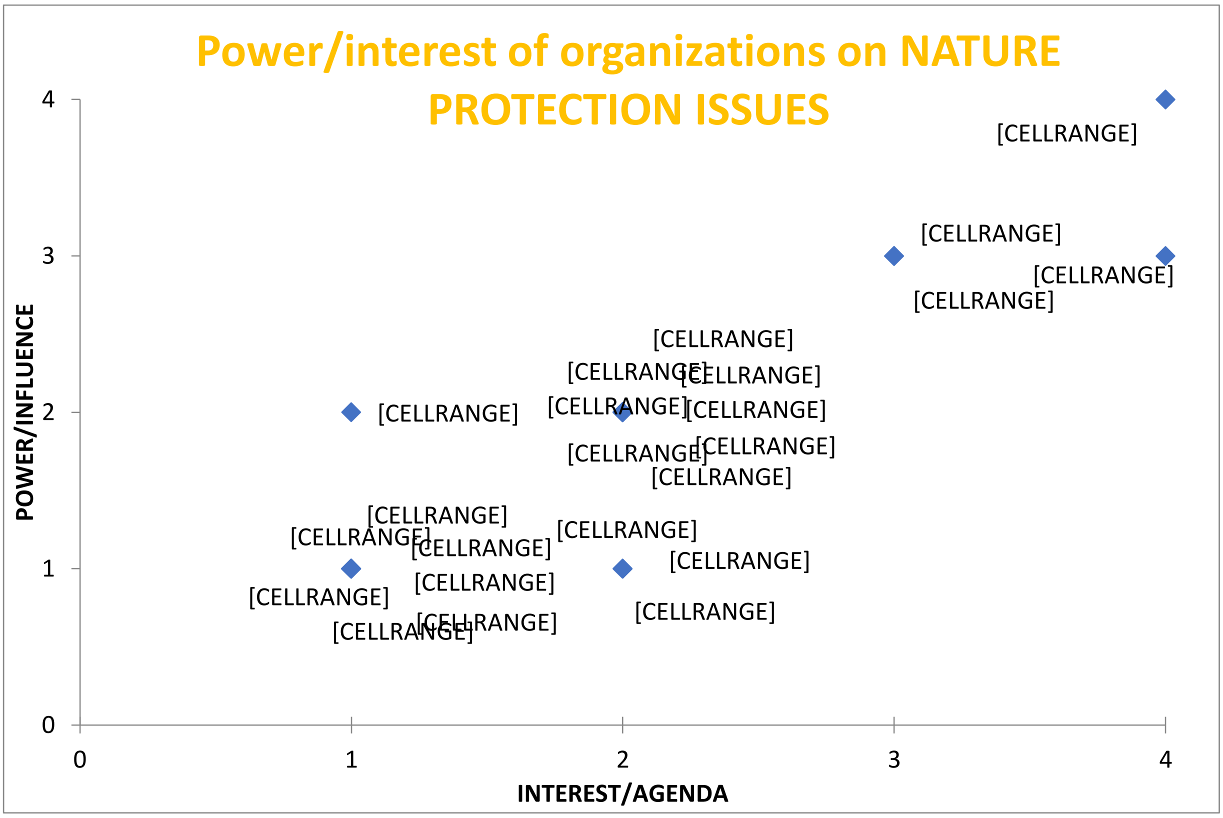


Figure 2.8. Power and interest of stakeholders on Nature protection issues



3. Mapping of policy goals and instruments

This chapter gives an overview on main policy documents in Latvia (see Tables 3.1.). It also provides an inventory of policy objectives related to energy (including transport and industry), climate, agriculture and food production, forestry, land use, and environmental/nature protection (see Tables 3.2. - 3.6.). The chapter highlights the general and specific policy instruments in each relevant policy sector in Latvia (see Table 3.7 – 3.10.).

Table 3.1. Short description of policy documents

Type of document	Title of document	Short description of document content	Life span of policy
Energy Strategy	"Long-Term Energy Strategy of Latvia 2030 - Competitive Energy for the Society"	The strategy sets targets for increasing of renewable energy sources (RES) in heating, electricity production and transport sector; for reduction of import of energy and for reduction of heat consumption in buildings	2030
Guidelines for the development of energy sector	"The Guidelines for the Development of Energy Sector for 2016-2020"	The guidelines set targets for use of RES, energy efficiency, reduction of greenhouse gas emissions	2016-2020
Guidelines for the development of transport sector	"The Guidelines for the Development of Transport Sector for 2014-2020"	The guidelines set priorities to reduce energy consumption in transport sector and use "cleaner" energy	2014-2020
Plan for development of alternative fuels	"Plan for development of alternative fuels 2017 – 2020'	The plan defines measures for promotion of introduction and application of alternative fuels	2017-2020
Guidelines for the development of industry sector	"The Guidelines for the Development of Industry Sector for 2014-2020"	The guidelines set targets and direction of action in the industry sector, e.g., application of innovative technologies, promotion of export, etc.	2014 - 2020

Program for rural development	"Latvia – Rural Development Programme (National) 2014 – 2020"	The program sets directions for rural development in Latvia e.g. efficient use of resources, climate change resistant economy with low level of CO_2 emissions in agriculture, food production and forestry	2014 - 2020
Guidelines for the development of forestry and related branches	"The Guidelines for the development of forestry and related branches 2015.-2020"	The guidelines set targets and directions for forestry development e.g., sustainable forest management, competitive production	2015 - 2020
Environmental policy guidelines	"Environmental policy guidelines 2014-2020"	The guidelines set targets and directions for environmental protection e.g., sustainable development, maintenance of environmental quality and biodiversity	2014 - 2020
Waste management plan	"National waste management plan 2013-2020"	The plan set targets and directions of waste management, e.g., rational use of resources, reduction of waste amount to be deposited	2013 - 2020

Table 3.1. Overarching and specific policy objectives for Energy policy

Energy policy		
Overarching objectives	Specific objectives	Reference documents
Competitive economy, sustainable energy to be reached by increasing energy efficiency and use of renewable energy	The Strategy sets non-binding targets to be reached by 2030: • 50% of renewable energy in total energy consumption to be reached by increasing the share of renewable energy sources in heat supply, electricity, and transport sectors; • 50% reduction of import of energy and energy sources from third countries (in	"Long-Term Energy Strategy of Latvia 2030 - Competitive Energy for the Society"

	• comparison to 2011); • 50% reduction energy demand for heating of buildings (current heat energy demand is 200 kWh/m2/year).	
Sustainable energy considering economic, social, and environmental aspects	The Guidelines set targets to be reached by 2020: • 40% share of RES of total energy consumption; • 10% share of RES in total energy consumption in transport sector; • 6% reduction of GHG emissions per fuel or energy unit supplied; • Energy savings of 0,670 Mtoe (28 PJ); • Mandatory total energy saving of the country 0,850 Mtoe; • Refurbishment of 3% of the total area of public buildings (the total area of refurbishment 678 460 m^2); • 50% reduction of average heat energy consumption for heating compared to the consumption in 2009 (202 kWh/m^2), up to 150 kWh/m^2 per year by the year 2020; • Reduction of energy intensity from 372,9 kg oil equivalent per 1000 *euro* of GDP in 2010 to 280 kg oil equivalent per 1000 *euro* of GDP in 2020; • Limitation of GHG emission in economic branches of non-ETS sector not exceeding 17% of increase of emissions compared to the level in 2005; • Limitation of total GHG emissions not exceeding 12,16 Mt CO_2 equivalent in 2020.	"The Guidelines for the Development of Energy Sector for 2016-2020"

Table 2.3. Overarching and specific policy objectives for transport policy

Transport policy		
Overarching objectives	Specific objectives	Reference documents
Sustainable transport	• Using less amount and cleaner energy in vehicles, better application of modern infrastructure, reduction of negative impact on environment and natural resources; • Integrating all modes of public transport into a unified public transport system; ensuring quality of regional and local roads;	"The Guidelines for the Development of Transport Sector for 2014-2020"

	improving accessibility of information; ensuring conformity of vehicles to European technical standards and environmental requirements.	
Reduction of negative impact of transport to the environment	Promoting alternative fuels (i.e. electricity, natural gas and biomethane, hydrogen, biofuel, synthetic and paraffinic fuel) and the related infrastructure.	"Plan for development of alternative fuels 2017 – 2020'

Table 3.3. Overarching and specific policy objectives for Industrial policy

Industrial policy		
Overarching objectives	Specific objectives	Reference documents
Promotion of goods and services with higher added value.	• Accessibility of labour and education corresponding to the needs of national economy; • Development of industrial areas (high quality infrastructure, roads); • Promote technological development towards production of goods with higher added value; • Promotion of export; • Reduction of costs for energy sources (supporting programmes to increase energy efficiency and reduction of emissions)	"The Guidelines for the Development of Industry Sector for 2014-2020"

Table 3.4. Overarching and specific policy objectives for Agricultural, Food production, Forestry and Land use policy

Agricultural, Forestry and Land use policy		
Overarching objectives	Specific objectives	Reference documents
Sustainable agriculture	• Promote knowledge transfer in agriculture, forestry, and rural areas; • Increase rentability and competitiveness of enterprises, promote innovative technologies in agriculture and sustainable management of forests; • Promote organisation of food supply chains; • Restore, maintain, and improve ecosystems related to agriculture and forestry; • Promote efficient use of resources and support economy resistant to climate change, having low carbon dioxide emissions in agriculture, food and forestry sectors; • Promote social integration, reduction of poverty and economic development in rural areas.	Latvia – Rural Development Programme (National) 2014 – 2020
Sustainable forest management	• Sustainable and internationally acknowledged management of forests, including CO_2 capture; • Competitive forestry products with high added value reflecting the needs of clients; • Relevant educational and scientific potential and skills of human resources.	The Guidelines for the development of forestry and related branches 2015.-2020

Table 3.5. Overarching and specific policy objectives for Environmental, Water and Climate policy

Environmental policy		
Overarching objectives	Specific objectives	Reference documents
Ensuring possibility for inhabitants to live in clean and tidy environment, implementing sustainable activities, preserving quality of environment un	• Ensuring good management of environment at all levels, as well as good communication about environment based, promoting public participation in dealing with environmental issues • Ensuring sustainable use and protection of soil • Ensuring the society with updated and actual information about soil resources and current geological process that is considered for	Environmental policy guidelines 2014-2020

biodiversity, ensuring sustainable use of natural resources, as well as public participation in decision making and awareness on state of environment	development planning; • Preventing waste generation and ensuring reduction of waste to be deposited, ensuring rational use of waste resources, as well as safe disposal of waste; • Ensuring high quality of ecosystems, balancing environmental, social, and economic interests, promoting the "green" image of Latvia; • Reducing air pollution impact on inhabitants and ecosystems up to the level that does not create a threat to human health and does not create degradation of ecosystems • Ensuring contribution of Latvia to the global attempt for reduction of climate change, considering environmental, social, and economic interests of Latvia; • Promoting the readiness of Latvia to adapt to climate change and the related impacts; • Ensuring good water quality and sustainable use of water resource; • Ensuring sustainable use and protection of natural resources stimulating minimisation and management of environmental risks • Reducing negative environmental impacts on human health and well-being; • Ensuring timely and comprehensive information on environment and climate change to set the policy goals and relevant measures to improve the state of environment and timely response towards climate change as well as to evaluate the effectiveness of implemented measures and investments.	
Waste reduction	• Preventing generation of waste, ensuring significant reduction of total amount of waste; • Ensuring rational utilisation of waste; • Ensuring that waste generated is not hazardous and creates only minor risk to environment and human health; • Ensuring reduction of waste to be deposited and safe disposal.	National waste management plan 2013-2020

Table 3.6. General and specific policy instruments for Energy

Energy policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Provisions and support for energy production from RES (Feed-in-tariffs, subsidies)	Provisions to generate and sell energy produced from RES; provisions for mandatory purchase obligation; subsidies to support use of energy produced from RES in municipal buildings	Energy Law (adopted in 1998) Electricity Market Law (adopted in 2005) Law On the Energy Performance of Buildings (adopted in 2013) MK Nr. 262, adopted in 16.03.2010 MK Nr.152, adopted in 08.03.2016
Energy efficiency requirements	Requirement to reduce heat losses in centralized heat supply systems (heat losses ≤ 19% since 2018; 17% since 2019)	MK Nr. 243, adopted in 19.04.2016.
Provisions for energy production in co-generation (feed-in-tariffs, taxes)	Criteria for co-generation stations to obtain a permit for selling electricity within the mandatory purchase obligation; level of taxation	Electricity Market Law (adopted in 2005) Subsidised Electricity Tax Law (adopted in 2013) MK Nr. 221, adopted in 10.03.2009 MK Nr. 262, adopted in 16.03.2010 MK Nr. 1521, adopted in 17.12.2013
Energy performance of buildings (requirements, subsidies)	Requirements for implementation of measures increasing energy performance of buildings; Subsidies for refurbishment of dwelling houses; Target (12.31.2023): energy consumption for heating in buildings < 120 kWh/m2/year	Law On the Energy Performance of Buildings (adopted in 2013) MK Nr. 28, adopted in 15.01.2008 MK Nr. 138, adopted in 10.02.2009 MK Nr. 1332, adopted in 17.11.2009 MK Nr. 905, adopted in 28.09.2010 MK Nr. 907, adopted in 28.09.2010 MK Nr. 272, adopted in 05.04.2011 MK Nr.152, no 08.03.2016 Law On Assistance In Solving Apartment Matters (adopted in 2001) MK Nr. 237, adopted in 05.04.2005
Minimum requirements for energy performance	Requirements for energy performance certification and minimum energy	Law On Administration of Residential Houses (adopted in 2009)

of buildings	performance of buildings	Law On the Energy Performance of Buildings (adopted in 2013) MK Nr. 383 (adopted in 09.07.2013)
Electricity net payment	Order for electricity net payment for households	Electricity Market Law (adopted in 2005) MK Nr. 50, adopted in 21.01.2014
Quality criteria for biofuels	Criteria for sustainability of biofuels	Biofuel Law, adopted in 15.04.2005 MK Nr.545, adopted in 05.07.2011 MK Nr. 772, adopted in 18.10.2005
Natural resource tax	Natural resource tax is 0% for the energy produced in cogeneration and for the energy produced from renewable energy sources and peat	Natural Resources Tax law, (adopted in 2005)
Permits, emission limits	Permits for polluting activities, emission limit from combustion installations	Law On Pollution (adopted in 2001) MK Nr.187, adopted in 02.04.2013 MK Nr.1082, adopted in 30.11.2010 MK Nr.1015, adopted in 14.12.2004
Subsidy for energy production	Subsidy for energy production from agricultural or forestry biomass	MK Nr. 268, adopted in 16.03.2010.
Subsidy for increasing energy efficiency and use of RES	Subsidy for increasing energy performance and use of RES in industrial buildings or industrial processes	MK Nr. 590, adopted in 06.09.2016
Quality criteria for biofuels	Criteria for sustainability of biofuels	Biofuel Law, adopted in 15.04.2005 MK Nr.545, adopted in 05.07.2011 MK Nr. 772, adopted in 18.10.2005
Excise tax	Reduced excise tax for biofuels (0 EUR excise tax is for biofuel completely obtained from rape seed oil)	Law On Excise Duties (adopted in 01.05.2004)

Table 3.8. General and specific policy instruments for Industry

Industrial policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Reduction of electricity	Criteria for enterprises to obtain	MK Nr.395, adopted in 14.07.2015

payment	reduction of electricity payment	
Subsidies to promote export	Subsidies to promote export of products and services with high added value	MK Nr.678, adopted in 01.12.2015
Permits, limits	Permits for polluting activities from stationary sources; limits and restrictions to activities involving ozone depleting substances and fluorinated GHGs.	Law On Pollution (adopted in 2001) MK Nr. 182, adopted in 02.04.2013 MK Nr. 1082, adopted in 30.11.2010 MK Nr. 563, adopted in 12.07.2011
Natural resource tax	Tax for GHG emissions from stationary installations	Natural Resources Tax law, (adopted in 2005)
Subsidy to promote production	Subsidy to promote production of products of high added value in agriculture and forestry sectors	MK Nr.293 adopted in 10.05.2016

Table 3.9. General and specific policy instruments for Food, Agriculture, Forestry, and Land use

Food, Agricultural, Forestry and Land use policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Requirements for food quality schemes	Requirements for food quality schemes and its certification	MK Nr. 461, adopted in 12.08.2014
Subsidy for taking part in food quality scheme	Subsidy for agricultural enterprises to join food quality scheme	MK Nr. 1524, adopted in 17.12.2013
Subsidy for planting of trees	Subsidy for planting of trees in land not suitable for agriculture	Law On Agriculture and Rural Development (adopted in 2004) MK Nr. 1182, adopted in 13.10.2009.
Subsidy for rural development	Subsidy for rural development - improvement of environment, climate and rural landscape	MK Nr. 17, adopted in 07.04.2015.
Subsidy to improve melioration systems	Subsidy for reconstruction or renovation of melioration systems (and for new melioration system in agricultural land)	MK Nr. 792, adopted in 23.09.2008.
Direct payments (subsidies)	Subsidy for agricultural activities beneficial to climate and environment	MK Nr. 126, adopted in 10.03.2015.
Requirements and norms for organic fertilization of soils	Requirements and norms for organic fertilization of soils (amount of nitrogen on field)	MK Nr. 834, adopted in 23.12.2014. MK Nr. 17, adopted in 07.04.2015.

Subsidy for modernization of farms	Subsidy for construction and reconstruction of manure storage facilities	MK Nr. 1026, adopted in 01.11.2010.
Requirements for activities with manure	Requirements for collection, storage and distribution of manure	MK Nr. 829, adopted in 23.12.2014.
Subsidy for development of agriculture	Yearly amounts of subsidies for development of agriculture	Law On Agriculture and Rural Development (adopted in 2004)
Subsidy for activities not directly related to agriculture	Subsidies promoting the tourism	MK Nr. 320, adopted in 24.05.2016
Subsidy for fruits and vegetables to be delivered in short distances	Subsidy for fruits and vegetables if they have been grown applying integrated plant protection principles and are delivered to the educational establishment not longer than 300 km	MK Nr. 519, adopted in 08.09.2015.
Requirements for limitation of water pollution	Requirements for limitation of water pollution from point and diffuse sources	Water Management Law (adopted in 2002)
Requirements for application of sewage sludge	Requirements for application, monitoring and control of sewage sludge	MK Nr. 362, adopted in 02.05.2006.
Permits, requirements for polluting activities	Requirements to elaborate emission limit projects of stationary sources to reduce emissions of air polluting substances	Law On Pollution (adopted in 2001) MK Nr. 1082, adopted in 30.11.2010. MK Nr. 769, adopted in 13.11.2012. MK Nr. 182, adopted in 02.04.2013.
Natural resource tax	Tax for GHG emissions from stationary installations	Natural Resources Tax law (adopted in 2005)
Environmental impact assessment	Requirements and limitations for emissions of polluting substances to air, water, and soil	Law On Environmental Impact Assessment" (adopted in 1998) MK Nr. 157, adopted in 23.03.2004. MK Nr. 300, adopted in 19.04.2011. MK Nr. 18, adopted in 13.01.2015.
Arranging agricultural land within forest areas	Procedure and limitations for arranging agricultural land within forest areas	Law On Agriculture and Rural Development (adopted in 2004) MK Nr. 118, adopted in 05.03.2013.
Requirements for forest	Requirements for forest protection	MK Nr.947, adopted in 18.12.2012

protection	when carrying out forest management activities (e.g., tree cutting)	
Requirements for renovation of forests	Requirements for growing of trees to renovate the forest	MK Nr.159, adopted in 26.03.2013 MK Nr.308, adopted in 02.05.2012
Requirements to preserve the genetic bank of forests	Requirements for keeping the biodiversity and setting the minimum number of tree specimens in forests	MK Nr.177, adopted in 02.04.2013
Limitation of vehicle emissions	Limitation of emissions for tractor engines	MK Nr.535, adopted in 27.06.2006
Subsidies for forest management	Subsidies for renovation of forests and planting of trees (e.g., in areas not suitable for agriculture)	Law On Agriculture and Rural Development, adopted in 24.04.2004 MK Nr.455, adopted in 04.08.2015
Requirements for maintenance of melioration systems	Requirements for maintenance and use of melioration systems	Amelioration Law, adopted in 25.01.2010
Requirements for forest management	Requirements for forest management plan and forest management measures	Law on Forests, adopted in 17.03.2000 MK Nr.67, adopted in 04.02.2014 MK Nr.248, adopted in 07.05.2013
Payment for causing negative environmental effects	Payment to state for causing negative environmental effect due to deforestation (reducing CO_2 capturing potential)	MK Nr.889, adopted in 18.12.2012 MK Nr.228, adopted in 29.04.2003
Tree cutting limitations	Limitations for tree cutting in biologically valuable areas	MK Nr.936, adopted in 18.12.2012
Requirements for forest management	Requirements for tree cutting within and outside the forest	MK Nr.935, adopted in 18.12.2012 MK Nr.309, adopted in 02.05.2012
Subsidies for enterprises	Subsidies for agricultural and forestry enterprises to elaborate innovative technologies and products	MK Nr.593 adopted in 13.10.2015

Table 3.10. General and specific policy instruments for Environment, Water, and Climate

Environmental, Water and Climate policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Requirements for	Restrictions of activities with coastal	Protection Zone Law (adopted in

management of protecting belts around the water bodies	dunes	11.03.1997)
Requirements for water protection and management	Requirements for protection and management of surface and groundwater	Water Management Law (adopted in 2002)
Quality requirements for water	Regarding the Quality of Surface Waters and Groundwaters	MK Nr. 118, adopted in 12.03.2002
Restrictions to build dams on rivers	Restrictions to build or restore dams for hydro-power plants on certain rivers or river stretches	MK Nr. 27, adopted in 15.01.2002
Requirements for waste management	Requirements for rational utilization of waste reducing emissions and the total amount of waste	Waste Management Law adopted in 18.11.2010; MK Nr.788, adopted in 13.12.2016. MK Nr.564, adopted in 12.07.2011
Waste management fee	Fee for management of various types of waste	Waste Management Law adopted in 18.11.2010
Requirements for waste management	Requirements for separate collection of waste and regeneration, reuse, and recycling	MK Nr.184, adopted in 02.04.2013
Requirements for waste management	Requirements for waste separation fields and composting of waste	MK Nr.898, adopted in 22.11.2011
Requirements for waste incineration	Requirements for waste incineration and operation of waste incinerators	MK Nr.401, adopted in 24.05.2011
Subsidies for waste management	Subsidies for development of separate collection of waste	MK Nr.494, adopted in 26.07.2016
Requirements for landfills	Requirements for erection of landfills and landfill management, including requirements for collection, treatment and use of landfill gas for energy generation or incineration	MK Nr.1032, adopted in 27.12.2011
Requirements for wind turbine location	Limitations for location of wind turbines e.g. with respect to nature protection areas,	Protection zone Law (1997) Law on Specially Protected Nature Territories (1993)

4. Assessment of policy coherence

4.1. Assessment of interactions between nexus critical objectives

This sub-chapter includes the description of the nexus critical objectives and explanation of the reason these instruments are considered particularly critical or interesting to investigate in a nexus perspective for the Latvia case study. In total 15 Nexus critical objectives (NCOs) covering Energy, Food & Agriculture, Water, Land, Forestry and Climate policy sectors have been selected to assess interactions for the Latvia case study (See Table 4.1). A nexus critical objective is defined as the policy objective that according to the stakeholders and the policy analysis is highly relevant for the issues under investigation in the case study and has a potentially high number of interactions with other objectives in the nexus (Munaretto and Witmer, 2017).

Table 4.1. Nexus critical objectives for which to assess interactions for the Latvia case study

Energy		
Code	Heading (short description)	Detailed description (including specification of context)
E1	Increase use of renewable energy sources (RES)	Refers to the increased share of renewable energy (40%) from total gross final energy consumption by 2020 (this target is set for Latvia in the Renewable Energy Directive 2009/28/EC, Annex I)
E2	Increase use of RES in transport energy	Refers to the increased share of renewable energy in the transport sector to at least 10% of gross final energy consumption for transport by 2020
E3	Increase the efficiency of use of energy sources	Refers to all sectors where efficiency can be improved (buildings, cars, industry, agriculture, housing, etc.). Targets to be reached by 2020: total cumulative energy savings – 0.85 Mtoe (9897 GWh); total savings of primary resources – 0.67 (28PJ) by 2020; energy performance of residential and non-residential buildings – specific energy consumption for heating – 150 kWh/m^2/year; 3% State owned building space renovation (678 460m^2 in total)
Food and agriculture		
Code	Heading (short description)	Detailed description (including specification of context)
FA1	Increase the efficiency of use of resources	Refers to prudent use of resources, supporting climate resilient and low carbon economy in agriculture and food sectors, application of innovative technologies
FA2	Prevent deterioration of ecosystems from agriculture and	Refers to prevention and reduction of pollution (air, water, land) and waste minimisation from agriculture

	food production	and food sector
FA3	Increase of economic development of rural areas	Refers to reduction of poverty, social integration, and entrepreneurship
Water		
Code	Heading (short description)	Detailed description (including specification of context)
W1	Sustainable and rational use of water resources	Refers to sustainable and rational use of water resources and sufficient supply to inhabitants with good quality surface water and groundwater
W2	Protection of the aquatic environment	Refers to protection of the aquatic environment, gradually reducing emission and discharge of priority substances, phasing out emission and discharge of substances, which are especially hazardous to the aquatic environment
W3	Prevention of pollution of the sea	Refers to reduction of eutrophication of inland water bodies and the Baltic Sea (HELCOM Convention)
Land		
L1	Efficient use of land	Refers to prevention to fragmentation, reduction of abandoned areas of usable arable land, efficient use of built up areas and re-cultivation of degraded territories
L2	Quality of soil and biodiversity	Refers to soil protection (including prevention of erosion) and increase of soil quality
Forestry		
FO1	Sustainable forest management	Refers to maintenance of forest areas, increase of forest productivity (including amelioration) and afforested areas
FO2	Production of high added value forestry products	Refers to increased competitiveness of forestry sector, higher productivity, application of innovative technologies
Climate		
C1	Climate change mitigation	Refers to the reduction of GHG emissions by setting GHG emission targets for the EU ETS and non-ETS sectors
C2	Climate change adaptation	Refers to selection and application of measures for adaptation to climate change in various sectors

The scoring of the interactions was performed in a step-wise, iterative fashion, using multiple sources of information (expert judgement, interviews with stakeholders, scientific and grey literature) as guided by a project document (Munaretto and Witmer, 2017). A scoring matrix has been used to illustrate the interactions among the selected objectives in the relevant nexus policy sectors. A scoring scale of +3, +2, +1, 0, -1, -2, -3 is used to assess the interactions where negative scores identify conflicts between pairs of objectives and positive scores identify synergies between pairs of objectives. The score 0 indicates the absence of a significant interaction. The scoring of interactions between pairs of NCOs has been done in both directions (see Table 4.2). The table reflects what happens to the objective x (in rows) if a progress is made on the objective y (in column).

Table 4.2. The scoring matrix for the assessment of objectives' interaction in the relevant Nexus policy sectors

	E1	E2	E3	FA1	FA2	FA3	W1	W2	W3	L1	L2	FO1	FO2	C1	C2
E1		+3	+1	+2	0	0	0	-1/0	0	0/+1	-1/0	-1/+1	+1	+3	0
E2	+3		0	+2	0	0	0	-1/0	-1/0	0	-2/0	0	+1	+3	0
E3	0	0		0	0	0	0	0	0	0	0	0	0	+3	+1
FA1	+2	+2	+1		0	+1	0	+1	+1	+2	+2	0	0	+2	+3
FA2	+1	-2/+1	0	+2		-1/+1	0	+3	+2	+1	+2	0	0	+2	0
FA3	+1	+1	+1	+1	0		0	0	0	+1	0	+1	+1	0	+2
W1	-1/0	0	0	0	+2	0		+2	+1	0	0	0	0	0	0
W2	-2/0	-2/0	0	+1	+3	-1/0	+1		+3	-1/0	+2	+1	0	0/+1	+2
W3	-1/0	-1/0	0	+1	+3	-1/0	+1	+2		-1/0	+1	+1	0	0/+1	+2
L1	-1/+1	+1	0	0	0	-1/+1	0	0	0		+1	+2	0	0	0
L2	-1/0	-2/0	0	+2	+2	-1/+1	0	+1	0	-1/+1		+2	0	0	+2
FO1	-2/0	0	0	0	0	-1/+1	0	0	0	0	+2		0	+3	+2
FO2	-1	0	+1	0	0	0/+1	0	0	0	0	+1	+3		+1	0
C1	+2	+1	+3	+1	+2	-1/+1	0	0	0	+1	+1	+2	+1		0
C2	0/+1	-1/0	+1	+2	0	-1/+1	0	+1	+1	+1	+1	+2	0	+1	

The justification of the scoring is being done by BEF experts and verified with experts of the relevant policy sector during the stakeholder interviews and two workshops organised on November 2017 and on March 2018 in Riga, Latvia. Description of the justification is presented in Annex 1.

The assessment of interactions showed that the objectives related to the Energy Nexus have the highest level of interactions (both synergies and conflicts) with the NCOs of other Nexus sectors. Particularly the objective to increase the share of renewable energy sources is interacting with almost all NCOs of the sectors.

NCOs of the Climate Nexus (climate change mitigation and adaptation) have the highest number of synergies with the policy objectives of other sectors. Mostly synergies have been detected between NCOs of the Energy sector and Climate corresponding to the goals of the Energy sector to reduce GHG emissions and increase the share of RES in total gross final energy consumption of the country.

No strong conflicts among the NCOs have been identified. However, according to stakeholders, in practice, conflicts can arise depending on implementation pathway and approaches selected. The following examples of potential conflicts have been mentioned by stakeholders:

- Growing of energy crops and fast-growing trees for production of energy biomass (e.g., 1st generation biofuels) helps to increase the share of RES in energy production and to use the local energy sources, but increase water pollution through the leakages of fertilisers (biogens) and pesticides, herbicides applied: Conflict between Energy NCOs and Water NCOs;
- Energy production in hydropower plants helps to reach targets for the use of RES, but has a negative impact on water quality and water ecosystems: Conflict between Energy NCOs and Water NCOs;

- Growing of energy crops and fast-growing trees for production of energy biomass helps to increase the share of RES in energy production but reduces the land available for agricultural activities and cause deterioration of ecosystems: Conflict between Energy NCOs and Food& Agriculture NCOs;
- Cultivation of monocultures of energy plants help to meet RE targets, but have a negative effect on land e.g. by causing land fragmentation, land deterioration: Conflict between Energy NCOs and Land NCOs;
- Energy production in hydropower plants helps to reach targets for the use of RES, but has a negative impact on land use e.g., by flooding: Conflict between Energy NCOs and Land NCOs;
- Unsustainable forest management (e.g. clear-cuts) to obtain biomass for energy production can help to achieve the RES target, but may have negative impact on forest ecosystems: Conflict between Energy NCOs and Forestry NCOs;
- Cutting of trees for production of wood-based fuels may increase the share of RES in energy consumption, but reduces the resources available for production of high added value products e.g., furniture: Conflict between Energy NCOs and Forestry NCOs;
- Cutting of trees in forests and exporting the wood for renewable energy production abroad creates income to the forestry sector and helps to reach RES targets in the countries importing the wood fuels but has a negative impact on meeting the GHG emission reduction and CO_2 sequestration targets in Latvia: Conflict between Energy NCOs and Climate NCOs;
- Growing of biomass for production of 1st generation biofuels increase the use of local RES for energy production but can have a negative impact on biodiversity thus reducing ability for adaptation to climate change: Conflict between Energy NCOs and Climate NCOs;
- Land transformation i.e. erection of arable land, requiring afforestation or ploughing of (semi) natural meadows to increase the volume of agricultural land for food or feed production creates a conflict with climate change mitigation targets (reduction of GHG emissions and CO_2 sequestration). Conflict between Food& Agriculture NCOs and Climate NCOs;
- Afforestation for transformation of land from forest to agricultural land has a negative impact on water quality by increase of leakage of biogens: Conflict between Food& Agriculture NCOs and Water NCOs;
- Fertilisation of arable land to increase the yields depending on fertilisation amounts applied can have a negative impact on land (soil) and water quality through leakages: Conflict between Food& Agriculture NCOs and Water NCOs;
- The amount of fertilisers used and fertilisation methods applied on agricultural land to increase agricultural productivity have an impact on the amount of GHG emissions from agricultural activities: Conflict between Food & Agriculture NCOs and Climate NCOs.

4.2. Assessment of interactions between nexus critical instruments and nexus critical objectives

This sub-chapter reflects on selected nexus critical instruments in a nexus perspective and the assessment of interactions between nexus critical instruments and nexus critical objectives. A nexus critical instrument is defined *as the policy instrument that according to the stakeholders and the policy* *analysis is highly relevant for the issues under investigation in the case study and has a potentially high number of interactions with the nexus critical objectives* (Munaretto and Witmer, 2017).

In Latvia case study are 26 nexus critical instruments identified: 7 in energy, 5 in food and agriculture, 3 in water, 3 in land, 5 in forestry and 3 in climate nexus domains (Table 4.3). The selection of these instruments has been based on previous (Block 1) analysis and the communication with stakeholders.

Table 4.3. List of the nexus critical instruments in nexus sectors

Energy		
Code	Heading (short description)	Detailed description (including specification of context)
Ea	Electricity Production and Price Determination	Determined conditions to produce electricity by using renewable energy resources, as well as the criteria for the qualification of producers for the receipt of the right to the mandatory procurement of electricity produced and the procedures for waiving thereof
Eb	Natural resource tax	Determined taxable objects and tax rates (e.g., GHG emissions)
Ec	Criteria for sustainability of biofuels	Determined sustainability criteria for biofuels and bioliquids (refers to biofuels and bioliquids from biomass originating from agriculture and forestry)
Ed	Subsidy for energy production from agricultural or forestry biomass	Determined subsidy for energy production from agricultural or forestry biomass in combined heat and power (CHP) generation
Ee	Subsidies for refurbishment of dwelling houses	Determined requirements for energy efficiency after refurbishment of buildings
Ef	Energy efficiency in centralized heat supply	Determined requirements for energy efficiency in production and heat supply
Eg	Energy for transport (fuels) *(in adoption)*	Determined requirements for market penetration of renewable energy sources in transport sector
Food and agriculture		
Code	Heading (short description)	Description (including specification of context)
Fa	Direct payments and subsidies to farmers	Determined direct payments and subsidies (for agricultural activities beneficial to climate and environment) to farmers under support schemes within the framework of the common agricultural policy, including voluntary coupled support for certain types of cultures and livestock.
Fb	Subsidies to improve melioration systems	Determined subsidy for reconstruction or renovation of melioration systems (and for new melioration system in

		agricultural land)
Fc	Subsidy for modernization of farms	Determined subsidy for construction and reconstruction of manure storage facilities
Fd	Protection from pollution with nitrates	Determined requirements for application of organic and mineral fertilisers
Fe	Food quality schemes	Determined quality criteria for types of cultures and livestock products
Water		
Code	Heading (short description)	Description (including specification of context)
Wa	Surface water body protection zones	Determined restrictions for application of organic and mineral fertilisers within the water body protection zone
Wb	Water monitoring programs	Determines the ecological water quality and changes in water status
Wc	Permits for polluting activities	Determined requirements for limitation of water pollution from point and diffuse sources
Land		
La	Land use change	Determined requirements for land use change e.g. procedure and limitations for arranging agricultural land within forest areas;
Lb	Wind turbine location	Determined limitations for location of wind turbines e.g. with respect to nature protection areas
Lc	Immovable Property Tax	Determined immovable property tax rate or rates for different types of land use (including setting higher tax rate for agricultural land not being farmed)
Forestry		
Foa	Subsidy for forest management	Determined subsidies for renovation of forests and planting of trees (e.g., in areas not suitable for agriculture)
Fob	Tree cutting limitations	Requirements for tree cutting within and outside the forest
Foc	Requirements to preserve the genetic bank of forests	Requirements for keeping the biodiversity and setting the minimum number of tree specimens in forests
Fod	Requirements for maintenance of melioration systems	Requirements for maintenance and use of melioration systems
Foe	Subsidies for enterprises	Subsidies for agricultural and forestry enterprises to elaborate innovative technologies and high added value products

Climate		
Ca	Payment for causing negative environmental effects	Payment to state for causing negative environmental effect due to deforestation (reducing CO_2 capturing potential)
Cb	Natural resource tax	Determined tax for GHG emissions from stationary installations
Cc	Requirements for activities with manure	Requirements for collection, storage and distribution of manure

The scoring of the interactions was performed in a step-wise, iterative fashion, using multiple sources of information (expert judgement, interviews with stakeholders, scientific and grey literature) as guided by a project document (Munaretto and Witmer, 2017). The scoring matrix (Table 4.4) is built on considerations of only direct interactions between nexus critical instruments and nexus critical objectives with additional considerations, when relevant, of the long-term objectives and the context factors (e.g., geographic, socio-economic domains). Justification of interactions is presented in Annex 2.

Table 4.4. Interactions between nexus critical instruments and nexus critical objectives

	E1	E2	E3	FA1	FA2	FA3	W1	W2	W3	L1	L2	FO1	FO2	C1	C2	Tot.n. (+)	Tot.n.(-)	Tot.n.(-/+)
Ea	+3	+2	+1	+2	+2	+1	0	0	0	0	0	0	0	+2	0	7	0	0
Eb	+3	0	+1	+1	+1	0	0	0	0	0	0	0	0	+3	0	5	0	0
Ec	-1	-1	0	+2	+1	0	0	+1	+1	0	+3	+2	0	0	+1	7	2	0
Ed	+1	+1	0	0	+2	+1	0	-2	-1	-1	-2	0	0	+2	-2	5	5	0
Ee	+1	0	+3	0	0	0	0	0	0	0	0	0	0	+2	+1	4	0	0
Ef	0	0	+2	0	0	0	0	0	0	0	0	0	0	+1	0	2	0	0
Eg	+3	+3	+1	+2	+2	+1	0	-1/0	-1/0	-1/+1	-1/0	0	0	+2	-1/0	7	4	1
Fa	0	0	0	+3	+1	+3	0	+1	+1	+2	+1	0	0	0	+1	8	0	0
Fb	0	0	0	+1	0	+2	0	+1	+2	+2	-2/+2	0	0	0	-2/+2	5	0	2
Fc	0	0	0	0	+2	0	+1	+2	+2	0	0	0	0	0	0	4	0	0
Fd	0	0	0	0	+2	0	+1	+2	+2	0	+2	0	0	+1	0	6	0	0
Fe	0	0	0	0	+1	-1/+1	0	+1	+1	0	+1	0	0	+1	+1	6	0	1
Wa	0	0	0	0	+2	0	+1	+2	+1	-1/+1	0	0	0	0	0/+1	5	0	1
Wb	0	0	0	0	0	0	+3	+2	+2	0	0	0	0	0	+1	4	0	0
Wc	0	0	0	0	+3	0	+2	+2	+1	0	+1	0	-1/+1	0	+1	6	0	1
La	-1/+1	0	0	0	0	-1/+1	0	0	0	+3	0	+3	0	+2	+1	4	0	2
Lb	-2	0	0	0	0	0	0	0	0	+1	0	+1	0	-1/+1	+1	3	1	1
Lc	0	0	0	+2	0	+2	0	0	0	+3	0	0	0	0	0	3	0	0
Foa	+2	0	0	-1	0	+1	0	+2	+1	+2	+1	+3	+2	+3	+3	10	1	0
Fob	-2	0	0	0	0	-1	0	+1	+1	+2	+1	+3	-1	+3	+3	7	3	0
Foc	-1	0	0	0	0	0	0	0	0	0	0	+3	0	+1	+2	3	1	0
Fod	0	0	0	0	0	0	0	0	0	+1	+3	+3	+1	+2	+2	6	0	0
Foe	0	+1	0	+2	+2	+3	0	0	0	0	0	0	+3	0	0	5	0	0
Ca	-2	0	0	0	0	-1	0	0	0	+1	0	+3	-1	+3	+1	4	3	0
Cb	+2	+1	+2	+1	+2	-1	0	0	0	0	0	0	0	+3	0	6	1	0
Cc	0	0	0	+1	+2	0	+1	+3	+2	0	+2	0	0	+2	0	7	0	0
Tot.n.(+)	7	5	6	10	14	8	6	12	12	9	9	8	3	16	14			
Tot.n.(-)	5	1	0	1	0	3	0	2	2	1	2	0	2	0	2			
Tot.n.(-/+)	1	0	0	0	0	2	0	0	0	2	1	0	1	1	1			

The assessment of the interactions between nexus critical instruments and nexus critical objectives indicates that policy instruments partly supports implementation of nexus critical objectives in energy, food and agriculture, water, land, forestry, and climate sectors. In energy sector, several instruments favouring the increase of use of RES sources (Ea, Eb) supports the achievement of respective energy and climate objectives and contribute positively to food and agriculture objectives by favouring agricultural waste minimization. On the other hand, the instrument specifically supporting subsidized energy production from agricultural or forestry biomass (Ed) reveals constraints in the achievement of water objectives, land objectives and climate adaptation objectives through negative effects from growing energy crops. Energy efficiency instruments (Ee, Ef) have synergies with energy and climate objectives. Somewhat contradicting interactions to nexus critical objectives are found by instruments on market penetration of RES in transport (Eg) compared to criteria for sustainability of biofuels (Ec). While market penetration of RES based alternative fuels strongly supports energy, GHG emission reduction and food and agriculture goals, these can hinder the achievement of water and land-use objectives if mono-culture crops are grown for 1st generation biofuel production. In contrast, criteria for sustainability of biofuels (Ec) may impede the energy objectives while supporting the food and agriculture objectives, water objectives, land objectives, forestry objectives and adaptation to climate change.

Interactions between instruments in food and agriculture sector supports the achievement of objectives in the food and agriculture sector because they enable the efficient use of resources (e.g., agricultural land, protection against flooding of fields) and prevention of pollution (e.g., from manure storage facilities, from application of fertilizers). Also, these instruments contribute to the achievement of water, land, and climate objectives. Instruments in the water sector contribute strongly to the achievement of the water objectives, and harmonically support the land-use and climate adaptation objectives. Land-use instruments support strongly the objective on efficient use of land (L1) while the objective on quality of soil and biodiversity (L2) is rather addressed by instruments in other policy areas. Instruments concerning the land use change (La) and wind turbine location (Lb) promote achievement of land-use and forestry objectives on sustainable use of resource but may not support energy objectives by the limitations for location of wind turbines hindering the increased use of RES. On the other hand, for the achievement of energy goals the potentially conflicting interactions concern the development of RES infrastructures (i.e., wind turbines) which have impacts on land use and forestry (CO_2 sequestration) goals and on maintaining biodiversity and natural environment (protected areas).

In forestry sector, instruments concerning the forest management activities are combined harmonically with climate and land-use objectives while the energy objective on increased share of renewable energy on the one hand is enhanced by incremental volume of forest biomass but on the other hand is hindered by limitations to the forest preservation and biomass harvesting. Limitations to tree cutting have a positive effect on protection of aquatic environment thus also supporting water objectives. The instrument on subsidies to agricultural and forestry enterprises (Foe) enhances attainment of objectives in energy, food and agriculture, and forestry sectors by promoting innovative technologies, economic activity, and production of high added value products.

The instrument that is most effectively combined with the majority of nexus critical objectives is in forestry sector (Foa) "Subsidy for forest management" (total score of "+" 20). This instrument focuses on renovation of forest and planting of trees to promote well maintained forest supporting attainment of objectives in all nexus sectors. In Latvia, forestry is key to sustainability of biomass resources and a key sector supporting economic development. Controversial instruments are (Ed): "Subsidy for energy production from agricultural and forestry biomass" (score of "+" 7, score of "-"8) and (Ca): "Payment for causing negative environmental effects due to deforestation" (score of "+" 8, score of "-"4).

The combined effect of nexus critical instruments is strongly supportive in the achievement of climate goals: (C1) climate change mitigation objective (number of "+" 16), and (C2) climate adaptation objective, as well as water objectives on goals related to protection of aquatic environment (W2, W3), and to food and agriculture objectives - to prevent deterioration of ecosystems (FA2) and to increase efficiency of use of resources (FA1). Somewhat ambiguous combined effect of nexus critical instruments applies to the energy goals on (E1) increase use of renewable energy sources (number of "+" 7, "-" 5). Instruments favourable to economic conditions (e.g., promoting market penetration, relief from natural resource tax, subsidies) support the RES increase. Conditions set by the instruments on resource sustainability affects economic activities e.g., limitations to tree cutting and payment for negative environmental effects due to deforestation, request to preserve the genetic bank of forests, limitations for location of wind turbines. The achievement of the goal (FA3) increase of economic development of rural areas (number of "+"8, "-" 3) is mainly supported by direct payments and subsidies to entrepreneurs for certain activities while the restrictions to the resource use (e.g., limitation to tree cutting, averting of deforestation, tax for GHG emissions) can be a hindering factor. Attainment of the goal (FO2) on production of high added value forestry products (number of "+"3, "-" 2) is mainly effected by forestry instruments and poorly supported by instruments in other nexus areas.

4.3. Assessment of vertical interactions between policies

This sub-chapter highlights the interactions between the EU and national policies in the relevant Nexus sectors of the Latvia case study. Few global policies important for the Latvia case study are also included in the analyses. The assessment is based on the available literature sources and communication with stakeholders. The analysis is focused the following key questions:

1) to what extent higher level policies (objectives and instruments) are transposed and implemented at lower level and why;
2) what are the factors supporting or hindering the implementation of higher level policies at lower level;
3) to what extent lower level policies (objectives and instruments) are supported or hindered by higher level policies and why.

Being an EU Member state, Latvia is following the obligations derived from the EU legislative framework including transposition of the provisions of the EU Directives into the national legislation and implementing the requirements. The results of the analyses of vertical interactions among the policies and illustration how these interactions hamper or support the achievement of the NCOs in the Latvia case study is summarised in Table 4.5.

Table 4.5. Vertical interactions among policies

HIGHER>LOWER	
Higher level policies successfully implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
Kyoto Protocol	Ratified and fully adopted in Latvia in 2002 for reaching the goals of the climate policy and reduction of greenhouse gas emissions for the period from 2008 – 2012 (quantitative commitments). Latvia is participating in the EU Emission trading system (EU ETS), International emission trading scheme, as well as joint implementation projects and clean development mechanisms.
Doha amendment of the Kyoto Protocol	Ratified and fully adopted in Latvia in 2017 (Law "On the Doha Amendment to the Kyoto Protocol of the United Nations Framework Convention on Climate Change" of 01.10.2015) for reaching the goals of the Climate policy i.e. reduction of GHG emissions for the period from 2013 – 2020. Ratification of Doha amendment of the Kyoto Protocol does not change the Latvia Climate Policy goals and targets related to reduction of GHG emission undertaken already by

	earlier commitments.
Paris Agreement	Ratified in Latvia in 2017 (Law "On United Nations Framework Convention on Climate Change Paris Agreement" of 02.02.2017) for reduction of GHG emissions and improve the ability for adaptation to climate change. Latvia is already following implementation of the Goals defined in the Paris Agreement thus ratification of the Agreement does not have a significant impact on the society.
Fuel Quality Directive 98/70/EC	Cabinet of Ministers Regulation No. 545 "Regulations Regarding the Sustainability Criteria for Biofuels and Bioliquids, the Mechanism for Introducing Thereof, and the Procedure by Which They Shall Be Supervised and Monitored (of 05.07.2011) and Cabinet of Ministers Regulation No.772 "Regulations Regarding Requirements for Biofuel Quality, Conformity Assessment, Market Supervision and Procedures for Consumer Information" (of 18.10.2005)
Energy efficiency Directive 2012/27/EU	Requirements are transposed in Latvia by the Energy Efficiency Law (adopted in 2016) and by the Law "On the Energy Performance of Buildings" (adopted in 2013).
Water Framework Directive 2000/60/EC	Requirements are transposed in Latvia by Water Management Law (adopted in 2002).
The Drinking Water Directive 98/83/EC	Requirements are transposed in Latvia by the Cabinet of Ministers Regulation No. 671 (of 14.11.2017)
Groundwater Directive 2006/118/EC	Requirements are transposed in Latvia by the Cabinet of Ministers Regulation No. 118 "Regulations Regarding the Quality of Surface Waters and Groundwaters" (of 12.03.2002)
Nitrates Directive 91/676/EEC	Requirements are transposed in Latvia by the Law "On Pollution (adopted in 2001) and several Cabinet of Ministers Regulations.
Helsinki Convention	Ratified and adopted in Latvia by Law on Helsinki Conventions on the protection of marine environment of the Baltic Sea are (adopted in 1994)
GHG emission allowance trading Directive 2003/87/EC	Requirements are transposed in Latvia by the Law on Pollution (adopted in 2001) and by the Cabinet of Ministers Regulation No. 769 "Regulations Regarding Participation of Stationary Technological Installations in the Emission Allowance Trading Scheme of the European Union" (of 13.11.2012).
Higher level policies only partly implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
Renewable Energy Directive 2009/28/EC	Requirements are transposed in Latvia by Energy Law (adopted in 1998), Electricity Market Law (adopted in 2005) and Biofuel Law (adopted in 15.04.2005). Development of regulation to achieve the 10% share of RES in

	transport is in the process.
Directive (EU) 2015/1513 on quality of petrol and diesel fuels	Transposition of the requirements is in the process.
Directive on alternative fuel infrastructure Directive 2014/94/EU	Requirements are transposed in Latvia by Cabinet of Ministers Order No 202 (adopted in 2017). Implementation of the requirements set by the Order is in process and will be done according to the prescribed deadlines up to the year 2030.
Higher level policies poorly implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
None	None
LOWER >HIGHER	
Lower level policies fully supported by higher level policies	
Policy	Description of reason and how NCOs are influenced
“Long-Term Energy Strategy of Latvia 2030 - Competitive Energy for the Society”	Adopted in 2013 for promotion of sustainable energy. It focusses on increasing energy efficiency and use of renewable energy sources, safety of energy supply for consumers. Fully supported by higher (European) level policies (Directive 2008/28/EC, Directive 2012/27/EU).
“The Guidelines for the Development of Energy Sector for 2016-2020”	Adopted in 2016 to increase the competitiveness of national economy. It focuses on sustainable energy development – increasing of energy efficiency, use of RES, reduction of GHG emissions. Fully supported by higher (European) level policies (Directive 2008/28/EC, Directive 2012/27/EU, (Directive 2008/28/EC, Directive 2012/27/EU).
“Long-term strategy for refurbishment of buildings 2014 - 2020”	Adopted in 2014 to increase the energy performance of buildings. Focuses on residential and non-residential buildings. Fully supported by higher (European) level policies (Directive 2009/28/EC).
Electricity Market Law	Adopted in 2005 to establish prerequisites for the operation of an efficiently functioning electricity market and to promote the production of electricity by using renewable energy resources (incentive measures are determined). It governs the types of activities to be performed in the electricity market - production, transmission, distribution, trade of electricity as a free circulation commodity and the provision of services necessary for the trade. Fully supported

	by higher (European) level policies (Directive 2009/28/EC).
Energy Efficiency Law	Adopted in 2016 for increasing the energy efficiency. It focuses on energy efficiency planning and monitoring requirements and on efficiency conditions for energy production, transmission, and distribution. Fully supported by higher (European) level policies (Directive 2009/28/EC).
Law On the Energy Performance of Buildings	Adopted in 2013 to increase energy performance of buildings. It sets minimum energy performance standards for existing, planned, refurbished, renovated. Fully supported by higher (European) level policies (Directive 2009/28/EC).
Cabinet of Ministers Order No 202 "Plan for development of alternative fuels 2017 – 2020"	Adopted in 2017 to reduce negative impact of transport on the environment (reduction of GHG emissions). It focuses on creation of the infrastructure for alternative fuels. Fully supported by higher (European) level policies (Directive 2014/94/EU).
"Latvia – Rural Development Programme (National) 2014 – 2020"	Adopted in 2015 (last time amended in 09.02.2018) to utilize the European Agricultural Fund for Rural Development (EAFRD) funding for agriculture and rural development. It focuses on management and control of the funds granted. Fully supported by higher (European) level policies (Regulation (EU) No 1303/2013, Regulation (EU) No 1305/2013, Regulation (EU) No 1306/2013, Regulation (EU) No 1310/2013, etc.).
Law On Agriculture and Rural Development	Adopted in 2004 to provide a legal basis for agricultural development and to specify sustainable agricultural and rural development policy. It focuses on State aid and the EU support to be granted to promote agricultural, rural and fisheries development. Fully supported by higher (European) level policies (the Common Agricultural Policy and the Common Fisheries Policy).
Cabinet of Ministers Order No 611 "The Guidelines for the development of forestry and related branches 2015.-2020"	Adopted in 2015 to support sustainable management of forests. It strives for internationally recognized sustainable, competitive forestry producing high added value products. It focuses at ensuring availability of wood-based resources and on the possibilities for increasing CO_2 sequestration potential. Fully supported by higher (European) level policies (EU Forest Strategy adopted in 2013).
Water Management Law	Adopted in 2002 for the protection and management of surface water and groundwater. It focuses on the emission limitation from sources of point pollution and diffuse pollution, reduction of flood risk Fully supported by higher (European) level policies (Directive 2000/60/EC, Directive 2006/7/EC, Directive 2006/118/EC, Directive 2007/60/EC, Directive 2008/105/EC).
Law on Specially Protected Nature	Adopted in 1993 for protection and preservation of natural diversity. It focuses on specially protected nature territories - strict nature reserves, national parks,

Territories	biosphere reserves, nature parks, nature monuments, nature reserves, protected sea territories and protected landscape areas. Fully supported by higher (European) level policies (Directive 92/43/EEC, Directive 2009/147/EEC, Directive 2008/56/EC).
Lower level policies only partly supported by higher level policies	
Policy	Description of reason and how NCOs are influenced
None	None
Lower level policies hindered/disrupted by higher level policies	
Policy	Description of reason and how NCOs are influenced
None	None

The analyses of vertical interactions among higher and lower level policies for the Latvia case study show that there are no higher (European Union) level policies that hamper the implementation of national scale policies. The Nexus related policy goals are supported by the EU policies having common targets and priorities. Latvia has transposed most of the provisions set by the EU legislative framework in the relevant legislative acts – Laws, Cabinet of Ministers Regulations and Orders. Legislative acts adopted before the accession of Latvia in the EU are being updated taking into consideration the most recent developments and changes. Transposition of requirements related to promotion of the production and use of alternative fuels is still in the process. It includes setting the national policy framework for the market development of alternative fuels and their infrastructure, technical specifications for recharging and refuelling stations and appropriate consumer information on alternative fuels. Transposition of additional requirements related to the sustainability of biofuels and reaching of the 10% share of RES in transport is still in the process.

The EU **Climate** policy comprise a set of regulations to be directly implemented by Member States. It is a challenge in implementation to find a balance between reduction of GHG emissions, conditions for economic development and the social dimension. As a common practice, national policies are developed from the perspective of sectorial interests. Given the horizontal nature of Climate policy, experts from the Ministry of Environmental protection and regional development (MEPRD) have pointed out the need for close cooperation and involvement of stakeholders from various sectors to develop national legislation supporting practical implementation of the requirements and achieving the targets.

Regarding the implementation of the Nexus policies on climate change mitigation, the targets for Latvia set in the Kyoto Protocol for 2020 require the 21% reduction of GHG emissions in the ETS sector but allows to increase GHG emission by 17% in the non-ETS sector (compared to the year 2005). Experts envisage that this goal will be reached. However, further reduction of GHG emissions for reaching the targets set for the year 2030 will need implementation of additional measures. In the non-ETS sector, the transport sector, households, and the food production are generating the highest share of GHG emissions in the country. Experts from MEPRD have acknowledged that more efforts shall be devoted towards increasing the amount of carbon sequestration (yearly target is 16.302 Mt

CO_2) and paying attention to the forestry branch to ensure sustainable dynamics and diverse structure of forests in Latvia[15].

Aiming at reduction of GHG emissions, Latvia has joined 2 international emission trading schemes. By participating in these schemes during the period from 2009 to 2016, Latvia has received financing of EUR 250 million. Approximately EUR 200 million was redirected for the Climate Change Financial Instrument (CCFI). Meanwhile EUR 50 million was redirected for the Auctioning Instrument of Emission Allowances (AIEA). The funding is to be used for projects envisaging the reduction of climate change and have been allocated according to tendering procedure. [16] The CCFI projects implemented within the period from 2009 to 2015 in overall have achieved their goals of emission reduction, while implementation of AIEA projects was commenced only in 2016. The State Audit Office performing an audit in 2017 have identified certain drawbacks in management of the funding available e.g., lack of action plan for reduction of climate change, on allocation of funds for other purposes not directly linked with reducing climate change. [17],[18]

In the **Energy sector**, according to the targets set by the Directive 2009/28/EC (Annex I), Latvia shall reach the 40% share of energy from renewable sources in gross final consumption of energy in 2020 (compared to 32.6% in 2005). In 2015 the indicator constituted 37.6 %. From 2011 to 2016, the gross energy consumption has not changed significantly (184.5 PJ in 2016) while the share of renewables in it has increased.[19] Renewable electricity generation has been stimulated through a complex support system based on a feed-in tariff having a positive impact on energy production from RES in the country. However, national subsidies are applied also in large CHP installations where natural gas is used. Such constellation creates distortion and discredits this instrument. Electricity production from renewable energy sources e.g., wind, solar is progressing on slow pace, thus making it difficult to achieve the EU renewable energy targets. Since 1 January 2014 electricity production from RES has been promoted also through net-metering. However, it has been acknowledged that subsidising the use of natural gas in cogeneration, projects requiring high investments, production of energy from renewable sources has created a heavy financial obligations for electricity users due to the mandatory purchase mechanism and will remain high for the next coming years. [20] A proposal for a national support mechanism for electricity production from RES should be developed in 2018.[21], [22]

[15] Eksperti: Latvijai smagi jāstrādā, lai sasniegtu Parīzes klimata pārmaiņu nolīguma mērķus https://www.lsm.lv/raksts/zinas/latvija/eksperti-latvijai-smagi-jastrada-lai-sasniegtu-parizes-klimata-parmainu-noliguma-merkus.a179663/

[16] The State Audit Office (2017), Still much work ahead for VARAM to implement a targeted climate policy, http://www.lrvk.gov.lv/en/still-much-work-ahead-varam-implement-targeted-climate-policy/

[17] Latvijas Republikas Valsts kontrole (2017), Vai Vides aizsardzības un reģionālās attīstības ministrijas administrētie klimata pārmaiņu samazināšanai paredzētie līdzekļi tiek plānoti un izlietoti efektīvi un atbilstoši normatīvo aktu prasībām?, http://www.lrvk.gov.lv/uploads/reviziju-zinojumi/2016/2.4.1-16_2016/revizijas-zinojums-varam.pdf

[18] Latvijas Republikas Valsts kontrole (10/03/2017) VARAM vēl daudz darāmā mērķtiecīgas klimata politikas īstenošanā, http://www.lrvk.gov.lv/varam-vel-daudz-darama-merktiecigas-klimata-politikas-istenosana/

[19] Central Statistical Bureau of Latvia (20.06.2017). Share of renewable energy resources in gross energy consumption increases, http://www.csb.gov.lv/en/notikumi/share-renewable-energy-resources-gross-energy-consumption-increases-45897.html

[20] Enerģētikas Drošības Komisija (2018). Komisijas darba pārskata ziņojums (30.11.2016 – 31.01.2018), https://www.president.lv/storage/kcfinder/files/citi/Energetikas_komisijas_zinojums_31012018(1).pdf

[21] RES LEGAL Europe, http://www.res-legal.eu/search-by-country/latvia/

Concerning the use of renewables in transport sector, the share of renewables constituted 3.9% in 2015 (10% target to be reached by 2020).[23] In Latvia, renewable energy use in the transport sector is promoted through obligation to sell petrol and diesel blended with biofuels and a tax regulation mechanism. [24]

Regarding implementation of requirements on fuel quality, the sustainability criteria for biofuels have been set, however, there is no obligation to sell petrol and diesel blended only with biofuels corresponding to the sustainability criteria. There are also no exemptions for application of reduced excise duty tax for all biofuels. Thus, for reaching the target - 10% of energy in transport from renewable sources by 2020, there is a need to amend the legislation with requirements regarding application of sustainability criteria of biofuels (including the revision of the excise duty tax). [25]

With respect to energy efficiency, pursuant to the Directive 2012/27/EU (Article 3), the indicative national energy efficiency target, based on primary energy savings in 2020 is 0.670 Mtoe (28 PJ) which corresponds to final energy savings of 0.457 Mtoe (19 PJ).[26] It is estimated that the measures implemented and envisaged will result only in 14.6% of this mandatory target. Implementation of additional measures e.g., introduction of Energy Efficiency Obligation Schemes (EEOS)[27] to reach the target is necessary. Additional measures e.g. utilisation of Auctioning Instrument of Emission Allowances (AIEA), changes in taxation system, voluntary agreements with entrepreneurs on increasing energy efficiency and with public sector (municipalities) on introduction of energy management systems shall be applied as well. [28]

Implementation of the EU Common **Agricultural** Policy in Latvia is based on National Rural Development Program (NRDP). Opinion of the Ministry of Agriculture[29] is that implementation of NRDP in the period 2014 -2020 is successful. Availability of EU funding has secured 2.3-fold increase in agricultural production, 3-fold increase in income per person employed in agriculture in the year 2017 as compared to 2004. Within this period the added value of agriculture has increased by 39%.[30]

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[22] Klūga M., lsm.lv ziņu redakcija, (17.04.2018). Priekšlikumi OIK maksājumu atcelšanai valdībā jāiesniedz līdz septembrim, https://www.lsm.lv/raksts/zinas/ekonomika/priekslikumi-oik-maksajumu-atcelsanai-valdiba-jaiesniedz-lidz-septembrim.a275269/

[23] Central Statistical Bureau of Latvia (20.06.2017). Share of renewable energy resources in gross energy consumption increases, http://www.csb.gov.lv/en/notikumi/share-renewable-energy-resources-gross-energy-consumption-increases-45897.html

[24] RES LEGAL Europe, http://www.res-legal.eu/search-by-country/latvia

[25] MK Rīkojums Nr. 379 (21.07.2017) Par konceptuālo ziņojumu "Par atjaunojamo energoresursu izmantošanu transporta sektorā"

[26] Report on the progress achieved in 2014 towards implementing national energy efficiency targets for the year 2020 pursuant to Article 24(1) and Section 1 of Annex XIV to Directive 2012/27/EU, https://ec.europa.eu/energy/sites/ener/files/documents/Latvia%202016%20Energy%20Efficiency%20Annual%20Report%20EN.pdf

[27] Association Technique Energie Environment (30.06.2017). Snapshot of Energy Efficiency Obligations schemes in Europe: 2017 update, http://atee.fr/sites/default/files/part_6-_2017_snapshot_of_eeos_in_europe.pdf

[28] MK Rīkojums Nr. 257 (24.05.2017), Par Energoefektivitātes politikas alternatīvo pasākumu plānu enerģijas galapatēriņa ietaupījuma mērķa 2014.- 2020. gadam sasniegšanai

[29] Lauku attīstības programma 2018. gadā – ražošanas attīstībai, zināšanu pilnveidei un inovācijām (05.02.2018) https://lvportals.lv/autors/862-zemkopibas-ministrija

[30] Avotiņš V. (12.02.2018). Jānis Dūklavs: Latvija bez laukiem nav iedomājama http://news.lv/Neatkariga_Rita_Avize_Latvijai/2018/02/12/janis-duklavs-latvija-bez-laukiem-nav-iedomajama

However, challenge for the agriculture sector is a discrepancy of direct payments per ha between different EU Member States. Direct payments in Latvia are among the lowest ones: 196 EUR/ha is planned for 2020 and 202 EUR/ha in 2026.[31] Additional challenge is related to decrease in population creating a shortage of human resources employed in agriculture sector and having a negative impact on regional development in rural areas. In future the key focus of agriculture in Latvia shall be on adaptation to market fluctuations, innovations, modernisation of production technologies including increase of efficiency, advanced and based on needs education, adaptation to climate change and reduction of GHG emissions.[32] In contrast, by opinion of environmental NGOs, the effort from current agricultural practice in Latvia is insufficient for maintaining of environmental sustainability e.g., resulting in loss of semi natural meadows. According to the Latvia's national inventory report 1990 – 2016, other examples of agricultural practices having a negative impact on environment and climate change is related to increase of GHG emissions from management of agricultural soils (increase of N_2O emissions because of application of fertilisers, increase of CO_2 emissions because of liming of soils), manure management and the enteric fermentation of domestic livestock.

River basin management planning is a back-bone in implementation of the EU **Water** policy in Latvia. Four river basin districts are distinguished, and the respective River basin Management Plans are elaborated. However, the planning process does not go smoothly due to lack of man power, capacities, as well as fragmented background data and scarce availability of estimated effects from measures already implemented. This makes the planning ambiguous and creates resistance towards new measures. For example, farmers are reluctant to implement more stringent requirements to protect the water resources.

Protection of natural resources through **land** management is ensured by implementation of the provisions for specially protected nature territories in Latvia. Regulations on protection and use of these territories - types of permissible and prohibited activities (e.g., tree cutting, land use, transformation of land) are determined on national, regional, and local level. Land owners have a yearly right to apply for and receive compensation for restriction of economic activities in the protected nature territories (45-160 EUR/ha depending on restrictions in the given territory).[33],[34],[35] Although the management system of protected nature territories is in place since many years, land/forest owners report on various uncertainties related to changes in protection status of the areas, insufficient information on new restrictions, the amount and procedure for receiving compensations.[36]

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[31] Ministry of Agriculture (01.06.2018), Zemkopības ministrs Jānis Dūklavs: Eiropas Komisijas priekšlikums būtiski samazināt finansējumu lauksaimniecībai apdraud Latvijas lauku attīstību, https://lvportals.lv/autors/862-zemkopibas-ministrija

[32] Avotiņš V. (12.02.2018). Jānis Dūklavs: Latvija bez laukiem nav iedomājama http://news.lv/Neatkariga_Rita_Avize_Latvijai/2018/02/12/janis-duklavs-latvija-bez-laukiem-nav-iedomajama

[33] Latvijas Avīze (16.02.2014), Saimniekošanas iespējas mežā, kas atrodas dabas lieguma zonā, http://www.la.lv/mezs-dabas-lieguma-zona%E2%80%A9/

[34] Likums "Par īpaši aizsargājamām dabas teritorijām" // Law on Specially Protected Nature Territories, https://likumi.lv/ta/id/59994-par-ipasi-aizsargajamam-dabas-teritorijam

[35] Rūtenberga-Bērziņa I. (09.04.2018). Sazināsies ar meža īpašniekiem, kuri nepiesakās NATURA 2000 kompensācijai, http://new.llkc.lv/lv/nozares/mezsaimnieciba/sazinasies-ar-meza-ipasniekiem-kuri-nepiesakas-natura-2000-kompensacijai

[36] Dzedulis Z. (28.09.2017), Pārprastas dabas aizsardzības dēļ meža īpašnieks – muļķa lomā, http://laukos.la.lv/cik-ilgi-vel-jagaida-trispirkstu-dzenis/

Although being in favour for nature protection in general, landowners have pointed the dissatisfaction due to decrease in income because of nature conservation restrictions. Both nature conservation experts and forest/land owners acknowledge the need for a closer dialogue between the stakeholders to find the balance between nature protection needs and economic activities. [37]

The **forest** sector is one of the key pillars of the national economy.[38] Forests cover more than 3 million ha or about 50% of the territory of Latvia.[39] The area of forestland and the total volume of timber is growing due to sustainable forest management activities, afforestation of infertile land and land not suitable for agriculture, growing of trees, application of modern technologies in forestry. In average about 12 million m^3 of timber have been harvested yearly, but less than annual increment. At the same time, stakeholders have admitted that more attention in the forest management shall be paid towards the increase of CO_2 sequestration potential by better management of the age structure of forests in the country.[40]

Environmental NGOs are closely following the policy development in the forestry sector and have pointed out the need to increase that involvement of the society to ensure the transparency and openness in the forestry policy development process.[41] Environmental NGOs have emphasized that finding compromises between social (e.g., society needs for ecosystem services), economic (e.g., increasing demand in timber), and environmental (e.g., biodiversity protection, adaptation to climate change) needs is very important to ensure sustainable forest development. These aspects shall be incorporated into the forest management programs to serve the multipurpose goals. [42] Moreover, the knowledge and awareness of forest managers on forest ecosystems, responsibility of forest owners shall be increased. [43]

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[37] Ambote S. (28.09.2017). Dabas skaitīšana atsegusi dabas un ekonomisko interešu sadursmi, https://www.lsm.lv/raksts/zinas/ekonomika/dabas-skaitisana-atsegusi-dabas-un-ekonomisko-interesu-sadursmi.a251746/

[38] Meža Avīze (04/10/2017), Meža nozare iezīmē nākotnes izaicinājumus, http://www.mezaavize.lv/meza-nozare-iezime-nakotnes-izaicinajumus/

[39] Biedrība "Zaļās mājas" Latvian forest sector in facts and figures 2018, https://www.zm.gov.lv/public/ck/files/skaitlifakti_EN_2018web.pdf

[40] Biedrība "Zaļās mājas" (2016), Meža nozare Latvijas 25.neatkarības gados, https://www.zm.gov.lv/public/ck/files/Meza_nozare_25_%20(1).pdf

[41] Pasaules Dabas Fonds (201.12.2017). Vides organizācijas aicina uz caurspīdīgu un atklātu mežu politikas veidošanas procesu, http://lv-pdf.panda.org/sugas_ekosistmas/mezs2/?228010/aicina%2Duz%2Dcaurspidigu%2Dun%2Datklatu%2Dmezu%2Dpolitikas%2Dveidosanas%2Dprocesu

[42] Pasaules Dabas Fonds, Problēmas Latvijas mežsaimniecībā, http://lv-pdf.panda.org/sugas_ekosistmas/mezs2/

[43] Pasaules Dabas Fonds, Problēmas Latvijas mežsaimniecībā, http://lv-pdf.panda.org/sugas_ekosistmas/mezs2/

5. Formal and informal arrangements adopted to address conflicts, negotiate trade-offs and exploit synergies in practice

This chapter presents practices of policy implementation relevant to the NCOs of the Latvia case study. It highlights how problems and opportunities are managed by formal and informal rules/practices. The chapter reflects enabling and hindering factors explored based on the literature and communication of stakeholders. The results of the analyses summarising formal and informal arrangements, description of each arrangement, enabling and limiting factors and the effects on achievements of NCOs is presented in Table 5.1.

Table 5.1. Formal and informal arrangements

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of nexus critical objectives
Formal	Council for National Economy – Collaboration between Ministry of Economics, Latvian Chamber of Commerce and Industry, Employers' Confederation of Latvia, Free Trade Union Confederation of Latvia, The Latvian Association of Local and Regional Governments	Elaborates and evaluates proposals for the long-term development of national economy	The Council meets upon the need, organizes working groups on various topics e.g. energy, involving stakeholders in evaluation and elaboration of proposals. Reports from the Council meetings are publicly available. The Council works effectively on elaboration of proposals to improve the policy and legislation related to entrepreneurship. The MoEconomics presents the view point of the Council in the meetings of the Cabinet of Ministers and other fora. The decisions of the Council are recommendatory.	This arrangement supports implementation of sustainability principles in the business sector
	Inter-ministerial collaboration (working group)	Elaborates coordinated opinions (in	The working group comprises high level officials (e.g., deputy	This arrangement supports the goals concerning climate

	on Climate and Energy policy for the period from 2020 – 2030	consultation with other ministries concerned) on issues related to energy and climate policy developments up to the year 2030.	State secretaries, Heads of departments) from the Ministries (MEPRD; Foreign Affairs; Economics, Transport, Finances, Agriculture) involved in the decision making on Climate and Energy issues. The Working group works effectively and elaborates the national position towards the EU 2030 Climate and Energy Framework e.g. with respect to the national GHG emission reduction targets for 2030.	change mitigation, sustainable use of energy sources
	Consultative Board for Climate Change Financing Instrument	Provides proposals (recommendations) for improvements of legislative framework related to application of climate change financial instrument (green investment scheme), follows the funding procedure and implementation of projects.	The Board comprises representatives from the Ministries (MEPRD; Economics, Transport, Agriculture, Education) and NGOs. It has been established to promote the economic efficiency of utilisation of the resources of the climate change financial instrument to promote co-operation and the exchange of information among State administrative institutions, individuals, and the public at large on issues related to implementation of the climate change financial instrument. The Council can submit proposals to the MEPRD regarding the reallocation of such resources according to priorities, which have been obtained from	This arrangement supports the goals concerning climate change mitigation (reduction of GHG emissions in energy, transport, construction sector by improving energy efficiency, promoting use of renewable energy sources)

			selling the greenhouse gas emission units belonging to the State. The Board meets regularly (twice a year) and works effectively. Decisions of the Council are of a recommendatory nature.	
	Interinstitutiona l Expert working group on climate change adaptation	Ensures information exchange on issues related to climate change adaptation (e.g., research, measures, policy documents, legislative framework). The working group shall prepare proposals for policy measures on climate change adaptation.	The Working group is compromised by specialists from ministries (MEPRD, Health, Finance, Agriculture, Transport, Economics, Welfare) and their subordinated institutions. The Working group meets at least twice a year (First meeting took place on 15 February 2018). The decisions of the working group are of a recommendatory nature.	This arrangement supports the climate change adaptation policy goals.
	The Council for cooperation on Climate technologies	Promotes information exchange and cooperation on technologies for climate change mitigation and impact reduction.	The Council is coordinated by the MEPRD. Council members are representatives from professional (branch specific) organizations e.g., various renewable energy sources, municipalities. The Council meets every 3 months. It works effectively and elaborates recommendations for improvement of national and EU policy and legislation in the field of climate change mitigation technologies. The	This arrangement supports climate change mitigation Goals (reduction of GHG emissions)

			decisions of the Council are of a recommendatory nature.	
	Environmental Consultative Board	Provides consultancy, promotes involvement of the society in policy development and implementation related to environmental protection.	The Board consists of representatives from 20 NGOs active in the field of environmental protection. The Board works very effectively. It meets at least every 2 months. The Board provides consolidated opinion on new policy and legislation developments in various fields and sectors that are having an impact on environmental protection. The decisions of the Board are of a recommendatory nature.	This arrangement supports goals of sustainable resource management, environmental protection
	River basin management consultative boards	Coordinates the interests and activities of state authorities, municipalities, entrepreneurs, NGO on issues related to environmental quality in a particular River basin.	There are 4 River basin management consultative boards in Latvia consisting of representatives from public (state, municipal) institutions, NGOs. The Boards work effectively. They provide recommendations on policy and legislation development in relation to water management and water resource protection. Each Board is having biannual meetings. The decisions of the Boards are of a recommendatory nature.	This arrangement supports meeting the water policy goals.
	Consultative board of Agricultural NGOs	Ensures collaboration between the Ministry of Agriculture and	The Consultative board consists of nine NGOs representing the interests of farmers, rural inhabitants, and food	This arrangement supports the goals of sustainable agricultural policy and rural

		NGOs	producers in Latvia. The board meets ad hoc depending on the need. The Board works effectively. It elaborates consolidated proposals for the policy development in the agriculture sector. The decisions of the Board are of a recommendatory nature except the strategical decisions on acceptance or rejection of projects.	development.
	Latvian Agricultural Organization Cooperation Council	The council is an association uniting 58 NGOs of agricultural production and processing and in total represent more than 15000 producers	The Council formulates a common opinion to represent producers' interests in the discussions with state administration. The Council works effectively. It involves agricultural NGOs in agricultural and rural development policy formation and implementation. It aims at promotion of competitive agricultural production, processing, and export, at stimulating rural development and promotion of alternative types of occupation in rural areas. The Council is meeting frequently and regularly.	This arrangement supports the goals of sustainable agricultural policy and rural development.
	Agriculture and Environment Consultative Board	The Board promotes cooperation between state and municipal institutions, NGOs in agriculture sector.	Comprises representatives from the MEPRD, Ministry of Agriculture and their subordinated institutions, environmental NGOs. The Board works effectively. It meets ad hoc depending	This arrangement supports the goals of sustainable use of land use, agriculture, and environmental protection.

			on the need. It prepares consolidated proposals for the policy development in the field of agriculture and environmental protection to ensure the balanced representation of the interests of agriculture and environmental protection. The decisions of the Board are of a recommendatory nature.	
	Consultative Board on Forestry	The Board provides consultancy and coordinates activities to promote sustainable forestry development and implementation in the country.	The Board consists of managers of public and private forests, forestry industry, environmental specialists. The Board works effectively. The Board meets at least once per quarter. It provides consultancy and coordinates submission of opinions to policy development (National, EU) in the field of forestry. The decisions of the Board are of a recommendatory nature.	This arrangement supports the goals of sustainable forestry.
Informal	Energy Committee of the "Latvian Chamber of commerce and industry" (LCCI)	LCCI Council committees are created as necessary, to discuss specific, narrower sectoral or political field matters.	The committee comprises members/experts of the association "Latvian Chamber of commerce and industry". The decisions of the Committee are of a recommendatory nature. The Committee meets ad hoc upon the need. The committee works effectively. It organizes seminars and working group discussions on actual issues related to the energy sector in the	This arrangement supports the goals of sustainable energy, energy efficiency

			country. The Committee aims to elaborate proposals for energy pricing policy (including the mandatory purchase of energy produced from RES or in cogeneration processes) promoting entrepreneurship in the country.	
	Collaboration of the Ministry of Economics with NGOs	The MoEconomics organises the collaboration with NGOs in the frame of various committees and events relevant to the fields of competences of the Ministry of Economics.	MoEconomics collaborates with more than 100 NGOs on various issues e.g., use of energy sources, energy efficiency, biofuels.	This arrangement supports the goals of sustainable development in various sectors

Both formal and informal arrangements (committees, working groups, councils) have been established between public authorities, research, business, and NGOs to ensure public participation in the policy development. One of the main aims of these arrangements are to follow up the policy developments in the respective sectors, exchange information and opinions, discuss and submit a consolidated proposal representing the common view point of the arrangement towards the national or international policy or legislation development. The collaboration works effectively as institutions/organisations are having an interest to present and share their opinions, thus organisations are actively seeking for participation in such collaborative arrangements. The factors enabling successful cooperation are related to the common goals to be achieved e.g., sustainable development, rational use of resources. On the other hand, lobbying of interests of different stakeholder groups create conflicts and hinder the successful outcome of certain arrangements, for example, there are conflicting needs and interests of:

- agri-business towards intensive agricultural practices versus soil, water, nature protection needs, and GHG emission reduction. For example, due to intensification of agricultural activities, abandonment of land and inappropriate management, melioration of grasslands, the area of natural grasslands is decreasing in Latvia. Moreover, the amount of direct payments for biodiversity maintenance in natural grasslands has decreased by 47%, thus creating unfavourable economic conditions for grassland maintenance[44], [45];

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[44] Latvijas Dabas Fonds (02.05.2013), Latvijas dabiskie zālāji mirst - par Latvijas Lauku attīstības programmas 2014.-2020. vides pasākumiem, https://ldf.lv/lv/article/latvijas-dabiskie-zalaji-mirst-par-latvijas-lauku-attistibas-programmas-2014-2020-vides

[45] Latvijas Ornitoloģijas Biedrība. Palieņu pļavas Latvijā. http://www.lob.lv/lv/LIFE_plavas/plavas_Latvija.php

- forest owners/logging companies for exploitation of forests versus the need for preservation of forest ecosystem, CO_2 sequestration, adaptation to climate change. For example, recently there was a debate between environmental NGOs, forestry policy makers, and logging companies on reduction of diameter-limit for cutting in the country that would have a significant negative impact on forest ecosystems. Environmental NGOs are closely following the policy development in the forestry sector and have pointed out the need to increase the involvement of the society to ensure the transparency and openness in the forestry policy development process.[46];
- producers of biomass for energy production (1st generation biofuels) versus soil, water and nature protection needs. Growing of rape is promoted by biofuel producers while environmental specialists are pointing out the negative impacts on environment and the need to seek new technologies and sources for 2nd and 3rd generation biofuels. [47];
- energy producers in hydropower plants (HPPs) versus the need for protection of water ecosystems, fish resources. In Latvia because of environmental concerns the current legislation restricts construction and reconstruction of HPP on certain rivers. Stakeholders have referred to frequent debates between entrepreneurs representing small HPPs and specialists from the environmental sector on negative impacts on nature and environment caused by hydropower plans.[48]

6. Success stories and failures

This chapter highlights the success stories and failures regarding the nexus policies in the case study area. Taking into consideration the issues analysed so far, the available literature sources and communication with stakeholders, the success stories and failures have been reflected with respect to policy design and policy implementation. The success stories and failures are briefly presented in the Table 6.1.

Table 6.1. Success stories and failures

Type of successful policy arrangement	Description	Factors of success, do's
Mechanism for sustainable forest management system	The policy mechanism comprises regulations determining forest	• Targeted forest management activities

[46] Pasaules Dabas Fonds (201.12.2017). Vides organizācijas aicina uz caurspīdīgu un atklātu mežu politikas veidošanas procesu, http://lv-pdf.panda.org/sugas_ekosistmas/mezs2/?228010/aicina%2Duz%2Dcaurspidigu%2Dun%2Datklatu%2Dmezu%2Dpolitikas%2Dveidosanas%2Dprocesu

[47] Latvijas Sabiedriskie mediji (13.02.2012). Dabas aizstāvji brīdina par kaitējumu videi no biodegvielas ražošanas, https://www.lsm.lv/raksts/zinas/ekonomika/dabas-aizstavji-bridina-par-kaitejumu-videi-no-biodegvielas-razosanas.a31388/

[48] Vīksne I. (15.10.2012), Mazie HES prasīs vēl piecas upes, http://nra.lv/latvija/81478-mazie-hes-prasis-vel-piecas-upes.htm

	management regime and goals of economic utilization, ecological and social priorities; and subsidies promoting sustainable forest management. A forest management plan is one of prerequisites to receive State and EU financing and co-financing for the development of forestry. Implementation of the mechanism has resulted in increased amount of wood stock due to increase in forest land and favourable forestry practices (e.g., afforestation, maintenance of genetic bank) during the recent 20 years.	
Regulations and funding for reconstruction to improve energy performance of centralised heat supply systems	Centralised heat supply system (few large scale and ca. 550 small scale installations in Latvia) has undergone substantial reconstruction and modernisation meeting the recent technological requirements.	• Availability of EU funding for renovation of centralised engineering systems
Regulations and availability of direct payments to promote agricultural production	The country has a capacity to ensure local agricultural resources for food production (crops, vegetables and potatoes, and milk and dairy) and a potential for export of high added value food products. Implementation of the mechanism has resulted in self-supply of main agricultural products, except for pork and poultry.	• Efficient use of agriculture land resources • EU Subsidies for agricultural activities
Type of unsuccessful policy arrangement	Description	• Factors of failure, don'ts
Mechanism for mandatory procurement of energy produced from renewable energy sources and co-generation	The expenses of such procurement are covered by all electricity final customers of Latvia in proportion to their electricity consumption. The Regulatory framework has not implied stability, transparency and clearly defined conditions for all players involved.	• Insufficient cost-benefit estimation • Weak management (issuing of permits) and enforcement procedure (control over installation operation and the amount of energy production) • Reduction of competitiveness due to higher costs of energy for entrepreneurs

Harmonisation of measures between sectors	Development of RBMP and Rural Support Program at a concurrent manner could be a bonus and a problem. For example, harmonization of measures between Agriculture and Water sectors requests closer coordination between the responsible authorities. Currently better cooperation is between experts and implementers; however, the attitude shall change on national level towards the environmental policy and producing sectors.	• Development programs in sectors are focused on sector specific issues • Lack of integrated approach between sectors
Mechanism for production of high added value forestry, wood processing and furniture products	Despite the focus of policy arrangement on stimulation of deeper wood processing the share of high added value wood products (e.g., furniture) in net turn-over of the sector is still low. Tax policy, limited credit resources along with small local market do not promote production of high value wood products.	• Available support mechanisms for innovation and generation of added value products are insufficient to compete with international market prices (e.g., for raw and secondary processed material)

Success and failure in implementation of policies rather depend on economic factors, such as available funding and design of economic instruments. One of the key success factors is related to efficient management practices of the resource (e.g., water, forest, agricultural land). Failures are attributed to weak management, sectorial bound perspectives and short term thinking of development.

Unsuccessful policy arrangement is in the nexus area of forestry for promotion of competitiveness and production of high added value forestry, wood processing and furniture products. The forest sector is one of the key cornerstones in the national economy and has a high export capacity. The industry still operates in the frame of long developed under market economy conditions with low added value per employee generated[49] and the policy arrangement thus focus on stimulation of deeper wood processing in a long-term development. By the opinion of Latvian Wood Industry Federation there are key preconditions to the success - for small and medium enterprises (SMEs) on availability of raw material, support to research and development (R&D) activities, access to qualified work force and sufficient local market for products; and for large companies important are access to raw material in the local market, infrastructure, qualified work force and cost competitiveness as compared to other regions. Despite the availability of financial instruments in support of innovations and business in

[49] Ozolins, J. & Nipers A. (2016) Wood and timber. Industry challenges. Certus. http://certusdomnica.lv/en/agenda/wood-and-timber/

Latvia, the response from SMEs is reserved due to rather high load of bureaucratic procedures and high effort to prepare for use of support instruments[50].

[50] Tirgus ziņojums (2017). Kokapstrādes un mēbeļu industrijas produktu inovācijas un eksporta spēju paaugstināšana Veru apgabalā un Vidzemes plānošanas reģionā.

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Annex 1. Justification of the scores assigned to interactions among the Nexus critical objectives of the selected policy sectors

Interaction	Score	Justification
Energy to Energy		
E2>E1	+3	Increasing the share of RES in transport sector increases the total share of RES in energy consumption
E3>E1	+1	Increasing energy efficiency cause increase the efficiency of energy production from RES
E1>E2	+3	Increasing the overall consumption of renewable energy sources, includes the target to increase use of RES in transport sector
E3>E2	0	There is no significant interaction between the goals
E1>E3	0	There is no significant interaction between the goals
E2>E3	0	There is no significant interaction between the goals
Energy to Food & Agriculture		
E1>FA1	+2	Increasing use of RES from agricultural activities (use of agricultural, food production residues) promotes prudent use of resources supporting low carbon economy
E2>FA1	+2	Application of innovative technologies for use of RES (e.g. from agriculture and food residues) in transport sector (i.e. 2nd generation biofuels) promote efficient use of resources
E3>FA1	+1	Increasing energy efficiency requirements fosters application of innovative technologies and subsequently also the efficiency of use of resources
E1>FA2	+1	Increasing use of RES from agricultural activities leads to waste minimisation from agriculture and food sector
E2>FA2	-2/+1	Using of 1st generation biofuels increase pollution and cause deterioration of ecosystems while production and use of 2nd and 3rd generation biofuels support reduction of the amount of biodegradable waste
E3>FA2	0	There is no significant interaction between the goals
E1>FA3	+1	Increasing use of RES can support development of entrepreneurship using RES for energy production in rural areas
E2>FA3	+1	Production of 2nd generation biofuels or electricity from RES can promote development of entrepreneurship in rural areas
E3>FA3	+1	Increasing energy efficiency cause savings for enterprises thus having a positive impact on business development
Energy to Water		

E1>W1	-1/0	Production of energy in hydropower plants can have a negative impact on water quality in surface water bodies
E2>W1	0	There is no significant interaction between the goals
E3>W1	0	There is no significant interaction between the goals
E1>W2	-2/0	Increasing production of 1st generation biofuels can have a negative impact on aquatic environment due to application of fertilisers, herbicides being applied for cultivation of energy crops
E2>W2	-2/0	Growing of energy crops for 1st generation of biofuels can cause water pollution by fertilisers and herbicides
E3>W2	0	There is no significant interaction between the goals
E1>W3	-1/0	Growing of energy crops can cause leakage of biogens and run offs into inland water bodies and the Baltic Sea
E2>W3	-1/0	Growing of energy crops for 1st generation of biofuels can cause leakage of biogens causing eutrophication of inland water bodies and the Sea
E3>W3	0	There is no significant interaction between the goals
Energy to Land		
E1>L1	-1/+1	Cultivation of monocultures of energy plants have a negative effect on land e.g. by causing land fragmentation. But it can also have a positive effect if abandoned areas are utilised or degraded areas are re-cultivated.
E2>L1	+1	Production of biofuels may increase re-cultivation of areas and utilisation of degraded areas
E3>L1	0	There is no significant interaction between the goals
E1>L2	-1/0	Growing of energy crops to produce 1st generation of biofuel causes land deterioration, while production/utilisation of wind and solar energy does not have an impact on soil quality
E2>L2	-2/0	Growing of energy crops for 1st generation biofuels cause land deterioration
E3>L2	0	There is no significant interaction between the goals
Energy to Forestry		
E1>FO1	-2/0	Cutting of trees to obtain biomass for energy production may have negative impact on forests; use of other types of RES do not have a negative impact on forest
E2>FO1	0	There is no significant interaction between the goals
E3>FO1	0	There is no significant interaction between the goals
E1>FO2	-1	Use of forest biomass for energy production can reduce the amount of biomass resource available to produce high added value forestry products
E2>FO2	0	There is no significant interaction between the goals
E3>FO2	+1	Increasing energy efficiency requirements promotes application of efficient and

		innovative technologies
Energy to Climate		
E1>C1	+2	Increasing use of RES result in reduction of GHG emissions
E2>C1	+1	Increasing use of RES in transport sector result in reduction of GHG emissions
E3>C1	+3	Increase of energy efficiency reduces GHG emissions
E1>C2	+1/0	Use of RES in decentralised and microgeneration reduces dependency on large networks thus creating better preparedness to climate change
E2>C2	-1/0	Growing of biomass for production of 1st generation biofuels can have a negative impact on biodiversity thus reducing ability for adaptation to climate change
E3>C2	+1	Increase of energy efficiency (e.g. thermal insulation of buildings) helps adaptation to climate change
Food & Agriculture to Energy		
FA1>E1	+2	Low carbon development promotes the use of RES
FA2>E1	0	There is no significant interaction between the goals
FA3>E1	0	There is no significant interaction between the goals
FA1>E2	+2	Low carbon development promotes the use of RES in transport sector
FA2>E2	0	There is no significant interaction between the goals
FA3>E2	0	There is no significant interaction between the goals
FA1>E3	0	There is no significant interaction between the goals
FA2>E3	0	There is no significant interaction between the goals
FA3>E3	0	There is no significant interaction between the goals
Food & Agriculture to Food & Agriculture		
FA2>FA1	0	There is no significant interaction between the goals
FA3>FA1	+1	Development of entrepreneurship provides favourable conditions for low carbon development, application of innovative technologies
FA1>FA2	+2	Application of innovative technologies, appropriate norms for use of organic and inorganic fertilisers promotes pollution reduction
FA3>FA2	-1/+1	The positive or negative impact on pollution level from use of resources in agriculture and food sector depends on exact type of activities of entrepreneurs
FA1>FA3	+1	Low carbon development promotes the development of economy
FA2>FA3	0	There is no significant interaction between the goals
Food & Agriculture to Water		
FA1>W1	0	There is no significant interaction between the goals

FA2>W1	+2	Reduction of pollution from agriculture and food sectors improves water quality
FA3>W1	0	There is no significant interaction between the goals
FA1>W2	+1	Application of innovative technologies, appropriate norms for use of organic and inorganic fertilisers promotes reduction of water pollution
FA2>W2	+3	Reduction of pollution from agriculture and food sectors reduces leakage of nutrients to water bodies
FA3>W2	-1/0	Depending on type of activities of entrepreneurs the impact can be neutral or negative if the economic activity creates leakage e.g., of nutrients to water bodies
FA1>W3	+1	Application of innovative technologies, appropriate norms for use of organic and inorganic fertilisers promotes reduction of water pollution including reduction of eutrophication of inland water bodies and the sea
FA2>W3	+3	Reduction of pollution from agriculture and food sectors reduces leakage of nutrients to water bodies further causing eutrophication of the sea
FA3>W3	-1/0	Depending on type of activities of entrepreneurs the impact can be neutral or negative if the economic activity creates leakage e.g., of nutrients to water bodies
Food & Agriculture to Land		
FA1>L1	0	There is no significant interaction between the goals
FA2>L1	0	There is no significant interaction between the goals
FA3>L1	-1/+1	Depending on type of activities the impact from business activities on efficient land use can be positive or negative
FA1>L2	+2	Application of modern technologies allows e.g., by applying precise agriculture methods reduces soil deterioration, helps preserving soil biodiversity
FA2>L2	+2	Reduction of pollution from agriculture and food sector increase the soil quality
FA3>L2	-1/+1	Depending on type of activities the impact from business activities on soil quality can be positive or negative
Food & Agriculture to Forestry		
FA1>FO1	0	There is no significant interaction between the goals
FA2>FO1	0	There is no significant interaction between the goals
FA3>FO1	-1/+1	The impact is negative if the type of activity is related to intensive cutting of trees in forests e.g., for erection of arable land, or positive if sustainable forestry management methods are applied
FA1>FO2	0	There is no significant interaction between the goals
FA2>FO2	0	There is no significant interaction between the goals
FA3>FO2	0/+1	The impact is positive if the activity is related to utilisation of forest residue and production of high added value forestry products
Food & Agriculture to Climate		

FA1>C1	+1	Low carbon development in agriculture and food sector shall help to reduce GHG emissions
FA2>C1	+2	Reduction of pollution from agriculture and food sector decrease GHG emissions
FA3>C1	-1/+1	Depending on the selected type of activity GHG emissions are increasing or decreasing
FA1>C2	+2	Efficient use of resources includes growing of cultures having better possibilities for adaptation to climate change
FA2>C2	0	There is no significant interaction between the goals
FA3>C2	-1/+1	Depending on the selected type of activity, the impact is negative if mono cultures are cultivated, thus reducing biodiversity; or positive, if the activities are related to growing of climate resilient cultures, erecting of wetlands preventing arable lands from flooding
Water to Energy		
W1>E1	0	There is no significant interaction between the goals
W2>E1	-1/0	Following the water protection needs growing of energy crops have to decrease thus reducing the available biomass for production of renewable energy (e.g., 1st generation biofuels)
W3>E1	0	There is no significant interaction between the goals
W1>E2	0	There is no significant interaction between the goals
W2>E2	-1/0	Following the water protection needs growing of energy crops have to decrease thus reducing the available biomass for production of renewable energy (e.g., 1st generation biofuels)
W3>E2	-1/0	Following the sea water protection needs from eutrophication, growing of energy crops have to decrease thus reducing the available biomass for production of renewable energy (e.g., 1st generation biofuels)
W1>E3	0	There is no significant interaction between the goals
W2>E3	0	There is no significant interaction between the goals
W3>E3	0	There is no significant interaction between the goals
Water to Food & Agriculture		
W1>FA1	0	There is no significant interaction between the goals
W2>FA1	+1	Protection of water environment by reducing pollution with hazardous substances has a positive impact on efficient use of resources, adaptation to climate change in agriculture and food sectors
W3>FA1	+1	Reduction of eutrophication of inland waters and the Baltic Sea promotes efficient use of resources
W1>FA2	0	There is no significant interaction between the goals

W2>FA2	+3	Protection of water environment helps to reduce water pollution
W3>FA2	+2	Reduction of eutrophication of inland waters and the Baltic Sea reduces the negative impact on ecosystems
W1>FA3	0	There is no significant interaction between the goals
W2>FA3	0	There is no significant interaction between the goals
W3>FA3	0	There is no significant interaction between the goals
Water to Water		
W2>W1	+2	Protection of water environment by reducing pollution with hazardous substances helps improvement of surface and ground water quality
W3>W1	+1	Reduction of eutrophication of inland waters and the Baltic Sea has a positive impact on rational and sustainable use of water resources
W1>W2	+1	Sustainable use of water resources promotes improving the water quality, requires less effort and chemicals for water purification and accordingly the impact of water purification on the water quality decreases
W3>W2	+3	Reduction of eutrophication of inland waters and the Baltic Sea promotes water protection
W1>W3	+1	Better quality water in inland water bodies creates smaller negative impact on the water quality in the sea
W2>W3	+2	Reduction of water pollution in inland waters reduces the eutrophication risk of the sea
Water to Land		
W1>L1	0	There is no significant interaction between the goals
W2>L1	0	There is no significant interaction between the goals
W3>L1	0	There is no significant interaction between the goals
W1>L2	0	There is no significant interaction between the goals
W2>L2	+1	Protection of water environment by reducing pollution has a positive impact on soil quality
W3>L2	0	There is no significant interaction between the goals
Water to Forestry		
W1>FO1	0	There is no significant interaction between the goals
W2>FO1	0	There is no significant interaction between the goals
W3>FO1	0	There is no significant interaction between the goals
W1>FO2	0	There is no significant interaction between the goals
W2>FO2	0	There is no significant interaction between the goals

W3>FO2	0	There is no significant interaction between the goals
Water to Climate		
W1>C1	0	There is no significant interaction between the goals
W2>C1	0	There is no significant interaction between the goals
W3>C1	0	There is no significant interaction between the goals
W1>C2	0	There is no significant interaction between the goals
W2>C2	+1	Protection of water environment by reducing pollution helps water ecosystems to adapt to the climate change
W3>C2	+1	Reduction of eutrophication of inland waters and the Baltic Sea promotes the persistence and adaptation to climate change of ecosystems
Land to Energy		
L1>E1	0/+1	Degraded areas and areas not suitable for agriculture can be used for production of renewable energy (solar, wind, biomass)
L2>E1	-1/0	Protection of soil quality requires avoiding growing energy crops thus reduces the biomass available for production of renewable energy
L1>E2	0	There is no significant interaction between the goals
L2>E2	-2/0	While protecting soil quality, energy crops shall not be grown and thus it reduces the amount of renewable energy sources available for 1st generation fuel production in transport sector
L1>E3	0	There is no significant interaction between the goals
L2>E3	0	There is no significant interaction between the goals
Land to Food & Agriculture		
L1>FA1	+2	Efficient use of land has a positive impact on efficient use of resources
L2>FA1	+2	Efficient land use e.g., avoiding land fragmentation improves the efficiency of the use of resources
L1>FA2	+1	Efficient use of land promotes reduction of pollution and reduction of amount of waste
L2>FA2	+2	Improving soil quality and ensuring reduction of erosion promotes improvement of stability of ecosystems
L1>FA3	+1	Efficient use of land has a positive effect on economic growth in rural areas
L2>FA3	0	There is no significant interaction between the goals
Land to Water		
L1>W1	0	There is no significant interaction between the goals
L2>W1	0	There is no significant interaction between the goals

L1>W2	-1/0	If energy crops are grown on the agricultural land, there is a high risk of water pollution having a negative impact on water quality
L2>W2	+2	Improving soil quality and ensuring reduction of erosion promotes improvement of water ecosystems and water protection in general
L1>W3	-1/0	If energy crops are grown on the agricultural land, there is a high risk of water pollution having a negative impact on water quality in the Sea
L2>W3	+1	Improving soil quality and ensuring reduction of erosion promotes protection of the sea water from pollution
Land to Land		
L2>L1	+1	Improving soil quality and ensuring reduction of erosion promotes more efficient use of land, improves the soil quality, provides wider utilisation opportunities of land
L1>L2	-1/+1	Growing of energy crops on agricultural land reduces soils quality, reduces biodiversity (monocultures). On the other hand, restoration (re-cultivation) of polluted/degraded areas for cultivation of energy crops improve the soil quality
Land to Forestry		
L1>FO1	0	There is no significant interaction between the goals
L2>FO1	+2	Improvement of soil quality and ensuring reduction of erosion improves the productivity of forests
L1>FO2	0	There is no significant interaction between the goals
L2>FO2	+1	Higher quality soil provides better conditions for the growth of forests providing resources for production of high added value products
Land to Climate		
L1>C1	+1	Efficient land use fosters reduction of GHG emissions
L2>C1	+1	Improvement of soil quality and ensuring reduction of erosion promotes reduction of GHG emissions (there are less GHG emissions from high quality soils in comparison to drained mires etc.)
L1>C2	+1	Efficient land use fosters adaptation to climate change
L2>C2	+1	Improvement of soil quality and ensuring reduction of erosion supports adaptation to climate change by promoting stability of ecosystems
Forestry to Energy		
FO1>E1	-1/+1	Sustainable forest management increases the amount of biomass (RES), but possibly for sustainable forest management the felling volume has to be reduced, thus decreasing the amount of the resource available for production of energy
FO2>E1	+1	Production of high added value products from forestry has a positive impact on increase of RES if wood waste is used for energy production

FO1>E2	0	There is no significant interaction between the goals
FO2>E2	+1	Production of high added value products from forestry has a positive impact if wood waste is used for production of 2nd generation biofuels or electricity
FO1>E3	0	There is no significant interaction between the goals
FO2>E3	0	There is no significant interaction between the goals
Forestry to Food & Agriculture		
FO1>FA1	0	There is no significant interaction between the goals
FO2>FA1	0	There is no significant interaction between the goals
FO1>FA2	0	There is no significant interaction between the goals
FO2>FA2	0	There is no significant interaction between the goals
FO1>FA3	+1	Better managed forests provide higher amount and teh variety of timber and non-timber products thus providing higher opportunities for development of entrepreneurship
FO2>FA3	+1	Production of high added value products from forestry can promote the economic development in rural areas having access to the resource
Forestry & Agriculture to Water		
FO1>W1	0	There is no significant interaction between the goals
FO2>W1	0	There is no significant interaction between the goals
FO1>W2	+1	Sustainable forest management promotes water protection by reducing water pollution originated from leakages to the water deriving from forest management
FO2>W2	0	There is no significant interaction between the goals
FO1>W3	+1	Sustainable forest management reduces eutrophication of inland water bodies and the sea
FO2>W3	0	There is no significant interaction between the goals
Forestry to Land		
FO1>L1	+2	Sustainable forest management promotes effective use of land, including afforestation of degraded areas or areas not suitable for agriculture
FO2>L1	0	There is no significant interaction between the goals
FO1>L2	+2	Sustainable forest management promotes soil protection, e.g., by preventing of soil erosion
FO2>L2	0	There is no significant interaction between the goals
Forestry to Forestry		
FO2>FO1	0	There is no significant interaction between the goals
FO1>FO2	+3	Sustainable forest management promotes the growth of resource (biomass in

		forests) that can be used for production of high added value products
Forestry to Climate		
FO1>C1	+2	Sustainable forest management promotes CO_2 sequestration
FO2>C1	+1	Production of high added value products from forestry promotes reduction of GHG emissions as biomass is not used for combustion but used for other purposes
FO1>C2	+2	Sustainable forest management promotes adaptation of forest ecosystems to climate change
FO2>C2	0	There is no significant interaction between the goals
Climate to Energy		
C1>E1	+3	Setting the emission limit targets promotes wider use of RES
C2>E1	0	There is no significant interaction between the goals
C1>E2	+3	Setting the emission limit targets promotes wider use of RES in the transport sector
C2>E2	0	There is no significant interaction between the goals
C1>E3	+3	Setting the emission limit targets promotes the increase of energy efficiency
C2>E3	+1	Adaptation to climate change promotes improving energy performance of buildings
Climate to Food & Agriculture		
C1>FA1	+2	Setting the emission limit targets promotes efficient use of resources avoiding GHG emissions
C2>FA1	+3	Adaptation to climate change promotes efficient use of resources
C1>FA2	+2	The impact is positive a setting emission limit targets promote collection of e.g. agricultural waste for production of energy
C2>FA2	0	There is no significant interaction between the goals
C1>FA3	0	There is no significant interaction between the goals
C2>FA3	+2	Adaptation to climate change promotes economic development in rural areas by stimulating entrepreneurs to find new and innovative solutions
Climate to Water		
C1>W1	0	There is no significant interaction between the goals
C2>W1	0	There is no significant interaction between the goals
C1>W2	0/+1	Setting emission limit targets (e.g., N) promotes reduction of nutrient leakage while reduction of other GHG does not affect the water quality
C2>W2	+2	The need for adaptation to climate change promotes finding of solutions to increase the stability and resistance of water ecosystems
C1>W3	0/+1	Setting emission limit targets (e.g., N) promotes reduction of nutrient leakage

		while reduction of other GHG does not affect the water quality in the sea
C2>W3	+2	Implementation of measures for climate change adaptation promotes finding of solutions to increase the stability and resistance of sea ecosystems towards climate change
Climate to Land		
C1>L1	0	There is no significant interaction between the goals
C2>L1	0	There is no significant interaction between the goals
C1>L2	0	There is no significant interaction between the goals
C2>L2	+2	Implementation of measures for climate change adaptation promotes finding of solutions to prevent soil erosion e.g., caused by heavy rains
Climate to Forestry		
C1>FO1	+3	The requirement for climate change mitigation, promotes sustainable forest management due to the need for CO_2 sequestration
C2>FO1	+2	Implementation of measures for climate change adaptation promotes adaptation of forest ecosystems e.g., elimination of insects, planting of trees according to sustainable forest management provisions
C1>FO2	+1	The requirement for climate change mitigation and reduction of GHG emissions, promotes production of high added value products
C2>FO2	0	There is no significant interaction between the goals
Climate to Climate		
C2>C1	0	There is no significant interaction between the goals
C1>C2	+1	The requirement for climate change mitigation promotes also adaptation to climate change e.g., by improving energy efficiency of buildings

Annex 2. Justification of interactions between NCIs and NCOs

Interaction	Score	Justification
Ea > E1	+3	The instrument sets favourable conditions to produce electricity from RES (compared to fossil fuels), thus increase in use of RES
Ea > E2	+2	Favourable conditions to produce electricity from RES support increase of RES in transport energy
Ea > E3	+1	Favourable conditions to produce electricity from RES can improve efficiency of use of energy sources
Ea > FA1	+2	Favourable conditions to produce electricity from RES support utilization of agricultural waste as a RES resource
Ea > FA2	+2	Favourable conditions to produce electricity from RES support utilization of agricultural waste as a RES resource, minimize waste
Ea > FA3	+1	Favourable conditions to produce electricity from RES support entrepreneurship in rural areas, e.g. biogas production plants
Ea >W1	0	No interaction identified
Ea > W2	0	No interaction identified
Ea > W3	0	No interaction identified
Ea > L1	0	No interaction identified
Ea > L2	0	No interaction identified
Ea > FO1	0	No interaction identified
Ea > FO2	0	No interaction identified
Ea > C1	+2	Favourable conditions to produce electricity from RES support use of RES resources and GHG reduction
Ea > C2	0	No interaction identified
Eb > E1	+3	Economic conditions favours to increased use of RES sources, because energy produced from RES sources is exempted from natural resource tax (CO_2 emissions)
Eb > E2	0	No interaction identified
Eb > E3	+1	Natural resource tax will be lower when energy efficiency is higher, and less amount of energy is needed because of less CO_2 emissions for production
Eb > FA1	+1	Economically beneficial is prudent use of resources, because the natural resource tax will be smaller
Eb > FA2	+1	Economically beneficial is to pay smaller natural resources tax, and thus it promotes activities to reduce air emissions from agricultural enterprises

Eb > FA3	0	No interaction identified
Eb >W1	0	No interaction identified
Eb > W2	0	No interaction identified
Eb > W3	0	No interaction identified
Eb > L1	0	No interaction identified
Eb > L2	0	No interaction identified
Eb > FO1	0	No interaction identified
Eb > FO2	0	No interaction identified
Eb > C1	+3	Economic conditions favours to GHG emission reduction in production of energy
Eb > C2	0	No interaction identified
Ec > E1	-1	Criteria for sustainability of biofuels may hinder use of RES because additional and more stringent requirements have to be fulfilled
Ec > E2	-1	Criteria for sustainability of biofuels may hinder use of RES in transport sector because additional and more stringent requirements have to be fulfilled
Ec > E3	0	No interaction identified
Ec > FA1	+2	Criteria for sustainability of biofuels support prudent use of resources in the production
Ec > FA2	+1	Due to criteria for sustainability of biofuels, growing of mono-culture in good quality agricultural land is not applied and the soil is less polluted, less mineral fertilizers (N) are used
Ec > FA3	0	No interaction identified
Ec >W1	0	No interaction identified
Ec > W2	+1	Due to criteria for sustainability of biofuels, growing of mono-culture in good quality agricultural land is not applied and the soil is less polluted, less mineral fertilizers (N) are used, reduced leakage of nutrients
Ec > W3	+1	Due to criteria for sustainability of biofuels, growing of mono-culture in good quality agricultural land is not applied and the soil is less polluted, less mineral fertilizers (N) are used, reduced leakage of nutrients, prevents eutrophication of the sea
Ec > L1	0	No interaction identified
Ec > L2	+3	Due to criteria for sustainability of biofuels, growing of mono-culture in good quality agricultural land and land with high biological diversity is not allowed
Ec > FO1	+2	Due to criteria for sustainability of biofuels, growing of mono-culture at primary forests and in forest land with high biological diversity is not allowed
Ec > FO2	0	No interaction identified

Ec > C1	0	No interaction identified
Ec > C2	+1	Application of criteria for sustainability of biofuels promotes preservation of biological diversity and thus better adaptation to climate change
Ed > E1	+1	Aid to the energy production from agricultural and forestry biomass increases RES use
Ed > E2	+1	Aid to the energy production from agricultural and forestry biomass increases RES use, also in transport – biogas (biomethane)
Ed > E3	0	No interaction identified
Ed > FA1	0	No interaction identified
Ed > FA2	+2	Aid to the energy production from agricultural biomass supports waste reduction from agricultural production
Ed > FA3	+1	Aid to energy production from agricultural biomass supports – entrepreneurship - biogas production in rural areas
Ed >W1	0	No interaction identified
Ed > W2	-2	Due to the aid to energy production from agricultural biomass by intensive growing of energy crops increases water pollution (N from fertilization)
Ed > W3	-1	Due to the aid to energy production from agricultural biomass by intensive growing of energy crops increases water pollution (N from fertilization) and this also enhances eutrophication of the sea
Ed > L1	-1	Due to the aid to energy production from agricultural biomass by intensive growing of energy crops – mono-culture enhances land fragmentation
Ed > L2	-2	Due to the aid to energy production from agricultural biomass by intensive growing of energy crops – mono-culture depletes soil
Ed > FO1	0	No interaction identified
Ed > FO2	0	No interaction identified
Ed > C1	+2	Aid to the energy production from agricultural biomass - biogas production supports GHG reduction
Ed > C2	-2	Due to the aid to energy production from agricultural biomass by intensive growing of energy crops reduces biodiversity and thus lowers adaptation capacity to climate change
Ee > E1	+1	By refurbishing of buildings and increasing energy efficiency use of RES is considered thus promoting use of RES
Ee > E2	0	No interaction identified
Ee > E3	+3	Refurbishment of buildings directly support increased efficiency
Ee > FA1	0	No interaction identified
Ee > FA2	0	No interaction identified

Ee > FA3	0	No interaction identified
Ee >W1	0	No interaction identified
Ee > W2	0	No interaction identified
Ee > W3	0	No interaction identified
Ee > L1	0	No interaction identified
Ee > L2	0	No interaction identified
Ee > FO1	0	No interaction identified
Ee > FO2	0	No interaction identified
Ee > C1	+2	Refurbishment of buildings enhance GHG emission reduction (less energy required)
Ee > C2	+1	Refurbished buildings are better adjusted to heat resistance that is related to adaptation to climate change
Ef > E1	0	No interaction identified
Ef > E2	0	No interaction identified
Ef > E3	+2	Energy efficiency in centralized heat supply (reduced heat losses) supports increase of the efficiency of use of energy sources
Ef > FA1	0	No interaction identified
Ef > FA2	0	No interaction identified
Ef > FA3	0	No interaction identified
Ef >W1	0	No interaction identified
Ef > W2	0	No interaction identified
Ef > W3	0	No interaction identified
Ef > L1	0	No interaction identified
Ef > L2	0	No interaction identified
Ef > FO1	0	No interaction identified
Ef > FO2	0	No interaction identified
Ef > C1	+1	Energy efficiency in centralized heat supply reduces heat losses and thus lowers GHG emissions (from production)
Ef > C2	0	No interaction identified
Eg > E1	+3	Market penetration of RES in transport sector supports use of RES (in general)
Eg > E2	+3	Market penetration of RES in transport sector directly increases use of RES in transport sector
Eg > E3	+1	For utilization of alternative (RES based) fuels are needed vehicles of newer

		generation which are more energy efficient
Eg > FA1	+2	Production of alternative fuels enhance low carbon economy in agriculture
Eg > FA2	+2	Production of alternative fuels supports minimization of waste from agriculture and food sectors (due to possibility of use as RES sources)
Eg > FA3	+1	Production of alternative fuels (e.g., biomethane) promotes economic activity in rural areas, because the resources are near to utilize
Eg >W1	0	No interaction identified
Eg > W2	-1/0	Production of RES based fuels can have negative effect on water quality (increased pollution with N) if crops are grown for 1st generation biofuel, no interaction for other alternative fuels
Eg > W3	-1/0	Production of RES based fuels can have negative effect on water quality (increased pollution with N, eutrophication of the sea) if crops are grown for 1st generation biofuel, no interaction for other alternative fuels
Eg > L1	-1/+1	Production of RES based fuels can have negative effect if mono-cultures are grown / enhancing effect if agricultural waste is utilized
Eg > L2	- 1/0	Production of RES based fuels can have negative effect if mono-cultures are grown / no interaction for other alternative fuels
Eg > FO1	0	No interaction identified
Eg > FO2	0	No interaction identified
Eg > C1	+2	Market penetration of RES in transport sector supports reduction of GHG emissions
Eg > C2	-1/0	Production of RES based fuels can have negative effect if mono-cultures are grown / no interaction for other alternative fuels
Fa > E1	0	No interaction identified
Fa > E2	0	No interaction identified
Fa > E3	0	No interaction identified
Fa > FA1	+3	Direct payments and subsidies for certain activities are directly aimed at efficient use of agricultural resource - land
Fa > FA2	+1	Direct payments and subsidies for certain activities are directed to prevention of pollution from fields
Fa > FA3	+3	Direct payments and subsidies for certain activities is a direct support to entrepreneurs in rural areas
Fa >W1	0	No interaction identified
Fa > W2	+1	Direct payments to farmers under support schemes for certain activities promotes protection against discharge of pollution to aquatic environment
Fa > W3	+1	Direct payments to farmers under support schemes for certain activities

		promotes protection against discharge of pollution to aquatic environment, thus also protecting the sea
Fa > L1	+2	Direct payments to farmers under support schemes for certain activities, incl., for mowing of meadows, protection to overgrowth, promotes efficient use of land
Fa > L2	+1	Direct payments to farmers under support schemes for certain activities, incl., greening measures protects soil depletion
Fa > FO1	0	No interaction identified
Fa > FO2	0	No interaction identified
Fa > C1	0	No interaction identified
Fa > C2	+1	Direct payments to farmers under support schemes for certain activities promote preservation of biological diversity
Fb > E1	0	No interaction identified
Fb > E2	0	No interaction identified
Fb > E3	0	No interaction identified
Fb > FA1	+1	Subsidies to improve melioration systems promotes protection against flooding of fields and thus supports prudent use of resources
Fb > FA2	0	No interaction identified
Fb > FA3	+2	Improved melioration systems are supporting better crop yields (compared to flooded fields), prevents harvest from damage thus support economic development at rural areas
Fb >W1	0	No interaction identified
Fb > W2	+1	Improved melioration systems protect water from direct run-off from fields
Fb > W3	+2	Improved melioration systems protect water from direct run-off from fields, thus also pollution of the sea (effects of self-purification before reaching the sea)
Fb > L1	+2	Improved melioration systems enlarge possibilities to maintain agricultural land thus promote efficient use of land
Fb > L2	+2/-2	Improved melioration systems protect soil against water erosion, but can reduce biological diversity (plants needing wet conditions)
Fb > FO1	0	No interaction identified
Fb > FO2	0	No interaction identified
Fb > C1	0	No interaction identified
Fb > C2	+2/-2	Improved melioration systems protect soil against water erosion thus promote adaptation to climate change, but can reduce biological diversity (plants needing wet conditions) thus reduce adaptation to climate change

Fc > E1	0	No interaction identified
Fc > E2	0	No interaction identified
Fc > E3	0	No interaction identified
Fc > FA1	0	No interaction identified
Fc > FA2	+2	Determined subsidy for construction and reconstruction of manure storage facilities is aimed to prevent from pollution at the environment
Fc > FA3	0	No interaction identified
Fc >W1	+1	Due to subsidy, appropriate manure storage facilities prevent infiltration of pollution and promote good quality water supplies, especially from shallow wells
Fc > W2	+2	Determined subsidy for construction and reconstruction of manure storage facilities is aimed to prevent from pollution at the environment
Fc > W3	+2	Determined subsidy for construction and reconstruction of manure storage facilities is aimed to prevent from pollution that can reach the sea
Fc > L1	0	No interaction identified
Fc > L2	0	No interaction identified
Fc > FO1	0	No interaction identified
Fc > FO2	0	No interaction identified
Fc > C1	0	No interaction identified
Fc > C2	0	No interaction identified
Fd > E1	0	No interaction identified
Fd > E2	0	No interaction identified
Fd > E3	0	No interaction identified
Fd > FA1	0	No interaction identified
Fd > FA2	+2	Requirements for fertilization rates of organic and mineral fertilizers promote protection from pollution at the environment
Fd > FA3	0	No interaction identified
Fd >W1	+1	Requirements for fertilization rates of organic and mineral fertilizers are aimed to protect good quality water
Fd > W2	+2	Requirements for fertilization rates of organic and mineral fertilizers are aimed to protect from pollution at the environment
Fd > W3	+2	Requirements for fertilization rates of organic and mineral fertilizers are aimed to protect from pollution at the environment, thus also in the sea
Fd > L1	0	No interaction identified

Fd > L2	+2	Requirements for fertilization rates of organic and mineral fertilizers are aimed to protect from pollution at the environment (protection against excess fertilization)
Fd > FO1	0	No interaction identified
Fd > FO2	0	No interaction identified
Fd > C1	+1	Precise fertilization reduces GHG emissions, e.g., air emissions
Fd > C2	0	No interaction identified
Fe > E1	0	No interaction identified
Fe > E2	0	No interaction identified
Fe > E3	0	No interaction identified
Fe > FA1	0	No interaction identified
Fe > FA2	+1	Considering food quality schemes - quality criteria, e.g., for biologic agriculture and biologic products helps to reduce pollution at the environment
Fe > FA3	+1/-1	Considering quality criteria for growing and selling of biologic products can promote entrepreneurship for products of high quality, but hinder activity if products are of low quality
Fe >W1	0	No interaction identified
Fe > W2	+1	Considering quality criteria for growing of biologic products promote reduction of pollution (reduced/avoided use of fertilizers by biological farms)
Fe > W3	+1	Considering quality criteria for growing of biologic products promote reduction of pollution (reduced/avoided use of fertilizers by biological farms), effect on the sea as well
Fe > L1	0	No interaction identified
Fe > L2	+1	Considering quality criteria for growing of biologic products producers reduce/avoid use of fertilizers thus supporting maintenance of soil quality
Fe > FO1	0	No interaction identified
Fe > FO2	0	No interaction identified
Fe > C1	+1	Considering quality criteria for growing of biologic products producers reduce/avoid use of fertilizers thus reducing (N) emissions
Fe > C2	+1	Considering quality criteria for growing of biologic products promote maintenance of biologic diversity
Wa > E1	0	No interaction identified
Wa > E2	0	No interaction identified
Wa > E3	0	No interaction identified
Wa > FA1	0	No interaction identified

Wa > FA2	+2	Surface water body protection zones (e.g., green belts) promotes prevention and reduction of pollution
Wa > FA3	0	No interaction identified
Wa >W1	+1	Surface water body protection zones (e.g., green belts) promotes maintenance of good quality water
Wa > W2	+2	Surface water body protection zones (e.g., green belts) promotes prevention against pollution discharge
Wa > W3	+1	Surface water body protection zones (e.g., green belts) promotes prevention against pollution discharge, refers also to the sea
Wa > L1	-1/+1	Surface water body protection zones promote efficient land-use (in protection belts), but restricts area of usable arable land
Wa > L2	0	No interaction identified
Wa > FO1	0	No interaction identified
Wa > FO2	0	No interaction identified
Wa > C1	0	No interaction identified
Wa > C2	0/+1	Surface water body protection zones are useful to protection against floods thus beneficial to climate change adaptation
Wb > E1	0	No interaction identified
Wb > E2	0	No interaction identified
Wb > E3	0	No interaction identified
Wb >FA1	0	No interaction identified
Wb >FA2	0	No interaction identified
Wb > FA3	0	No interaction identified
Wb >W1	+3	Water monitoring programs are directed to the water quality control potentially identifying pollution and measures to improve water quality
Wb > W2	+2	Water monitoring programs are directed to the water quality control potentially identifying pollution and measures to phase out emission sources and thus improve water quality
Wb > W3	+2	Water monitoring programs are directed to the water quality control potentially identifying pollution and measures to phase out emission sources and thus improve water quality, refers also to the sea
Wb > L1	0	No interaction identified
Wb > L2	0	No interaction identified
Wb > FO1	0	No interaction identified
Wb > FO2	0	No interaction identified

Wb > C1	0	No interaction identified
Wb > C2	+1	Water monitoring programs are directed to the water quality control where also biological diversity is accounted to take timely measures thus promoting climate change adaptation
Wc > E1	0	No interaction identified
Wc > E2	0	No interaction identified
Wc > E3	0	No interaction identified
Wc >FA1	0	No interaction identified
Wc >FA2	+3	By permits for polluting activities the pollution load is limited thus preventing of water pollution from agriculture and food sectors
Wc > FA3	0	No interaction identified
Wc >W1	+2	By permits for polluting activities the unsustainable (polluting) activities are restricted thus promoting maintenance of good quality water
Wc > W2	+2	By permits for polluting activities the unsustainable (polluting) activities are restricted thus promoting of phasing out emissions and protecting aquatic environment
Wc > W3	+1	By permits for polluting activities the unsustainable (polluting) activities are restricted reducing pollution of inland water bodies and thus also limiting pollution of the sea (discharges)
Wc > L1	0	No interaction identified
Wc > L2	+1	Permits for polluting activities also promotes soil protection (because polluted water is penetrating through the soil)
Wc > FO1	0	No interaction identified
Wc > FO2	-1/+1	Permits for polluting activities may promote application of innovative technologies for high added value forestry products; but producers may be confronted with strict limits for polluting activities requiring additional treatment of waste water and thus it may result in more costly production of high added value forestry products
Wc > C1	0	No interaction identified
Wc > C2	+1	By permits for polluting activities the unsustainable (polluting) activities are restricted and this is beneficial, e.g., less overgrowth of water bodies occurs thus maintaining better persistence of water ecosystem to climate change
La > E1	+1/-1	Requirements for land use change can permit activities supporting RES (e.g., solar panels, wind turbines) in land use thus favouring increased use of RES, but can be restrictions (e.g., prohibition of wind parks in forests) thus hindering use of RES
La > E2	0	No interaction identified

La	> E3	0	No interaction identified
La	>FA1	0	No interaction identified
La	>FA2	0	No interaction identified
La	> FA3	+1/-1	Requirements for land use change can promote or hinder economic and entrepreneurship activity in rural areas depending on type of activities
La	>W1	0	No interaction identified
La	> W2	0	No interaction identified
La	> W3	0	No interaction identified
La	> L1	+3	Requirements and potential limitations to certain type of land-use change restricts fragmentation thus directly supporting efficient use of land
La	> L2	0	No interaction identified
La	> FO1	+3	Requirements and potential limitations to certain type of land-use change, e.g., cutting of forest directly supports sustainable forest management
La	> FO2	0	No interaction identified
La	> C1	+2	Requirements and potential limitations to certain type of land-use change, e.g., cutting of forest supports efficient CO_2 capture thus supporting climate change mitigation
La	> C2	+1	Requirements and potential limitations to certain type of land-use change support resilience of ecosystems and climate change adaptation
Lb	> E1	-2	Limitations for location of wind turbines hinder development of wind parks and thus hinder increased use of RES
Lb	> E2	0	No interaction identified
Lb	> E3	0	No interaction identified
Lb	>FA1	0	No interaction identified
Lb	>FA2	0	No interaction identified
Lb	> FA3	0	No interaction identified
Lb	>W1	0	No interaction identified
Lb	> W2	0	No interaction identified
Lb	> W3	0	No interaction identified
Lb	> L1	+1	Limitations for location of wind turbines can promote efficient use of land, e.g., forests are not cut for erection of wind turbines
Lb	> L2	0	No interaction identified
Lb	> FO1	+1	Limitations for location of wind turbines can promote sustainable forest management because forests are not cut for erection of wind turbines

Lb	> FO2	0	No interaction identified
Lb	> C1	-1/+1	Limitations for location of wind turbines can restrict development of wind parks; but limiting location of wind turbines in forests can prevent forest cutting thus maintaining CO_2 sequestration
Lb	> C2	+1	Limitations for location of wind turbines can maintain biological diversity in protected territories
Lc	> E1	0	No interaction identified
Lc	> E2	0	No interaction identified
Lc	> E3	0	No interaction identified
Lc	>FA1	+2	Immovable property tax for different types of land use promotes rational use of resources
Lc	>FA2	0	No interaction identified
Lc	> FA3	+2	Immovable property tax for different types of land use promotes rational use of resources and enlargement of production
Lc	>W1	0	No interaction identified
Lc	> W2	0	No interaction identified
Lc	> W3	0	No interaction identified
Lc	> L1	+3	Immovable property tax, e.g., higher rate for abandoned agricultural land promotes efficient use of land by avoiding of abandonment of arable land
Lc	> L2	0	No interaction identified
Lc	> FO1	0	No interaction identified
Lc	> FO2	0	No interaction identified
Lc	> C1	0	No interaction identified
Lc	> C2	0	No interaction identified
Foa	> E1	+2	Subsidy for forest management supports increased volume of forest biomass thus promoting possibilities for use of RES
Foa	> E2	0	No interaction identified
Foa	> E3	0	No interaction identified
Foa	>FA1	-1	Subsidy for forest management and afforestation can take away land from agriculture
Foa	>FA2	0	No interaction identified
Foa	> FA3	+1	Subsidy for forest management resulting in renovated and well-maintained forest provides higher amount of biomass for harvesting thus supporting economic development
Foa	>W1	0	No interaction identified

Foa	> W2	+2	Subsidy for forest management will promote renovated and well-maintained forest better retaining nutrient leakage from forest areas
Foa	> W3	+1	Subsidy for forest management will promote renovated and well-maintained forest better retaining nutrient leakage from forest areas thus also reducing eutrophication of the sea
Foa	> L1	+2	Subsidy for forest management support afforestation of abandoned land and planting of forest in areas not usable for agriculture
Foa	> L2	+1	Subsidy for forest management will promote renovated and well-maintained forest thus also supporting prevention against soil erosion
Foa	> FO1	+3	Subsidy for forest management directly supports sustainable forest management
Foa	> FO2	+2	Subsidy for forest management will promote renovated and well-maintained forest thus higher quality timber is harvested for production of high added value forestry products
Foa	> C1	+3	Subsidy for forest management will promote renovated and well-maintained forest thus enhancing CO_2 sequestration
Foa	> C2	+3	Subsidy for forest management will promote renovated and well-maintained forest thus enhancing the resilience of forest ecosystem to climate change and promoting climate change adaptation
Fob	> E1	-2	Limitations to tree cutting hinder harvesting of biomass as a RES source to energy production
Fob	> E2	0	No interaction identified
Fob	> E3	0	No interaction identified
Fob	>FA1	0	No interaction identified
Fob	>FA2	0	No interaction identified
Fob	> FA3	-1	Limitations to tree cutting can reduce potential economic income for forest owners in short term
Fob	>W1	0	No interaction identified
Fob	> W2	+1	Limitations to tree cutting can have positive effect on protection of aquatic environment because leakage is less from forest land compared to a clear-cut territory
Fob	> W3	+1	Limitations to tree cutting can have a positive effect on protection or aquatic environment because leakage is less from forest land compared to a clear-cut territory, impact to the sea as well
Fob	> L1	+2	Limitations to tree cutting limits clear-cutting and thus also land fragmentation thus having positive effect on efficient use of land
Fob	> L2	+1	Limitations to tree cutting limits clear-cutting and thus also land erosion thus

		maintaining quality of soil
Fob > FO1	+3	Limitations to tree cutting directly supports sustainable forest management (e.g., limited clear-cuts, age of trees)
Fob > FO2	-1	Limitations to tree cutting can restrict timber harvesting for production of forestry products
Fob > C1	+3	Limitation to tree cutting restricts timber harvesting and thus supports CO_2 sequestration
Fob > C2	+3	Limitation to tree cutting restricts timber harvesting and thus supports resilience of forest ecosystems to climate change and increases climate change adaptation
Foc > E1	-1	Requirements to preserve the genetic bank of forests may hinder harvesting of biomass as a RES source to energy production
Foc > E2	0	No interaction identified
Foc > E3	0	No interaction identified
Foc >FA1	0	No interaction identified
Foc >FA2	0	No interaction identified
Foc > FA3	0	No interaction identified
Foc >W1	0	No interaction identified
Foc > W2	0	No interaction identified
Foc > W3	0	No interaction identified
Foc > L1	0	No interaction identified
Foc > L2	0	No interaction identified
Foc > FO1	+3	Requirements to preserve the genetic bank of forests directly promote sustainable forest management
Foc > FO2	0	No interaction identified
Foc > C1	+1	Requirements to preserve the genetic bank of forests supports CO_2 sequestration
Foc > C2	+2	Requirements to preserve the genetic bank of forests supports keeping the biodiversity thus promotes resilience of forest ecosystems to climate change and increases climate change adaptation
Fod > E1	0	No interaction identified
Fod > E2	0	No interaction identified
Fod > E3	0	No interaction identified
Fod >FA1	0	No interaction identified
Fod >FA2	0	No interaction identified

Fod	> FA3	0	No interaction identified
Fod	>W1	0	No interaction identified
Fod	> W2	0	No interaction identified
Fod	> W3	0	No interaction identified
Fod	> L1	+1	Requirements for maintenance of melioration systems promote efficient use of forest land
Fod	> L2	+3	Required maintenance of melioration systems increases soil quality in forests (protects from excess moisture)
Fod	> FO1	+3	Required maintenance of melioration systems promotes increases the forest productivity
Fod	> FO2	+1	Required maintenance of melioration systems supports better conditions for growing trees thus better quality of timber is obtained for use in production of high added value products
Fod	> C1	+2	Required maintenance of melioration systems supports better conditions for growing trees thus better CO_2 sequestration
Fod	> C2	+2	Required maintenance of melioration systems supports better conditions for growing trees (protects from excess moisture in soil) thus supporting resilience of forest ecosystems and better climate change adaptation
Foe	> E1	0	No interaction identified
Foe	> E2	+1	By subsidies to enterprises (e.g., to elaborate innovative technologies) is promoted production of 2^{nd} generation biofuels to increase RES in transport
Foe	> E3	0	No interaction identified
Foe	>FA1	+2	By subsidies to enterprises is promoted application of innovative technologies to increase the efficiency of use of resources
Foe	>FA2	+2	By subsidies to enterprises is promoted application of innovative technologies thus preventing pollution and minimizing waste
Foe	> FA3	+3	Subsidies to enterprises directly supports increase of economic activity in rural areas
Foe	>W1	0	No interaction identified
Foe	> W2	0	No interaction identified
Foe	> W3	0	No interaction identified
Foe	> L1	0	No interaction identified
Foe	> L2	0	No interaction identified
Foe	> FO1	0	No interaction identified
Foe	> FO2	+3	Subsidies to enterprises directly supports production of high added value products

Foe	> C1	0	No interaction identified
Foe	> C2	0	No interaction identified
Ca	> E1	-2	Payment for negative environmental effects due to deforestation hinders increased use of RES biomass
Ca	> E2	0	No interaction identified
Ca	> E3	0	No interaction identified
Ca	>FA1	0	No interaction identified
Ca	>FA2	0	No interaction identified
Ca	> FA3	-1	Payment for negative environmental effects due to deforestation may hinder economic development of rural areas if the activity is related to forest harvesting
Ca	>W1	0	No interaction identified
Ca	> W2	0	No interaction identified
Ca	> W3	0	No interaction identified
Ca	> L1	+1	Payment for negative environmental effects due to deforestation may prevent forest harvesting activity and thus prevent land fragmentation (clear-cut)
Ca	> L2	0	No interaction identified
Ca	> FO1	+3	Payment for negative environmental effects due to deforestation helps to limit areas for cutting and thus directly supports sustainable forest management
Ca	> FO2	-1	Payment for negative environmental effects due to deforestation may hinder production of high added value forestry products due to economic considerations
Ca	> C1	+3	Payment for negative environmental effects due to deforestation directly supports maintenance of forests for CO_2 sequestration
Ca	> C2	+1	Payment for negative environmental effects due to deforestation support maintenance of forest ecosystems and thus promote climate change adaptation
Cb	> E1	+2	By design of the natural resource tax for GHG emissions, the tax relief for RES sources supports increased use of RES
Cb	> E2	+1	By design of the natural resource tax for GHG emissions, the tax relief for RES sources supports increased use of RES in transport sector
Cb	> E3	+2	The natural resource tax for GHG emissions promotes activities to improve efficiency for use of energy sources
Cb	>FA1	+1	The natural resource tax for GHG emissions promotes more efficient use of resources to decrease the payment for CO_2 tax
Cb	>FA2	+2	The natural resource tax for GHG emissions promotes activities to reduce pollution and agricultural waste

Cb	> FA3	-1	The natural resource tax for GHG emissions may create additional expenses for entrepreneurs thus hindering their activity
Cb	>W1	0	No interaction identified
Cb	> W2	0	No interaction identified
Cb	> W3	0	No interaction identified
Cb	> L1	0	No interaction identified
Cb	> L2	0	No interaction identified
Cb	> FO1	0	No interaction identified
Cb	> FO2	0	No interaction identified
Cb	> C1	+3	The natural resource tax for GHG emissions directly promotes activities to reduce GHG emissions thus supporting climate change mitigation
Cb	> C2	0	No interaction identified
Cc	> E1	0	No interaction identified
Cc	> E2	0	No interaction identified
Cc	> E3	0	No interaction identified
Cc	>FA1	+1	Requirements for collection, storage and distribution of manure promotes efficient use of resources
Cc	>FA2	+2	Requirements for collection, storage and distribution of manure supports prevention and reduction of pollution from cattle farms
Cc	> FA3	0	No interaction identified
Cc	>W1	+1	Requirements for collection, storage and distribution of manure prevents pollution of shallow groundwater thus promotes supply to inhabitants with good quality water (from individual wells)
Cc	> W2	+3	Requirements for collection, storage and distribution of manure directly support prevention of pollution to aquatic environment from farms
Cc	> W3	+2	Requirements for collection, storage and distribution of manure support prevent of pollution to aquatic environment from farms, relates also to protection of eutrophication of the sea
Cc	> L1	0	No interaction identified
Cc	> L2	+2	Requirements for collection, storage, and distribution of manure support increase of soil quality (by appropriate operation with manure)
Cc	> FO1	0	No interaction identified
Cc	> FO2	0	No interaction identified
Cc	> C1	+2	Requirements for collection, storage, and distribution of manure support reduction of GHG emissions thus promote climate change mitigation

Cc > C2	0	No interaction identified

The Netherlands Case Study

Policy analysis

Authors: Trond Selnes, Vincent Linderhof, Roos Marinissen

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Glossary of terms

Term	EXPLANATION/MEANING
BBE	Bio-Based Economy
BBI JU	Bio-based Industries Joint Undertaking (BBI JU)
BEON	Bio-energy cluster East Netherlands/*Bio-energiecluster Oost-Nederland*
BTG	BTG Biomass Technology Group BV: company offering consultancy, R&D solutions for biomass in fuel, energy and bio-based resources.
CAP	Common Agricultural Policy
CBA	Cost-Benefit Analysis/*Kosten-Baten Analyse*
CBS	Statistics Netherlands/*Centraal Bureau voor de Statistiek*
CCS	Carbon Capture and Storage
CCU	Carbon Capture and Utilisation
CFS	UN Committee on World Food Security
CHILL	Chemelot Innovation and Learning Labs
CLM	Center for Agriculture and the Evironment /*Centrum voor Landbouw en Milieu*
CO_2	Carbon dioxide
DSM	Company: Chemical producer
ECN	Energy research Centre of the Netherlands/*Energieonderzoek Centrum Nederland*
EFRO	European Regional Development Fund (ERDF)/*Europees Fonds voor Regional Ontwikkeling*
ENECO	Company: energy supplier
ETS	EU Emission Trading System
EU	European Union
GDP	Gross Domestic Product
HDO	Wholesale, retail, commercial services and government sector/*Handel, diensten en overheid*
HLPE	The High Level Panel of Experts on Food Security and Nutrition
IPO	Association of Provinces/*Inter-Provinciaal Overlegorgaan*
LTO	Dutch Federation of Agriculture and Horticulture/ *Land- en Tuinbouw Organisatie*; an entrepreneurial and employers' organization
MIRT	Dutch Multi-Year Programme for Infrastructure, Spatial Planning and Transport/*Meerjarenprogramma Infrastructuur, Ruimte en Transport*
MW	megawatt
NCI	Nexus critical instruments
NCO	Nexus critical (policy) objectives
NGO	Non-Governmental Organization
PBE	Netherlands Platform Bio-Energy/*Platform BioEnergie*
PBL	Netherlands Environmental Assessment Agency/*Planbureau voor de Leefomgeving*
PJ	petajoules

Term	EXPLANATION/MEANING
RDP	Rural Development Programme
RWE	Company: energy supplier.
RVO	Rijksdienst voor Ondernemend Nederland/*Netherlands Enterprise Agency*
SABIC	Company: Chemical producer
SDE+	Promotion of renewable energy production subsidies/*Stimulering Duurzame Energieproductie subsidieregeling*
SDG	Sustainable Development Goal
SER	The Social and Economic Council of the Netherlands/*Sociaal-Economische Raad*
STOWA	Foundation for Applied Water Research/*Stichting Toegepast Onderzoek Waterbeheer*
TKI	Topconsortium for Knowledge and Innovation
UvW	Unie van Waterschappen/*Dutch Water Authorities*
VANG	From Waste to Resource/ *Van Afval Naar Grondstof*; public policy on waste
VNCI	Association of the Dutch Chemical Industry (VNCI)/*Vereniging van de Nederlandse Chemische Industrie*; VNCI promotes the collective interests of the chemical industry
VNG	Association of Netherlands Municipalities/*Vereniging van Nederlandse Gemeenten*
VVNH	The Netherlands Timber Trade Association/*Koninklijke Vereniging Van Nederlandse Houtondernemingen*
WFD	Water Framework Directive/*Kaderrichtlijn Water*
WUR	Wageningen University & Research
WWR	Company: biomass trader & recycling (World Wide Recycling)

Executive summary

This report contains the policy analysis of the case Netherlands within the SIM4NEXUS project. The report will be used for developing the SIM4NEXUS Serious Game for the Netherlands. The overall aim of the analysis is to provide for a comprehensive understanding of the role of biomass in a low-carbon and resource-efficient economy and the coherence of the relevant policies. The main research question **is:**

What is the role of biomass in the realization of a low-carbon and resource-efficient economy in the Netherlands in 2050?

The research sub-questions are:

- What sectors and policy domains are important for the use of biomass in the Dutch transition towards a low-carbon and resource-efficient economy in 2050?
- What are the main policy goals and policy instruments for these policy domains, and how coherent are these? How are they connected to EU and global policies?
- Which stakeholders are involved and what are their positions, roles, power and relationships?
- Which arrangements are made to address policy coherence, synergies, trade-offs in practice?
- What success stories and failure factors can be distilled from experiences in this case?

The main findings are the following:

Biomass plays a substantial role in the future policy renewable energy mix

Biomass is very likely to play a substantial role in the realization of a low-carbon and resource-efficient economy in the Netherlands in the future. The government sees a great potential for significant CO_2 reductions from biomass against moderate costs. The argument is that electricity can be made from wind and solar power, but transport and industry need biomass as well. Import of biomass will continue to play a major role, but also domestic rest streams, solid bio-waste and maybe new future developments such as aquatic seaweed. The role of biomass is mainly substantial where other renewables are less suitable, such as industrial heating, high value resources (chemical industry), the transport sector (shipping, aviation, trucks) and as back-up for the regular electricity production. Many of the high-end applications are likely to come from the growing bio-based economy. An increase in productivity in agriculture and forestry alone is not enough to increase the biomass supply. Conversion technologies, innovation, and acceptance of the public are important subjects that need attention as well. Important concepts in policy are now Circular and Bio-based Economy and the cascade approach, prioritising high-quality use and re-use of biomass above burning it as a fuel. The use of biomass as a fuel may be temporarily during the transition to a low-carbon economy and that in future all biomass will be used for the bio-based economy.

The PBL (2018) concludes that biomass indeed could be useful as energy for reducing CO2-emissions. It does not require major changes to the energy system, it is not complex, short term effects are achievable and the technology is relatively inexpensive. However, the future supply of biomass is uncertain and it is in particular unclear whether there will be biomass for other purposes than those that are seen as a priority, which is essentially where there are no sustainable alternatives. This means that biomass will not be available for cities, electricity, transportation of persons. The problem is that there is no international biomass market that comply with the Dutch sustainability criteria from the recent Energy Agreement. Strategies to enhance the domestic supply of biomass could then now become interesting.

Many sectors and policy domains important, but no clear demarcation of biomass as a sector or policy

A core feature of biomass is that many sectors and policy domains are important, but there is no clear demarcation of biomass as a sector or policy*.* As an economic activity biomass cuts through sectors and also policy domains. It is part of the energy policy, but also the waste, agricultural/food policy, the land use and spatial policy, and the Dutch government acknowledges the opportunities and importance of biomass for the bio-based economy for the Netherlands, which ensures that biomass is included in many economic sectors.

Ambitious policy goals – coherence in the policy-making more than the policy practice

With an ambitious governmental aim of 95% reduction of greenhouse gases in 2050, the government expects all sectors to contribute to the goal achievement. It is assessed to be hard if not impossible to reach this aim without an intensification of biomass production for energy. At the same time, using biomass for energy is situated in the lower levels of the value chain, and the aim is also to use the biomass at higher levels, in for instance the chemical industry or pharma. In general, coherence is often found at the level of policy-making, as less in the policy practice. The energy-biomass coherence is challenged by the fact that the energy policy aims for biomass as a source of energy while the government also aim to use biomass for higher end usage, although this is a development that is just starting to evolve. The policies for waste, food and biomass are very coherent and synergetic, as there is no cultivation of crops for energy and waste is about the use of rest streams. Agriculture, nature and biomass are sectors with less coherence and more potential for improvements in the synergy. Agriculture is about food production and not 'producing waste'. Nature is also about protecting nature not about 'rest streams'. And agriculture and nature are often conflicting policies. CAP is not very effective for this, despite its greening objectives and potential for supporting biomass usage. The Renewable Energy Directive could be synergetic but critics points to a lack of sustainability criteria. However, there are signs of change, as the notion of a bio-based economy is worked out further and brought to practice through for instance Green Deals or Investment Programs.

Stakeholders at work: multiple engagement in many formal and informal arrangements

With many sectors involved in biomass, there are also many stakeholders involved. And, as their involvement often relates to the many formal and informal arrangements, we bundle these two questions here. The Dutch government has since about 2010 been engaging stakeholders in a series of arrangements that have been set up to address coherence, synergies and trade-offs in the biomass practice. In 2011 the government published the results from the policy arrangement Conflicting Interests and how to deal with these in the bio-based economy (including biomass). This was important to establish insights into the problems faced by stakeholders and what the government could do or not do regarding these problems. Some are not to be changed due to safety reasons, others are market issues out of the reach for the government. However, many obstacles related to slow procedures and complex administration have been resolved and in some cases new and more suitable legal definitions have been made. Furthermore, the Transition House offered a way to ventilate business challenges, the Front Runners Office improved innovation ideas, the Acceleration Team Green Gas from 2013 worked on better procedures and licenses. Market parties could with these arrangements signal issues to the Program Department (*Programmadirectie*) Biobased Economy. This has led to shorter procedures and improvements in the Investment Subsidy SDE+. Despite progress on administrative red-tape and legal definitions, stakeholders still see these issues as obstacles. In 2016 an Energy Dialogue started for sharing views further and more direct on energy issues. More consultation followed in the run-up to the National Agreement on the Circular Economy. This also led to a Transition Agenda Circular Economy and after additional consultations and negotiations, a new Cabinet plan in 2018 to approach the climate challenges. In general, the Dutch government has been engaged in a lengthy multi-stakeholder approach (governments, business sector and NGOs) to tackle many of the problems, although plenty work remains.

Success and failure

Success factors are here sought more in the policy process than the effectivity, as we largely focus on rather recent policy developments. Success is found in the political willingness to engage in active and ongoing dialogue between public and private stakeholders. Such a dialogue fits the (policy) culture where it is common to share both problems and opportunities in a direct way. Also, there are favourable conditions for bio-based investments in the strategic location with big harbours, a good infrastructure, high quality knowledge institutions, a well-educated population and strong agricultural, chemical and energy sectors. Innovation is key to both public and private parties, to invest at the national and international level. Another success factor is the willingness to stimulate investments through public programmes for research, investments and business development for the short and long term. Strong partnerships on cross-sector innovations working on joint management for (using) new technologies or developing new business models carried forward by enthusiasm is a success factor. The government bundles much of the public aims, opportunities and stakeholder interaction into a joint framework regarding the biomass supply and/or production. Objectives such as optimizing generation of biomass from rest streams and optimizing closed resource loops form important parts of the policy on increasing biomass production.

The negative image of bio-energy is considered to be hampering the development of bio- energy projects. Although a strategy document as Biomassa 2030 clearly explains why it is worth investing and stimulating bio-energy but such a document has a limited reach and it is not enough to change the image of biomass. The sector is very diverse if not fragmented, there is a lack of expertise, skills and capital. Many stakeholders also finds the policy still to be fragmented with too much administrative red-tape. They also tend to view the ambitions for a national supply of biomass for energy as not clearly expressed in the Dutch policies. An underlying factor is also the inability to establish a level playing field, with a lack of clear sustainability criteria. A dialogue with critical voices from academia and NGOs would further enrich the policy on matters as sustainability.

1 Introduction

1.1 Problem description

During the 2015 Paris Climate Conference the Netherlands signed the Paris Agreement and committed to cut greenhouse gas emissions to 80-95% below 1990 levels by 2050 (European Commission 2017). To be able to reach this target, continued progress towards a low-carbon society needs to be made and renewable energy targets have been set by the European Union of 14% by 2020 and 16% by 2023. (European Commission, 2017c). An important way to achieve these goals is the transition from fossil fuels to renewable energy. Biomass is a necessary component of the renewable energy mix of the Netherlands and at present the most important source of renewable energy in the country (PBL 2016). However, the production of biomass for bioenergy can have negative implications. Cultivating crops for energy competes with food production in the case of biofuels and can lead to indirect land use change which eventually can lead to even more emissions than conventional energy usage (PBL 2013; Popp et al. 2014). This ambiguous nature of biofuels has resulted in biofuel debates worldwide and actions in policy-making. The UN Committee on World Food Security (CFS) recommended in October 2011 a review of biofuels policies in relation to food security so that 'they can be produced only where it is socially, economically, and environmentally feasible to do so' (HLPE 2014). However, it is very difficult to predict and control indirect land use change on a global scale.

Worldwide bioenergy potential is limited because land has multiple functions and is needed for multiple purposes. With global population continuing to grow, land and water are becoming more scarce, while agricultural production for food needs to increase about 60% by 2050 (Popp et al. 2014). This causes the future demand for bioenergy to be higher than the potential future supply in a sustainable way. Future technological innovations may help close the gap between global demand and global supply, but for now it is important that every potential of sustainable biomass production is utilized. Bioenergy is however recognized in the literature as a complex policy problem that touches upon several sectors and is often provided as an example of an issue that needs a nexus approach (International Council for Science 2016; United Nations Environment Programme 2015). The trade-off between bioenergy, food production and nature conservation is gaining significant attention in EU policy-making (International Council for Science 2016). When it comes to biofuels, EU policies seem ambiguous: they encourage the use of biofuels (through, for example, targets for renewable energy in transport), but at the same time seek to control growth by posing stringent conditions on sustainability (Smyth et al. 2010). Although the sustainability of some biomass processes and products is questioned, there are currently not enough other options to exclude biomass as a renewable energy source (Keith 2001). Furthermore, research has shown that the development of biomass is significantly affected by other policies such as waste, emissions, agriculture, and the environment (Smyth et al. 2010). (Rogge and Reichardt 2015) claim that to be able to move to a decarbonized energy system, the main challenge is to improve the understanding of the policies and politics of transitions.

The maximum biomass production capacity in the Netherlands is estimated to be 200 PJ (PBL and ECN 2011). However, in the process of calculating this number only the supply options from the agricultural production chain and nature management were considered. The policy requirements for the development of such an amount of sustainable biomass production have not been investigated (Linderhof et al. 2017). Reaching the maximum potential of biomass is considered to be a challenge and this challenge will become even bigger if the policy framework hampers producing more biomass.

McCormick and Kåberger (2007) concluded that there are considerable biomass resources in the European Union and that there are mature conversion technologies to exploit the potentials of bioenergy. The challenge is about how to accelerate the implementation of the bioenergy systems. They conclude that key barriers are non-technical matters of the implementation stage of bioenergy systems rather than technical: economic conditions, know-how, institutional capacity and supply chain coordination. We will address such issues here as well.

Summarized, the main problem addressed in this report is the ambiguity between on the one hand the need to use biomass as an essential source of renewable energy to reach the goal of a low-carbon economy in 2050 (Linderhof et al. 2017), and on the other hand the potential trade-offs on water, land and food, and the discrepancy with the goals of a circular and bio-based economy. This report focusses on the governance and policies related to this problem.

1.2 Context and Nexus sectors investigated

Biomass is heavily related to issues of land, nature (forestry), food, water and agriculture (Linderhof et al. 2017). This is not unique to the Dutch case, but how the mix of issues works is unique to every country.

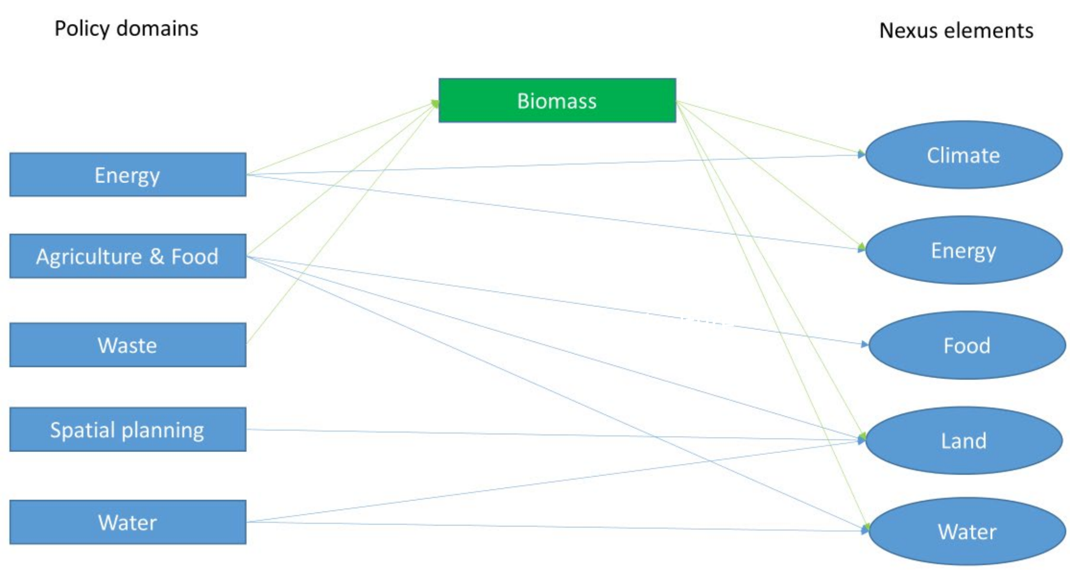


Figure 1: Policy domains in the Netherlands and the Nexus elements

1.2.1 General context: a small open country - issues interlinked

The Netherlands comprises an area of 37,354 km^2 and is partly sub-sea level. It borders to Germany to the east, Belgium to the south, and the North Sea to the northwest, sharing maritime borders in the North Sea with Belgium, the United Kingdom, and Germany. It has a population of 17 million inhabitants and a population density of about 450 inhabitants per km^2. There is a strong pressure on land that is scarce and expensive, and agriculture, energy, water, nature, climate are strongly interconnected. The Netherlands has also an open economy, as indicated by the (in 2013) 83% share of exports in the total GDP (http://www.oecd.org/environment/oecd-environmental-performance-reviews-the-netherlands-2015-9789264240056-en.htm).

Dutch consumption largely depends on imported food and on natural resources abroad. With regard to biomass, the expectation is that the demand for biomass will increase the coming years. This is due to an increasing focus on climate issues and more opportunities for applying biomass in the chain from production to re-usage of waste. Biomass is now produced/applied in a wide range of sectors, the chemical sector, transport, energy, agriculture and forestry. The so-called Circular and Bio-based Economy (although not equal concepts) are now leading concepts for the policy.

Both barriers to the transition to a low carbon economy as well as synergies and trade-offs between policies related to this transition are based on the interlinked character of the issues. In the societal discussions, energy issues and the energy mix are linked to its effects on the quality of the physical environment (e.g. water, air, climate, biodiversity, agriculture, industry, cities and sustainable consumption and production).

1.2.2 Climate/Energy/biomass

In order to provide a view to the energy usage, Table 1 shows the share of renewables in the energy mix and how it is predicted to grow heavily in order to meet climate targets.

Table 1: Dutch national primary energy usage by source (PJ)

Energy source	2000	2015	2020	2035
Oil	1,173	1,173	1,212	1,253
Gas	1,217	1,191	1,040	885
Coal	325	516	326	292
Renewable energy	52	136	276	491
Other	72	88	92	35
Import balance electricity	65 (import)	40 (import)	75 (import)	-74 (export)
Total	3,204	3,144	3,020	2,882

Source: (Schoots et al. 2016 p. 15)

In the case of the Netherlands, the energy demand of is fulfilled by a variety of energy sources. In 2015 the Dutch primary energy usage was 3144 PJ. Of this, 136 PJ (4.3 %) came from renewable energy sources (Schoots et al. 2016).

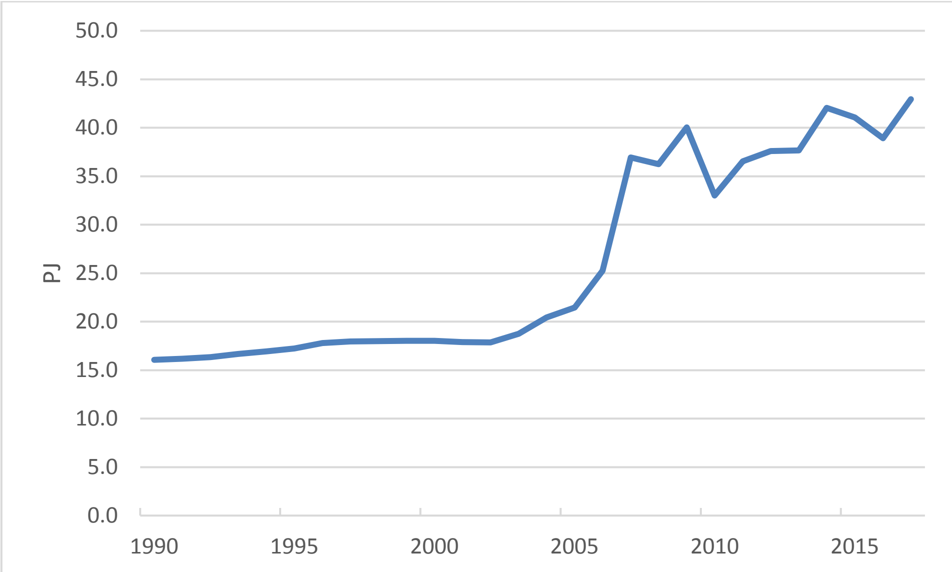


Figure 2: Biomass use for energy (PJ) 1990-2017 in the Netherlands: Statistics Netherlands.

The Netherlands uses three main types of renewable energy sources: solar power, wind power and biomass. **Figure 3** shows the share of every renewable energy sources in the renewable energy mix in the period 2000-2035. The projections for the period 2020-2035 include current and intended policies.

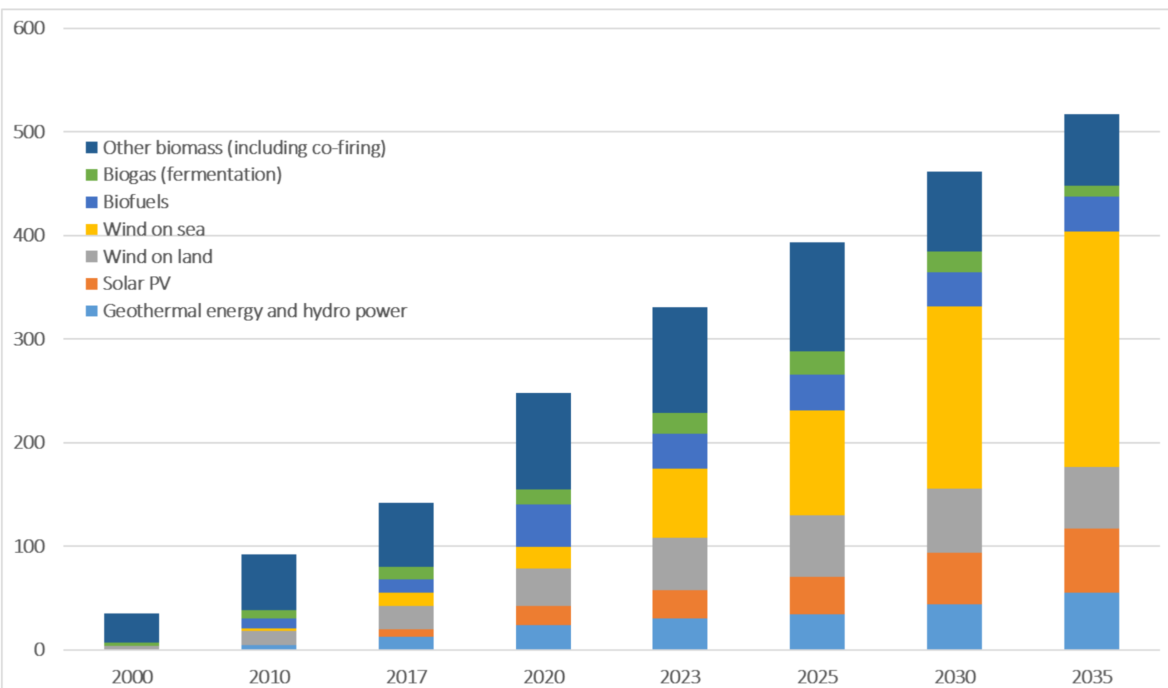


Figure 3: Contribution of several technologies to the Dutch renewable energy mix in PJ.
Source: Derived from (Schoots et al. 2017), p. 85.

As shown in Figure 3, biomass is the largest renewable source in the mix and is expected to grow significantly and then decline over time. Biomass is an umbrella term for all organic material that stems from plants (including algae, trees and crops) (McKendry 2002). The energy derived from biomass is called bioenergy, which is bioenergy is the conversion of biomass resources such as agricultural and forest residues, organic municipal waste and energy crops into useful energy carriers including heat, electricity and transport fuels (European Union 2009). Biomass is an essential factor in the renewable energy mix because of its potential for significant reduction in global CO_2 emissions at moderate costs (Keith 2001). Not all biomass can be used for generating energy and different types of biomass are suitable for different types of energy. For an overview of the types of biomass production in the Netherlands, see **Table 2**.

The Netherlands produced between 40-45 PJ of bioenergy in 2015 (Statistics Netherlands, 2016), see **Figure 2**. The expected Dutch demand for biomass in 2050, based on the ambitions for renewable energy, will be 1,600 PJ (PBL 2013).

Table 2: Types of Dutch biomass production for bioenergy in 2015 and their shares

Type of biomass	Share in 2015 (%)
Household waste and industrial waste	34.8
Logs and scrap wood (A-wood) for usage in heaters and boilers	17.8
Pruned cuttings	11.4
Biogas from fluid manure	7.2
B-wood (painted, lacquered, or glued wood)	6.1
Wood pellets	3.5
Wet residues from food processing industry	3.2
Animal fat	3.2
Biogas from solid manure	3.0
Biogas from sewage treatment	2.7
Bone meal	2.6
Residues from agriculture	0.1

Source: Schoots and Hammingh et al. (2015), p. 64

There has been discussions about the sustainability of bioenergy. Biomass is a renewable source and captures CO_2 during its growth process. This can balance the CO_2 that is emitted while burning it (Keith 2001). It depends on the lifetime of the biomass and the extra emissions during processing and transportation whether there is a real emission balance. Furthermore, the origin of the biomass and production process is important. When nature is converted to agricultural land, there is a loss of biodiversity and a release of CO_2 emissions. This is called direct land use change. Indirect land use change has similar negative implications. This happens when biomass is grown on agricultural land that causes a shift of food production to somewhere else where land needs to be converted (PBL 2013; Popp et al. 2014). This is very difficult to control and measure on a global scale.

The current level of national biomass supply in the Netherlands is limited and cannot meet the expected demand for bioenergy in the future (PBL and ECN 2011; (Ministry of Economic Affairs and Ministry of Infrastructure and the Environment 2015). More import seems inevitable. Especially for biofuels, since they are not grown yet and not expected to be grown in the Netherlands. But the national production potential has not been reached yet. PBL estimates, based on research by Wageningen University, that the maximal production capacity of available biomass in the Netherlands is 200 PJ (PBL 2013). This may look like a small number, but it is almost three times the amount of bioenergy that was produced in 2015. PBL claims that it will be a big challenge to reach this maximum potential. The Union of gas suppliers (i.e. Gasunie) presented a potential of 133 PJ in 2023 and 203 PJ in 2035 (Schulze et al. 2017).

1.2.3 Agriculture & Food

Important topics in the Dutch food policy are health, sustainability and efficiency. The government wants to approach the food sector from a chain perspective. The "Sustainable Food Agenda' ('Agenda Verduurzaming Voedsel') is an important instrument for this (Ministry of Economic Affairs and Alliance of more Sustainable Food 2013). Furthermore, innovation in food policy is stimulated via Green Deals and the Top sectors policy.

The most opportunities for biomass production in the Netherlands lay in optimizing the utilization of waste and residual flows in agriculture and forestry. Specifically, agriculture for bioenergy purposes is expected to have only a small contribution because of spatial constraints in the Netherlands (PBL and ECN 2011). Apart from being a challenge, producing more biomass on national scale can also be beneficial. For example, some types of plantations for bioenergy such as short rotation willow plantations could enhance ecosystem services like water filtration and flood prevention (Popp et al. 2014).

1.2.4 Land use and spatial planning

Land use is source of debate in the Netherlands. Land is scarce and highly populated and there is competition on land use. Nature is one of the sectors that demand land. Yet the Netherlands is also a major producer and export country of food products. The government has the ambition to stay a frontrunner in this area.

The Ministry of Environment and Infrastructure presented their ambitions regarding the spatial and mobility policies in one vision document (Ministry of Infrastructure and the Environment 2012). Three clear goals are presented: The Netherlands competitive, the Netherlands accessible, and the Netherlands liveable and safe. To these goals belong thirteen 'national interests', of which several serve multiple goals. The vision document presents a new role division. The municipalities are responsible for the spatial development of cities and rural areas. The provinces have a connecting role and function as an area manager. The national government stays responsible for the system of spatial planning and special areas.

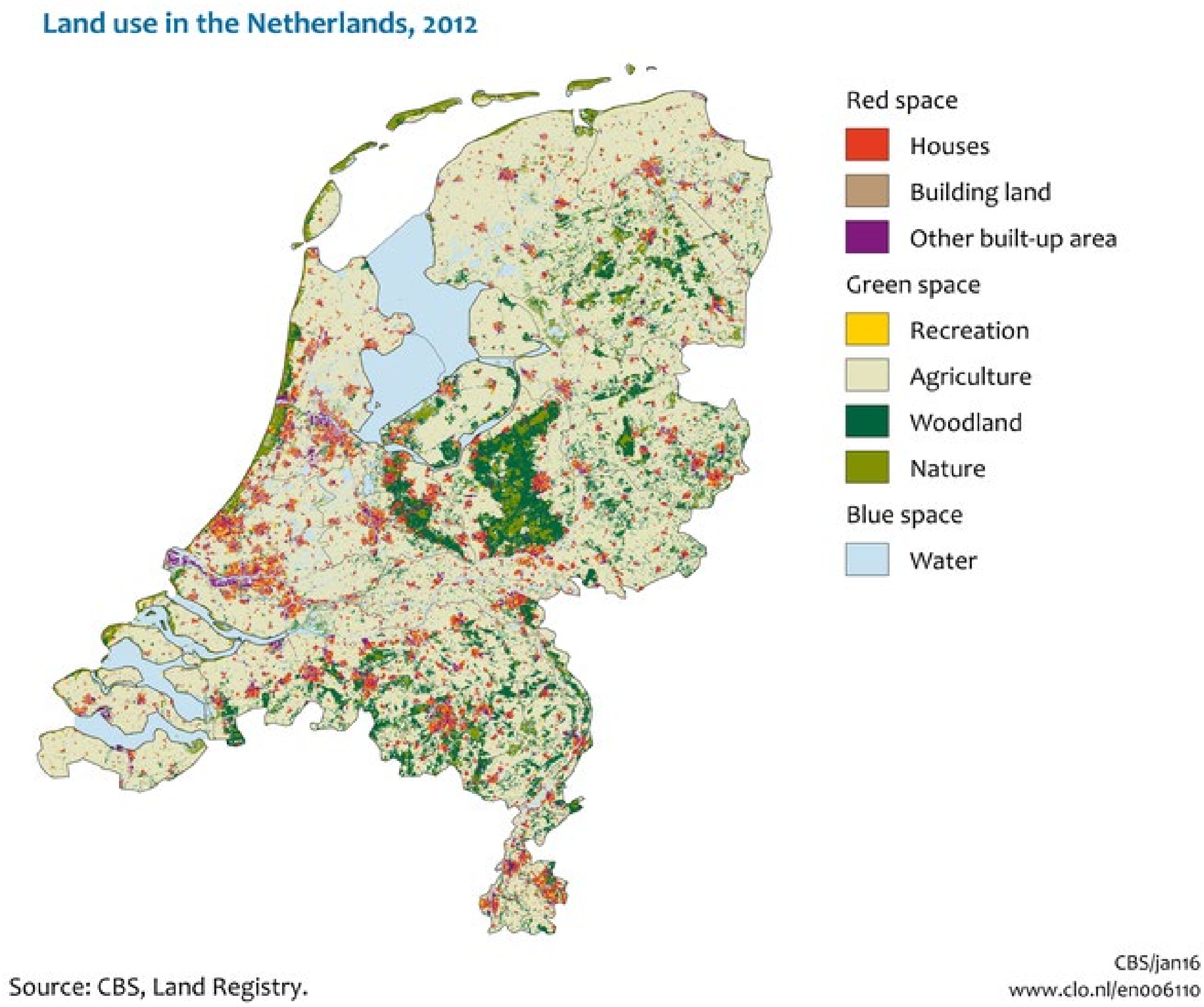


Figure 4 Land use in the Netherlands

1.2.5 Nature

From the beginning of January 2017, three laws regarding nature protection, protection of wild flora and fauna and forest protection are integrated in one new law: nature protection law (de Wet Natuurbescherming) . At the same time, a shift towards more decentralized responsibilities has taken place. The national government emphasizes that responsibilities regarding the implementation of the nature policy are now mainly at provincial and regional level. This is in line with the main course of the national government, to increase the involvement of the larger society. For this aim, the national government stimulates processes like Green Deals, where biomass has been and still is a part. However, the national government remains responsible for the ambitions, the policy framework and the results.

1.2.6 Waste

The aim of the Dutch waste policy is an optimal utilization of resources, as part of the circular economy. Important topics in this policy domain are the circular economy and sustainable chains. There a number of objectives on increasing the useful application of waste. The 'from waste to resource' programme (VANG) forms the basis for all the efforts regarding waste (Ministry of Infrastructure and the Environment 2014b).

1.2.7 Water

Water is one of the issues that signifies the importance of links between issues the most. The Netherlands is a delta and more than 75% of its water is coming into the Netherlands from cross-border rivers such as Rhine and Meuse. The western part of the country with high population density and a high share of GDP is sub-sea level. The country faces vulnerabilities as flood risks, droughts, subsidence, eutrophication, salinization, loss of agricultural production, biodiversity loss, fish migration barriers, and loss of retention buffers. Shipping, urban areas, drinking water, industry, it is all connected to water. Water and energy aspects are linked in many ways: the risk of cooling water shortage and damage to river ecosystems. The main question here is how can the water systems be used for sustainable energy generation. These discussions comprise the role of hydropower, tidal energy, energy from waste and wastewater. The potential of biomass (energy crops) and biofuels to replace non-renewable energy are parts of this ongoing discussion, see Figure 4.

1.3 Key research questions

The overall research question of the SIM4NEXUS case study of the Netherlands is the following:

What is the role of biomass in the realization of a low-carbon and resource-efficient economy in the Netherlands in 2050?

With an ambitious governmental aim of 95% reduction of greenhouse gases in 2050, all sectors must contribute to the goal achievement. The question here is about the role of biomass. It is assessed to be hard if not impossible to reach this aim without an intensification of biomass production for energy. At the same time, using biomass for energy is situated in the lower levels of the value chain, and the aim is to use the biomass at higher levels, in the chemical industry or pharma. There are also a multitude of policy objectives and instruments involved on these matters. There are also many stakeholders (governments, business sector and NGOs) crucial to steer the required transition towards the realization of a low-carbon and resource-efficient economy in the Netherlands in 2050.

Before we can identify the policies and interventions for the future, we first analyse the current policies and interventions related to the nexus elements (climate, energy, water, land and food) with a specific emphasis on biomass. In particular, we also analyse the coherence of policies with respect to the objectives i.e. low-carbon economy and resource efficiency. The research questions for this report are:

- What sectors and policy domains are important for the use of biomass in the Dutch transition towards a low-carbon and resource-efficient economy in 2050?
- What are the main policy goals and policy instruments for these policy domains, and how coherent are these? How are they connected to EU and global policies?
- Which stakeholders are involved and what are their positions, roles, power and relationships?
- Which arrangements are made to address policy coherence, synergies, trade-offs in practice?
- What success stories and failure factors can be distilled from experiences in this case?

For this end we will look closer at the effects of these policies, including opportunities and challenges involved. The word biomass production here can be either about cultivating biomass with the purpose of generating energy (e.g. energy crops grown for biofuels), or generating biomass from other sources with the purpose of producing energy (e.g. biogas generated from organic waste). This report will be used for developing the Serious Game for the SIM4NEXUS case study for the Netherlands.

1.4 Approaches and outline

This study is conducted in a systematic way. First, we map the stakeholders of the different nexus elements from the different policy domains. The stakeholder mapping is explored with interaction of stakeholders. We selected key stakeholders for interviews and during the interview we asked for additional stakeholders to be included. In Chapter 2, we present the overview of stakeholders and their interest. Moreover, we present the way stakeholders are involved in the this study.

Second, we conducted a policy document review. We collected documents of policies currently in place. The emphasis of the collection of documents was the relevance of policy with respect to biomass. For the policy domains of energy/climate, agriculture and food, spatial planning, nature, waste and water, we reviewed the policies with respect to policy objectives and policy instruments.

Third, in Chapter 4 we assess the coherency or interaction between the different policies identified in Chapter 3. Both chapter 3 and 4 are largely based on the study of Marinissen (Marinissen 2017)). Identifying critical nexus objectives based upon the definition of a nexus critical objective (NCO) as the policy objective that shows high (potentially the highest) number of interactions with other objectives in the nexus and that is the most relevant to the research topic, see . We use a scoring system for measuring policy coherence based on (International Council for Science 2016) who explored his method on the coherence between Sustainable Development Goals. Policy coherence is measured for the interaction between policy objectives. Furthermore, the interaction between policy instruments are reviewed in a qualitative way as well. Finally, the vertical integration of policies in the Netherlands are reviewed based on the judgement of three experts.

In Chapter 5, policy arrangements and coherence of policies are discussed. Finally, Chapter 6 concludes and discusses the results of this study.

2 Mapping of stakeholders

2.1 Introduction

Stakeholders were identified based upon the review of policy documents and interviews. The literature and document review was meant to investigate which policies there are in the Netherlands and also to provide input for an assessment of the policy, and it also served the stakeholder interaction by offering input into the discussion. Policy interaction analysis forms an effective tool to map the key issues by identifying synergies and trade-offs in a network setting, see (International Council for Science 2016). The website of the National government in the Netherlands and other relevant sites were used to search for the key policy documents in a specific field.

The stakeholder interviews were performed with the purpose of obtaining information about how they perceive barriers and support from policy. This provides valuable empirical information that enriches the theoretical part of the research.

A selection criterion for stakeholders is that they should have been working with biomass and bio-energy in the research, advisory and/or production field for a considerable amount of time. In this way it can be assumed they have good knowledge of the topic and experience with the developments in the biomass sector. Stakeholders were searched on Google and relevant websites regarding biomass and bio-energy in the Netherlands and on LinkedIn. More stakeholders were identified during the policy coherence assessment while reading the policy documents. The concept of snowball sampling is also used: respondents were asked which other stakeholders would be interesting to talk to.

This has led to a diverse group of stakeholders that has been interviewed. This group includes biomass experts from the research side, stakeholders that are expert in specific types of biomass application or production and people working on bio-energy and policies for a government (regional and national). The interviews were semi-structured.

2.2 Biomass stakeholders: mapping interests and influence

In this section we present and discuss the interests and influence of the main stakeholders in the case of biomass in the Nexus domain. First we present and discuss the national government (Section 2.2.1) and then the regional government (Section 2.2.2).

The national government

The national government with the Parliament and the Cabinet of Ministers are the highest decision making bodies. The ministries are the responsible bodies for working out these decisions into policies and they are also instrumental in the implementation of the policies. In addition, the ministries are also central in preparing policy decisions, answering questions from parliament, media, research, business and citizens at large. In 2017, there has been several changes in the departmental structure, see **Figure 5**. Two ministries dominated until the autumn of 2017: the ministry of Infrastructure and the Environment and the ministry of Economic Affairs. The Ministry of Infrastructure and the Environment covered most of the water and land-use planning policies and waste. The Ministry of Economic affairs was responsible for food and agriculture, and also the energy policy.

The new government reorganized the ministries and now the Ministry of Economic Affairs and Climate is essential for energy and climate and circular and bio-based economy. For agriculture and food, the most important ministry now is the Ministry of Agriculture, Nature and Food Quality. For water, a new Ministry of Infrastructure and Water is leading. Three ministries are thus leading when it comes to Nexus issues.

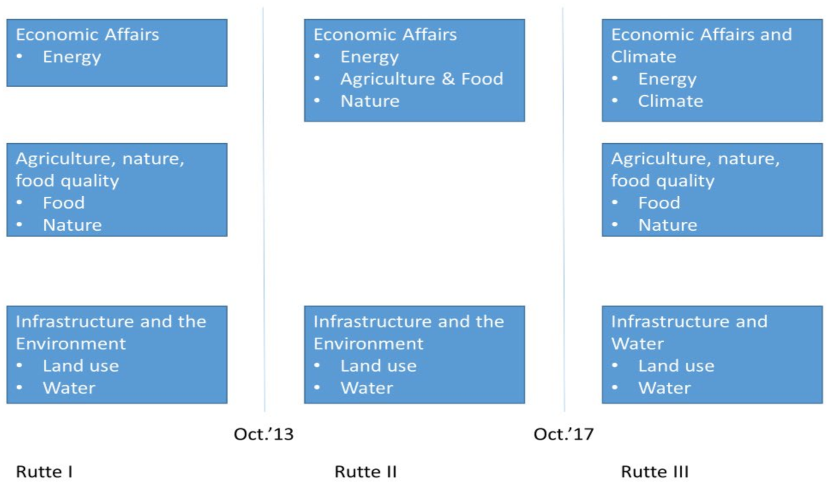


Figure 5: Recent changes in Dutch ministries regarding Nexus elements

An important portal for decision making is the Social and Economic Council (SER), which advises the Cabinet and Parliament on key issues as the social and economic policy; governance; law enforcement and self-regulatory matters as promoting desirable consumer or business trends, and it is a platform for discussing various social and economic issues. The SER Council consists of independent Crown-appointed members, employers, and employees.

Biomass: no clear demarcated field of forces

The lack of a specific and clearly demarcated biomass policy field in the Netherlands is due to the many-sided character of the biomass issues at stake. The point here is that biomass lacks a stronghold in one explicit ministry. Biomass is spread out on at least the three ministries described above. For energy matters the ministry of Economic Affairs and Climate is the most important ministry. The Ministry of Agriculture, Nature and Food Quality is the central policy-maker concerning agriculture and food. However, agriculture and food are broad issues carrying many contested matters of great societal concern. As a consequence, we see many actors having a great interest in this field. Climate issues are not even a 'sector' as such, it is part of the whole economy and society. The government now uses climate issues to speed up certain developments of the bio-economy, including biomass for energy (Ministry of Economic Affairs 2016a). The

Ministry of Economic Affairs is the central actor together with the Ministry of Infrastructure and Water. Since the Energy Dialogue (*Energiedebat*) in 2016, the Ministry of Economic Affairs and Climate has been actively promoting support for a joint agenda for all sectors of society. Fostering awareness of the energy transition in the Netherlands is one of the important issues. Water is one of the essential sectors in the Netherlands and the Ministry of Infrastructure and Water is the most important single actor. The Water Board Union is however important for the policy implementation. There are also strong links between water and agriculture and nature. For biomass, these links are important.

In sum, the ministries are (next to politics) central to the policy-making in the Netherlands. But for the implementation, they depend on a huge range of public and private actors. Numerous consultations and partnership relations are being carried out to stimulate support and coordinate the action. For active societal actors, there are opportunities for being heard, although many actors have access to these channels for influence.

The regional government

The province is the regional government of the Netherlands. The 12 provinces are central to much of the implementation of policy, particularly the implementation of the nature policy. The provinces also have a joint organization that represents them in many ways and also offers a platform for the provinces to consult among themselves: the Interprovincial Platform (*Interprovinciaal Overleg*). The municipality is the local government and the 380 municipalities are also united in the Association of Netherlands Municipalities (*Vereniging Nederlandse Gemeenten*, VNG). Here we refer to these regional governments as the 'provinces' respectively 'municipalities' The Dutch Water Authorities (*Unie van Waterschappen*, UvW) is a governmental public body covering water management issues. UvW is the national association for the 21 water boards, with its own research organization called STOWA.

Implementing agencies and research

There are various public agencies and research institutes involved in the Dutch policy-making. The usual division of work is that these are providing advice for the decision makers. The Netherlands Enterprise Agency (*Rijksdienst voor Ondernemend Nederland*, RVO) is important for the implementation of policy for improving opportunities/conditions for entrepreneurs in sustainable, agrarian, innovative and international business. RVO helps with grants and subsidies as SDE+, in finding business partners, know-how and compliance with laws and regulations. RVO is part of the Ministry of Economic Affairs and Climate Policy. The Netherlands Environmental Assessment Agency (*Planbureau voor de Leefomgeving*, PBL) is a prominent supplier of knowledge for the government. PBL is the national institute for strategic policy analysis in the fields of the environment, nature and spatial planning, contributing to the political and administrative decision-making by conducting outlook studies, analyses and solicited and unsolicited evaluations in which an integrated approach is considered paramount. It is part of the Ministry of Infrastructure and Water Management but other government departments may also ask PBL to conduct research. Of the other knowledge institutes there are universities as University Twente and Wageningen UR, ECN Energy and CLM for agriculture and environment.

The Cabinet policy: biomass needed for bio-based economic growth

A central part of the economic policy in the Netherlands is about generating growth. The government aims to achieve this growth by (among other) becoming a key centre for the bio-based economy, or bio-economy, in the next few years (VVD et al. 2017). For biomass, this means an approach where the government stimulates biomass as a part of its ambition to trigger a bio-based economy. Besides being a useful source of energy, biomass can also be used to make for instance plastic. Also the policy reflects this double role of biomass: as a source of energy but also by 'cascading', which is about resource efficiency where the biomass is used as high in the chain as possible. Thus, in the bio-economy, organic waste, algae and meat waste can be used to generate plastics, energy and fuel for the future. Much of the preparatory efforts in the bio-economy has been organized in the Topsectors arrangement and the Transition Agenda, with participation of public-private networks.

Public-private involvement in policy networks

There are many non-governmental stakeholders involved in biomass. There are many companies involved as the recycling and biomass trader WWR, the energy supplier RWE, the food and material business DSM. There are also business associations as Green Gas, representing 125 businesses and organizations, or the Platform Bioenergy PBE, representing the entire biomass chain. The Biomass Alliance is for instance an initiative for smart collaboration and new business cases for the Eastern Netherlands.

In the Dutch setting, non-governmental stakeholders are very active in policy-making, and there are various ways to involve private parties in policy. It is also common practice to do so. Typical ways of involvement in the preparation stage of policy-making range from more passive forms of informing the public, to consultations and more much active and interactive ways of working together in informal or slightly formalized settings as the Transition Teams for a circular economy. Regarding biomass, the last 8 years or so have been characterized with an extensive interaction. For carrying policies out, important roles are played by a range of public organizations; provinces, municipalities, water authorities and agencies. But also public private partnerships are often the chosen way forward. Private business actors as single companies or business associations participate in various tasks of public interest. They are consulted on policy issues and they are for instance involved in public-private collaborations as the '*Topsectors*' policy arrangement, organized around key sectors of the Dutch economy for connecting knowledge and stakeholders, inclusive policy-makers. Topsectors are organized in nine sectors. To be accepted as a Topsector the sector must be among the global leaders in this sector. The Topsectors are: (1) High tech systems and Materials, (2) Life sciences & Health, (3) Agri & Food, (4) Water, (5) Chemistry, (6) Horticulture & Starting – materials, (7) Creative Industry, (8) Energy and (9) Logistics. In the Topsectors, public and-private organization cooperate and it is used as a vehicle for establishing research projects. This form of collaboration is designed to promote innovation, to attract talent (human capital) and to ensure a solid position for the sectors in the international context. The Topsectors work on innovation/R&D, investments, fiscal incentives, guarantees and cutting down on bureaucracy and red tape (https://www.topsectoren.nl/). The most important Topsectors for biomass are Chemistry, Energy, Agri&Food, and Horticulture & Starting – materials.

Business companies are not always able or willing to participate in collaborative settings on their own, and branch organizations or business associations are then a way to carry out influence within for instance the Topsector policy, or all kinds of advisory committees and other fora with a policy impact.

Research institutes are also very much part of such collaborations but they are also important on their own. Examples are PBL, ECN (energy), WUR, CLM. Many public-private covenants have been concluded like the Dutch Energy Agreement for Sustainable Growth (SER 2013; SER 2015). Within these covenants public and private parties collaborate on sustainable growth, including a low-carbon economy.

Networks making policy content: Topsectors and the Transition Team Biomass and Food

The use of Topsector teams has been a part of the Cabinet policy since 2009. It is meant as an arrangement where actors meet and collaborate. For the Cabinet the top sectors are matchmakers for bringing parties together, driving innovation, facilitating the cutting of red tape, supporting the Cabinet in reducing the regulatory burden and a better alignment of the supply and the demand of people and knowledge in the business and industrial sectors. The government is also one of the parties and a co-investor. For each top sector, the government is striving for maximum returns from the means available: tax incentives, loan guarantee schemes and investments.

In the evaluation of the Topsector Policy (Dialogic 2017) it is concluded that it has not so much resulted in substantial output in terms of investments or business realizations but it has delivered collectivity and collaboration, and a more programme-oriented cohesion in fragmented areas of policy. The Topsector Energy is first of all a network actor of great interest for setting the agenda and developing new options and also more coherent policy options. The Topsector Agrifood (i.e. Top Consortium for Knowledge and Innovation TKI) coordinates the creation of the knowledge and innovation agenda. It takes care of the research programme and advises the Top Team Agriculture & Food concerning arrangements with the Minister of Climate and Economic Affairs, see https://topsectoragrifood.nl/en/kennis-en-innovatie-tki/. For biomass, the Topsector Agrifood works for instance on alternatives for fossil-based materials, high value material and better residual products.

International trends: influential but hard to influence

As much policy comes from the EU, for instance in agriculture, also the influence of the policy runs through the EU. However, the international influence is also broader than just the EU. Following the Energy Outlook 2017 (Schoots et al. 2017), we can say that also the development in surrounding countries is influential, with major impact on the Netherlands. For international companies this is obvious, but also for the coherence of for instance the energy policy. According to the Energy Outlook (*Energieverkenningen*) (Schoots et al. 2017) the developments in neighbouring countries is more meaningful to take into account than a national approach.

Regions at work: a call for shared responsibilities

It is also of importance to consider the regional aspects of the policy practice. We should here think of areas for various land use as agriculture, nature, energy installations and facilities etc. The Energy Outlook (Schoots et al. 2017) argued that for energy the increasing importance of regional partnerships between provincial and municipal authorities must be considered. Much of the energy transition falls under the responsibility of the provincial and municipal authorities, which have to deal with the consequences on land use, energy use in housing and built-up areas. The energy mix, with all kinds of renewables, will change the way policy is carried out and vice versa. More biomass, more solar panels and more wind turbines can be placed. But the Energy Outlook (Schoots et al. 2017) also argues that the use of land for energy production needs not be solely the responsibility of those local and regional authorities that have become accustomed to it over the past few decades, but can be shared by all authorities in the Netherlands. The effect will be a need for more coordination, more clarity around the delineation of responsibilities, appropriate funding, and suitable laws and regulations, which also involves the central government.

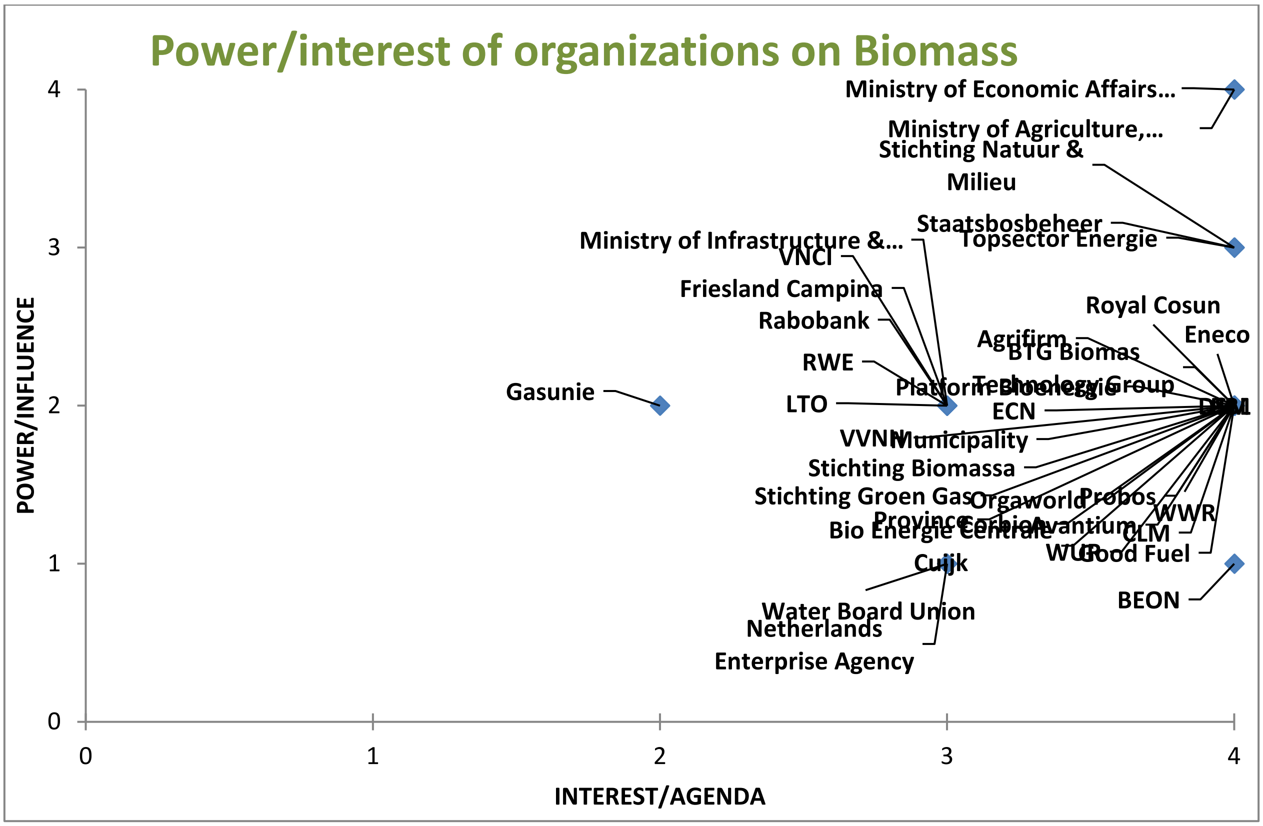


Figure 6: power/interest in biomass (source: this project)

The figure does not pretend to be an assessment casted in concrete. It does show how the constellation of actors stand in matters of interest and influence. In short we can say that the ministries of Agriculture, Nature and Food Quality and the Ministry of Economic Affairs and Climate are the most powerful actors, as the main actors in the policy-making process. Many other actors have a great interest in biomass but as stand-alone actors they have much less influence. Their influence grow whenever they unite or collaborate on a certain issue, as in the participation in policy groups as Topsector policy/Transition Teams. However, assessing influence in a field with no clear demarcation as a specific field or sector is hard. We do emphasize that working for and/or in an alliance which aligns with government departments would enhance one's chances of being heard. In the next figure we will discuss influence further.

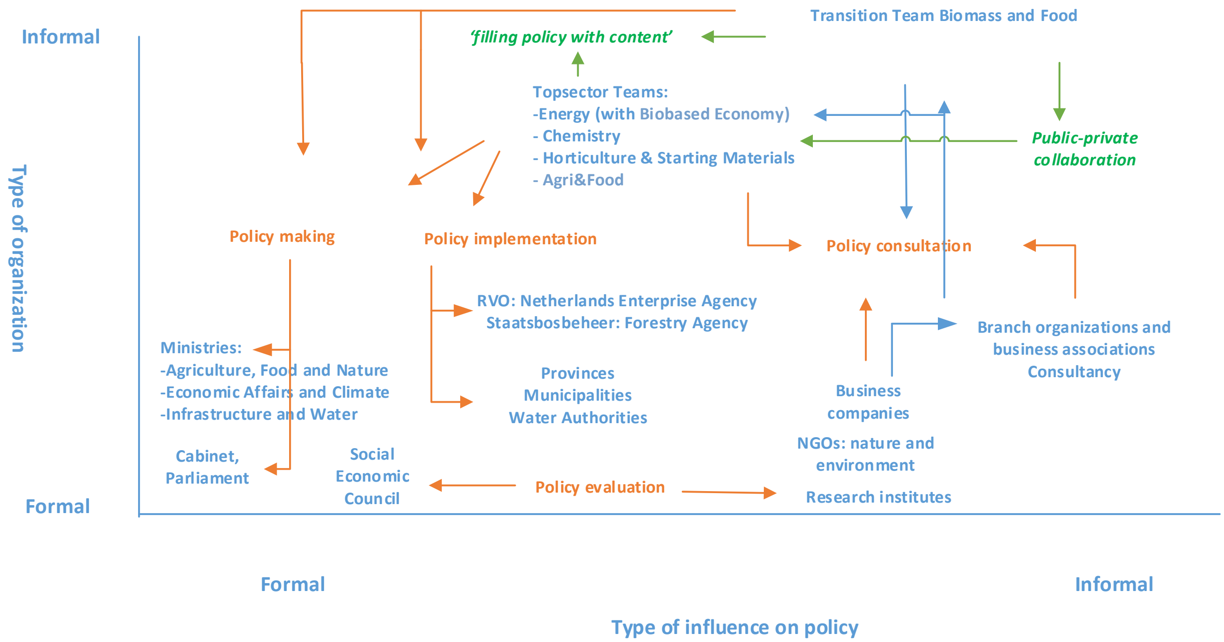


Figure 7: Stakeholder mapping (source: this project)

In this figure we make a distinction between formal and informal influence. The national government is here represented with more actors than in the previous figure. This is to make clear that also the national government is a broader field of influence than just the ministries, which eventually are the influential policy makers. Important roles are also played by evaluating actors. The Social Economic Council for instance, is central to assessing how a subject is viewed in powerful parts of the Dutch economy. Research institutes also have a say in policy by their evaluative research that is usually used in policy processes. In general, the huge appetite for less formal or even very informal arrangements in the Netherlands makes influence a rather blurry one for assessments. In the case of biomass for energy, a group of academics teamed up to protest in the newspaper NRC against the paper world of policy that for them is not sustainable at all. They pledge for a CO2 tax and no subsidies for biomass use for energy https://www.nrc.nl/nieuws/2018/11/16/biomassa-stoken-is-een-ramp-voor-het-klimaat-a2755398. Their input is then outside the world of policy arrangements but might eventually have (much) influence. It all depends on how this discussion evolve, as another group of academics stood up in the same newspaper to argue against the first group. https://www.nrc.nl/nieuws/2018/11/21/duurzame-biomassa-is-juist-een-heel-goed-idee-a2756060.

2.3 Stakeholder engagement

The potential users of this case-study are policy-makers and companies from different economic sectors such as food processing industry, farmers organisation, manufacturers of small-scale electricity technologies. For the purpose of this study we have conducted 17 interviews, with 1 group interview and we have held 2 workshops. In addition we had a Meet & Greet with the rather related Magic project. We tried to cover all different types of relevant stakeholders: public, business, NGOs and research, covering also all nexus sectors in our case study. For the government, we included both the national and the regional level (province), as well as the relevant state agencies. For NGOs and business, we tried to cover a broad field, including branch organizations, to get variety. We draw up a list of the people and organizations which exceeded 80 people from more than 40 organizations. They have been invited and they receive updates and texts. All stakeholders have shown interest in the project, although they do not always have time to participate in the workshops organised.

Table 3 List of stakeholders involved in the project Sim4Nexus in the Netherlands

Type of organization	Name of organization	**Description**	**Core Nexus Interest**
National government	Ministry of Infrastructure and Water	Main policy-maker for Infrastructure, water, spatial planning	Water, land, climate
	Ministry of Economic Affairs and Climate	Main policy-maker for energy and climate policy	Energy, climate
	Ministry of Agriculture, Nature and Food Quality	Main policy-maker for agriculture and nature policy	Food, land
	Staatsbosbeheer (National Forestry Agency)	Commissioned to strengthen the position of nature. Land owner and manager	Land
	Rijkswaterstaat: Public Agency Infrastructure	Implementing agency for the Dutch infrastructure.	Land, water.
	RVO Rijksdienst voor Ondernemend Nederland (Netherlands Enterprise Agency)	improve opportunities/conditions for entrepreneurs in sustainable, agrarian, innovative and international business (helps with grants and subsidies as SDE+, finding business partners, know-how and compliance with laws and regulations Part of the Ministry of Economic Affairs and Climate Policy	Energy, climate, food, land, water
	UvW - Dutch Water Authorities	Cooperation of the Dutch water boards	Water
Regional government	Provinces (3 in S4N: Overijssel, Gelderland, North Holland)	Implementation and coordination of policy at the regional level	Nature, land and water
Local government	Municipalities	Land use permits, local land use planning	Land
Research	PBL – Netherlands Environmental Assessment Agency	National institute for independent policy research	Climate, energy, food, land, water
	WUR – Wageningen University and Research	University research, many aspects of biomass, such as production technologies research	Climate, energy, food, land, water
	ECN - Energy research Centre of the Netherlands	ECN/part of TNO energy research, technology and market analysis.	Energy
	CLM Centrum Landbouw en Milieu	Research/Advisor on agriculture and environment	Energy, food
	University of Twente	University research, many aspects of biomass, fx production technologies research	Climate, energy, food, land, water

Type of organization	Name of organization	Description	Core Nexus Interest
Consultancy	BTG Biomass Technology Group	private group of companies, specialized in the process of conversion of biomass into useful fuels and energy: consultancy, project development, research	Energy
	Probos	non-profit institute for forestry, forest products and services Advisor on wood and timber use, biomass production and procurement	Land, energy
Public-private collaboration	Topsectors Energy, Agri. & food and Horticulture and Materials	A network initiated by the government to combine knowledge and stakeholders inclusive the policy-makers	Energy Agriculture Food
	Biomassa Alliantie	Biomass alliance for regional governments, public agencies, private business association, knowledge institutes	Land, energy
Business	ENECO	Energy company	Energy
	DSM	Multinational in products within health, food and materials	Food, energy
	Friesland Campina	Dairy producer	Food, land
	Bio Energie Centrale Cuijk	Bio-energy producer	Energy
	Avantium	Renewable chemistry/bio-based, multinational	Energy
	Corbion	Bioplastics, bio-chemicals	Energy
	Agrifirm	International agricultural cooperation	Food, land
	Orgaworld	Multinational on bio-waste	Land, food
	Rabobank	Financial services	Food, land
	Good Fuel	Biomass, multinational	Land, food
	Gasunie	Gas producer/trader	Energy
	WWR group	Biomass trader, recycling	Energy, land, food
	Energon B.V	Biomass, bio-energy (part of the WWR group)	Energy
	RWE	Energy supplier	Energy
Business association	Stichting Biomassa	Biomass processing innovation for the region Achterhoek	Energy, land, food
	Stichting Groen Gas	Green gas (biogas) representing 125 businesses and organizations	Energy
	VVNH	Employer organization for wood products/imports	Land
	VNCI	The Association of the Dutch Chemical Industry (VNCI) promotes the collective interests of the chemical industry	Food, energy
	Royal Cosun	Agro-industrial, food, non-food, chemistry	Food, land, energy
	Platform Bioenergie (PBE)	Biomass chain, advise, lobby, representation	Energy
Branche organization	LTO-Noord	Business and employers' organisation (50.000 farmers)	Land, food
NGO	BEON	Bioenergy Cluster Eastern Netherlands including provinces Overijssel and Gelderland, PBE, Probos, SNM, National Forestry Agency, Probos, LTO, Stichting Biomassa	Energy, land
	SNM Stichting Natuur en Milieu	Interest organisation for nature and environment	Climate, land, food, energy
	Natuurmonumenten	Nature organisation (700.000 members)	Climate, land, food, energy

At this moment we miss important stakeholders as banks and waste companies. We will take action to involve the Dutch Association of Waste Management Companies, which represents and lobbies nationally and internationally for the more than 50 members.

Although we have an extensive list of stakeholders, we could involve a wider range of stakeholders with interest in greenhouse gas emission reduction, such as representatives of the ten Dutch drinking water companies, more representatives of nature management organisations, representatives of solar and wind power companies.

When it comes to the process of engagement, we distinguish between four stages. First, we engage the stakeholders to discuss policy matters. Second we aim for input for the conceptual framework with relevant relationships and trade-offs, and also priorities and policy strategies. Third, we want to involve stakeholders in the building of the System Dynamics Model and finally the Serious Game.

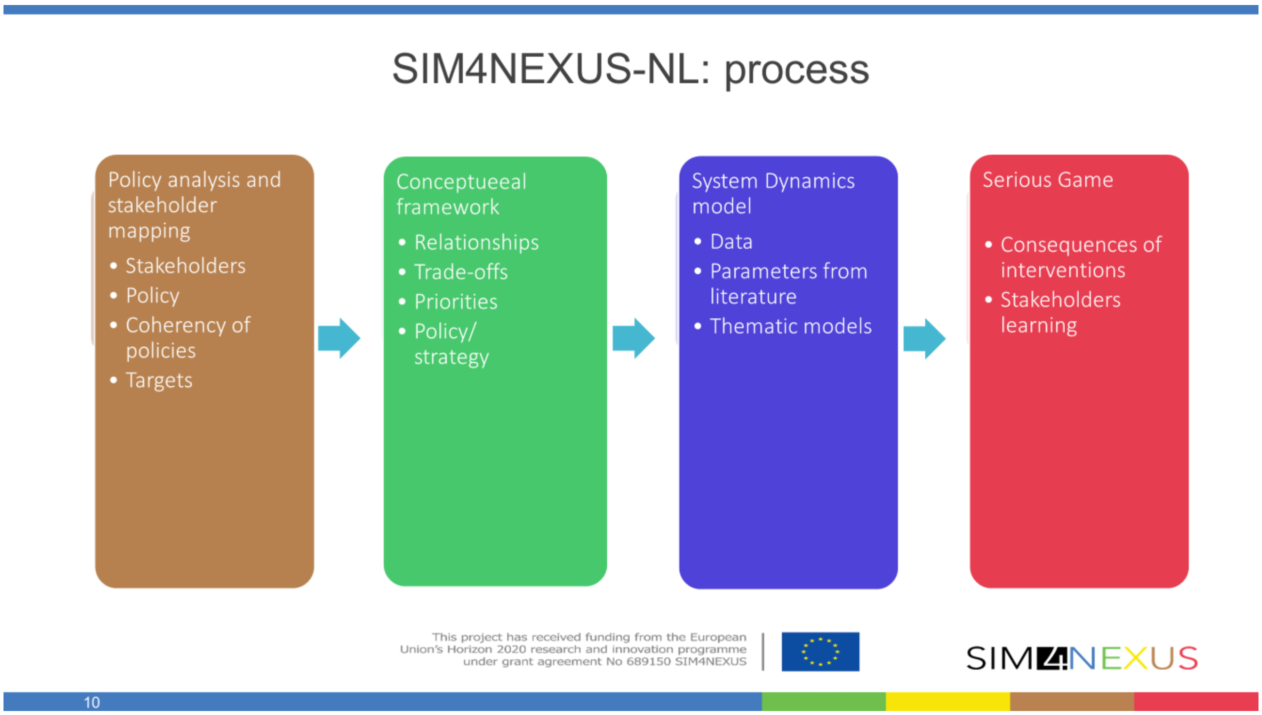


Figure 8: Four phases of the SIM4NEXUS project and the Netherlands case study

Stakeholder interaction is considered to be useful for several reasons:

- Dialogue among actors with various views & interests & disciplines
- Joint elaboration of opportunities & barriers
- Experience the advantages of the Serious Game for decision making processes
- Explore joint interests & deal with tension: make difficult choices
- Establish priorities from integrated assessments.

The case study for the Netherlands has four phases: (1) policy analysis, (2) preparation of the conceptual framework, (3) preparation of the system dynamics model and (4) preparing and playing the Serious Game, see **Figure 8**. Stakeholders interaction is foreseen in all stages of the case study

For the stakeholders of the case study in the Netherlands, four workshops will be organized. The stakeholder engagement in the workshops is shown in

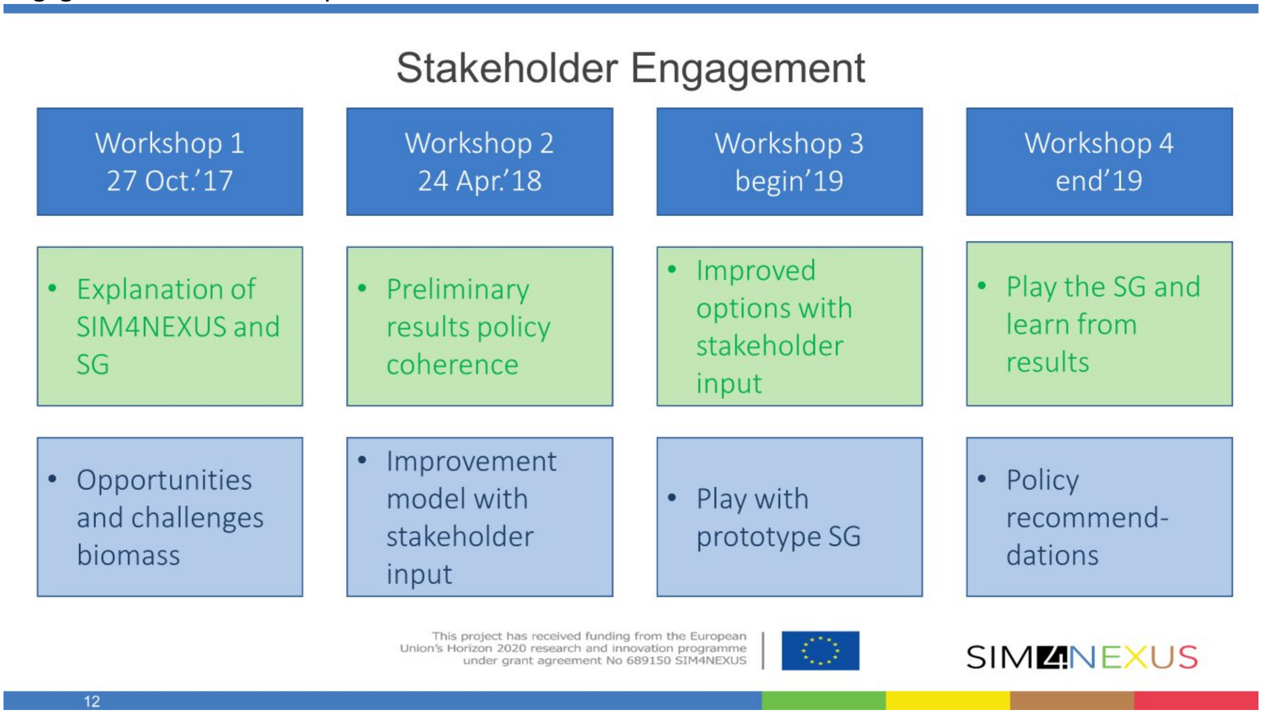


Figure 9 below. We offer the stakeholders

- Explanation of the SIM4NEXUS project in the Netherlands and the Serious Game to be build
- Results from the policy analysed and the coherency analysis in particular en
- Input on measures and instruments to be included in the System Dynamics model and the Serious Game.
- Play the Serious Game and learn from the results.
- We ask/asked the stakeholders the following input: which opportunities and challenges are there with the application of biomass as a renewable energy source?
- How can we improve the Conceptual Framework and the System Dynamics model to make the game as useful as possible?
- Play with the prototype of the Serious Game
- Policy recommendation based on playing the Serious Game.

The main conclusions from the interviews and workshops are the following:

1. *High ambitions*
   The ambition is high and a 95% reduction of greenhouse gases in 2050 cannot be achieved without biomass. But the supply of sustainable biomass is limited and the government aims for more supply.
2. *Image problem*
   The framing of the biomass image is essential but also negative. Image is however not the same as public opinion. There are many sorts of misunderstandings and lack of mutual understanding, which call for more work on communication and dialogue.
3. *Diversity of types of biomass is huge – a system-approach needed*
   Biomass is a 'container-concept' covering many types of biomass and activities. There is also competition as biomass for energy is low on the ladder of cascading compared to high-end chemical applications. A system-approach is needed to be able to assess the full scale and importance of biomass: chains, scale, cascading, The diversity also implies that the interests and views are fragmented and this is also about the culture of thinking and acting between sectors, between public and privates, national and regional.
4. *Many business opportunities – but not enough know-how and capital and fragmented policies*
   The diversity is also part of another feature of biomass; there are many business opportunities. Applying biomass is not optimal: there is not enough know-how and capital, and an uneven level playing field and stakeholders often sense the policy to be fragmented. The issue of soil quality is under-estimated and not optimally included. For many, the biomass usage 'has just started' as stakeholders see many opportunities for biomass usage. The inclusion of cities is one of the areas mentioned as a future prospect. But for biomass in general, the Investment programmes and subsidies should be geared up to include biomass for explicitly, that is not the case now.
5. *Stakeholder involvement in the Netherlands is huge*
   The stakeholder involvement in policy in the Netherlands is huge. Still, more real collaboration is felt to be needed, as nobody can come far alone.
6. *Coherency is often a 'narrative' and on paper: incentives still lacking and practice less coherent*
   Coherency is often typified as a 'narrative' that mainly exists on paper, as incentives still are lacking and the practice is less coherent or even contested. This goes for economic incentives for using rest-streams, norms for sustainability, protection of nature areas, ecosystems, soil quality. A part of the problem is that the biomass sector is not well organized. The question is whether it is realistic to talk about a sector as diverse as biomass.
7. *Global biomass needed but is it sustainable*
   The biomass needed globally must be available, but how do we know it is sustainable, many stakeholders ask. Besides, sustainable biomass can become scarce and we might use less sustainable biomass as well.
8. *Creating a Serious Game is very interesting*
   Creating a Serious Game is very interesting for learning how to deal with biomass

The stakeholders emphasized that the Dutch government has made major efforts the last 8 years to identify and tackle incoherencies and other obstacles to policy achievements. Much of this work has been made in close collaboration with societal stakeholders such as those involved in this project. With regard to the coherence of the policy, many stakeholders stress that still much of the coherency is 'on paper', but in practice there are incoherence's. One of the most important aspects of biomass as a policy issue is to continue the work on improving the negative image of the issue. Stakeholders report that the good ideas from the policy dialogue and work groups for the Transition Agenda are now put on hold because the government now wants to wait for the work that will be conducted with the stakeholders for the new climate policy. However, the recent climate policy shows a very ambitious government that aims to reduce the use of fossil energy usage.

Table 4 provides an impression of ideas for policy interventions in the Netherlands or the EU from the second workshop with stakeholders. Interventions not chosen are not mentioned in Table 4. The most frequently chosen intervention is raising more awareness of the types and usages of biomass.

Table 4: Policy interventions chose by stakeholders during the second workshop

Policy interventions	Scale	Count
Public information on types and usage of biomass: pros and cons of behaviour	divers	3
Adjust regulation to high-end usage and removal of obstacles: as definitions of waste and resources.	EU	2
Mandatory sustainability reports and labelling	EU	2
More green deals for high-end use of biomass	diverse	2
Phase out not-sustainable products if sustainable are available. Progressive mandatory % renewable resources in products.	EU	2
Price mechanism for the use of fossile resources	EU	2
Every organization (public or private) must have a sustainability plan for its own functioning (waste, purchase, buildings etc).	diverse	2
More usage of the EU-ETS (Emission Trading Scheme)	EU	2
Revise CAP: include rewards for more sustainable usage: (of Nitrate and Phosphate and organic matter in soil,; micro nutrients)	EU	2
Revise CAP: Direct Payments coupled to environmental and society based activities, instead of hectares.	EU	2
Revise the Rural Development Plans: include sustainable biomass production.	EU+NL	2
Environmental and climate costs in food prices.	diverse	
Space for renewable energy: resources, production, distribution etc	Nat, reg, local	+2 en -1 (do not)
Strategic partnerships with important biomass producing countries.	EU, nat	1
Harmonization of demands for sustainability (also norms for biomass.	EU	1
Education on sustainable consumption and production, on planetary boundaries and your own behaviour.	Diverse	1
Long-term goals for a circulair economy: create stable conditions for business and investors.	EU, nat	1
Ecodesign guidelines for a circulair economy: circular design, as in no pollution at the source or in the chain.	EU	1
Make an investment programme SDE++ for circular resources.	Nat	1
Investment funds and risk guarantees for business plans (for innovative bio-based investment plans).	Nat	1
One clear label for sustainability: energy and resource use.	diverse	1
EU energy efficiency: directive should be implemented progressively stricter.	EU	1
Investments and subsidies arrangement SDE+: broaden to Carbon Capture and Storage (CCS), CCU and include biomass	Nat	1
Make an investment programme SDE++ for circular resources.	Nat	1

* Count is the number of stakeholder groups during the second workshop of the case study that chose this particular intervention. There were four stakeholder groups during the second workshop.

3 Mapping of policy objectives and instruments

3.1 Key policy objectives and instruments

The main interest in the case study is the role of biomass in the efforts to realize a low-carbon and resource-efficient economy. Biomass is used for different reasons such as food production, organic manure, biofuel production, energy production and nature amongst others. In addition, biomass originates from different sources and processes such as nature management, waste (organic waste) from human consumption, manure, crop production (wheat, reed and sugar cane for instance) and crops residues. As a consequence, there is not one single field of policy covering biomass. We selected the following policy dimensions for the review, namely energy policy, agricultural (and food) policy, waste policy, nature policy and water policy. In the review, we will mainly focus on renewable energy and biomass use for energy production.

The key vision of the national government is that there will be potentially enough biomass available to fulfil the Dutch objectives for biomass for food, feed, energy, transportation, chemistry and materials . It will however require further efforts to increase the biomass supply and an optimal and efficient utilization of biomass. Sustainability is an essential condition in this for the government (Ministry of Economic Affairs and Ministry of Infrastructure and Environment, 2015).
In one of her studies PBL also concludes that biomass could be useful as energy for reducing CO_2-emissions (Hekkenberg et al. 2018). It does not require major changes to the energy system, it is not complex, short term effects are achievable and the technology is relatively inexpensive. However, the future supply of biomass is uncertain and it is in particular unclear whether there will be biomass for other purposes than those that are seen as a priority, which is essentially where there are no sustainable alternatives. This means that biomass will not be available for cities, electricity, transportation of persons. The problem is that there is no international biomass market that comply with the Dutch sustainability criteria from the recent Energy Agreement. Strategies to enhance the domestic supply of biomass could then now become interesting.

In general, the national government aims for a coherent policy for this bio-based economy (Ministry of Economic Affairs 2012). The ambition expressed in the policy vision Biomass 2030 is to be a front runner in sustainable produced biomass (Ministry of Economic Affairs and Ministry of Infrastructure and Environment, 2015). The aim for the Dutch agricultural sector is to keep its leading position as efficient producer of resources. Producing biomass is also meant to provide the management of nature and landscape a stronger financial basis (Ministry of Economic Affairs and Ministry of Infrastructure and Environment, 2015).

3.2 Inventory of policy objectives

3.2.1 Climate/Energy/biomass policy

Biomass plays a significant role in the current levels of renewable energy and will play a significant role in the renewable energy in the future. With the mapping of policies (either objectives or instruments) we do not cover the whole area of energy but we focus on the role of biomass. The information in this section is collected from several policy documents in the period since 2012 (Ministry of Economic Affairs 2012;

Ministry of Economic Affairs and Ministry of Infrastructure and the Environment 2015; Ministry of Economic Affairs and Climate 2018) and advise from SER (SER 2013, 2015, 2117, 2018).

The overarching objective in the energy policy related to biomass is the sustainable increase of biomass supply (Ministry of Economic Affairs and Ministry of Infrastructure and the Environment 2015). This will also affect the supply of biomass for energy production in a positive way. There are nine specific objectives identified for this sustainable increase of biomass supply. More specific objectives are listed in Table 5. The productivity of agriculture (B1) and forestry (B2) can be increased by using residues for energy production. For agriculture, residues like manure and crop residues after harvesting could be used for biogas or electricity production. For forestry, the residues of wood processing can be used to produce electricity. However, if wood is processed more efficiently, the amount of residues for electricity production will go down. Also, there are alternatives for using wood residues other than electricity production such as pressed wood products. Another objective is to induce more efforts for more efficient use of biomass in production processes via bio refinery (biofuel production) or co-production for instance (B3). In general, more biomass can be generated from residues or waste streams (B4). Also, harvesting and production processes can be adjusted so that more biomass is produced and less residues (B5). The development of alternative ways of producing resources without soil and biomass can be stimulated like using artificial photosynthesis for instance (B6). In this objective, the competition of soil use for food supply or energy supply is limited. Throughout the system of production and use of biomass, the system of material flows could be optimized or closed, i.e. cascade use of biomass (B7). As biomass production is traditionally focussed on terrestrial elements of the ecosphere, biomass from aquatic resources could be used more frequently (B8). Finally, areas which are (temporarily) unsuitable for agricultural food production can be used for biomass production that can be used for energy (and heat) production (B9).

The energy policy itself does not say much specific about biomass. It is however stimulating for biomass as it will increase the focus on renewables.

Table 5: Objectives in the energy/biomass policy

Overarching objectives	Code	Specific objectives
Sustainable increase in biomass supply	B1	Increasing productivity of agriculture (use of residues)
	B2	Increasing productivity of forestry (use of residues)
	B3	More efforts for efficiency of biomass processing, via bio-refinery and co-production
	B4	Improving generation of biomass from residues
	B5	Combatting waste during harvesting and processing
	B6	Stimulating development of alternative ways of producing resources without using soil and biomass (like artificial photosynthesis)
	B7	Optimizing and closing loops (Cascaded use of biomass)
	B8	Production of aquatic biomass
	B9	Use of degraded soils for biomass production

In addition to the energy policy with respect to the objectives of renewable energy including energy for biomass, the Netherlands is also developing a climate policy. It has been initiated by the Coalition Agreement in October 2017 (Ministry of Economic Affairs and Climate 2018). The objective of the climate policy is a significant reduction of greenhouse gases emission in line with the Paris Agreement on GHG reduction. The Netherlands aims for a 49% reduction of greenhouse gases emissions in 2030 compared to the 1990 level of emissions. With the different economic sectors, the Dutch government intend to make agreements on reduction of their GHG emissions. More specific objectives in terms of greenhouse gas emission reduction (CO_2 equivalents) are:

- Reduction aims per sector:
  - Industry 22 megatonnes
  - Transportation sector 7 megatonnes
  - Construction industry 7 megatonnes
  - Electricity production 20 megatonnes
  - Agriculture and land use 3.5 megatonnes
- End the electricity production from coal by 2030
- Install a minimum price for CO_2 emission permits in the electricity production
- Agriculture and land use: deliver (bio)resources for other sectors and contribute to negative emissions.

Furthermore, the Netherlands aims to take the lead in the EU to achieve a 55% reduction goal for greenhouse gases emission and to initiate collaboration with North-western Member States.

3.2.2 Agricultural & Food policy

The agricultural policy aims at a sustainable and viable agricultural sector in the Netherlands, and it has multiple objectives, see Table **6**. The improvement of the competitiveness of the agriculture is one of the core objectives of the agriculture in the Netherland. This objective is not directly related to biomass production, although it might have a derived objective in the case of the modernization (Ministry of Economic Affairs 2014a, 2017). In particular, the agricultural policy aims to improve sustainability in the sector, so that farmers comply to environmental and sustainability criteria such as protection of nature and improving water quality (less run-off of nutrients and pesticides). It includes diversifying crops (A1), maintaining permanent grassland (A2), conserving areas of ecological interest (A3), complying of farmers to environmental and sustainability criteria (A4), investing in nature and landscape in rural areas (A5), improving of water quality (A6), Restoring, preserving and enhancing ecosystems related to agriculture and forestry. (A8) and stimulating sustainable agricultural production (A9) (European Commission 2016a). Next to that, the agricultural policy tries to stabilize income for farmers, assist young farmers and improves the economic and social regeneration of rural areas (A7) (European Commission 2016b). Also, it stimulates a good functioning of the market, so that farmers are prepared for crisis situations such as safety nets for low agricultural price periods or damage in the case of extreme weather events. For our review, we do not distinguish between the sub-objectives of the stabilising objective.

In addition, the food policy aim at food security and good quality food in the Netherlands and around the World (Ministry of Economic Affairs and Alliance of more Sustainable Food 2013; Ministry of Economic Affairs, Ministry of Infrastructure and the Environment, and Ministry of Foreign Affairs 2015; Ministry of Economic Affairs and Ministry of Ministry of Health, Wellbeing and Sports 2013). One objective is th achieve food security worldwide, which includes enforcing international food security (F1) and developing alternative protein sources (F5). From a circular perspective, food chains or food systems are optimized. This objective includes the reduction of food waste (F2), being an example of high-quality efficient food production (F3), being an example of the use of renewable energy use and low emission technologies in food production (F4), the reduction of crop losses from production (F6), and the optimization of crop residues (F7), etc. It is possible that such a support for farmers, in particular, might stimulate more focus on a better usage of biomass, as it stimulates farmers to stay in business and doing so in a more sustainable way. It is a way to prepare the agriculture sector for the consequences climate change; reducing the emission of greenhouse gases.

The aim of making all the food on the Dutch market sustainably produced and distributed might be an example of how such aims might trigger more focus on how to deal with rest streams.

Table 6: Objectives in the agricultural and food policy

Overarching objectives	Code	Specific objectives
Agricultural policy		
Improving sustainability in the agricultural sector	A1	Crop diversification
	A2	Maintaining permanent grassland
	A3	Conserving 5% of areas of ecological interest
	A4	Compliance of farmers with environmental and sustainability criteria
	A5	Investments in nature and landscape
	A6	Improvement of water quality
	A8	Restoring, preserving and enhancing ecosystems related to agriculture and forestry
	A9	Increasing sustainable agricultural production
Improving competitiveness of the agricultural sector	A7	Creating conditions for the economic and social regeneration of rural areas (RDP)
	A7	Better food chain organization and risk management (RDP)
	A7	(Rural) Modernization and rejuvenation (RDP)
	A7	Good functioning of the market: Smarter co-operation and safety net for low prices
Food policy		
Achieving worldwide food security	F1	Enforcing international food security
	F5	Developing alternative protein sources
Sustainable food chains	F2	Reducing food waste from consumer side
	F3	The Netherlands a front runner in high quality efficient food production
	F4	Being a front runner in the use of renewable energy and low emissions in food production
	F6	Reducing crop losses from production
	F7	Optimal re-use of rest streams

3.2.3 Spatial planning policy

The spatial policy has not changed much since 2012. Yet the policy is rich in terms of policy parts and sub-goals (Ministry of Infrastructure and the Environment 2012). One of the reasons why the policy has not been updated is that a major revision is underway. The proposed new Omgevingswet (the Law on the spatial surroundings). The new law, expected to be in force in 2021, is more guided towards the policy process, with less administrative red-tape (simplified procedures), more freedom to act for regional and local governments, and more inclusion and space for non-governmental organizations.

For our analyses, however, we focus attention on the relevant objectives for biomass, see Table 7. The overarching objective is to increase the competiveness of the Netherlands with respect to the spatial economic structure. The specific objectives include the space for the main network of sustainable energy supply and transition (L1), sustainable, safe and efficient use of the subsoil (L2), space for the conservation of unique cultural historic and natural qualities (L3), space for water safety (L4), and a framework for climate change resilience in urban (re)development (L5).

Table 7: Objectives in the land use/spatial planning policy

Overarching objectives	Code	Specific objectives
Increase the competitiveness of the Netherlands by enforcing the spatial-economic structure of the Netherlands	L1	Space for the main network of (sustainable) energy supply and energy transition
	L2	Sustainable, safe and efficient use of the subsoil
	L3	Space for preservation and enforcement of (inter)national unique cultural historic and natural qualities
	L4	Space for water safety
	L5	A framework for climate resilient urban (re)development

3.2.4 Nature policy

Just as the spatial planning policy, the nature policy has become more guided towards the policy process, with less administrative red tape (simplified procedures), more freedom to act for regional and local governments, and more inclusion and space for non-governmental organizations. This approach followed as a result of a decentralization process that provided the provinces with much influence in the implementation of the nature policy (Ministry of Economic Affairs 2014b).

Table 8: Objectives in the nature policy

Overarching objectives	Code	Specific objectives
Sustainable chains	N1	More wood from sustainably managed forests on the Dutch market
	N2	Protection of nature on landscape level in production areas of agro resources
	N7	Production of biomass for electricity and heat is sustainable
	N10	Increasing Dutch wood production
Valuation of natural capital	N8	Working on closed loops and creating higher value for sustainable resources
	N9	Providing insight into the economic value of our ecosystem services
Including nature in the development of areas	N3	Ecosystems: Balancing food production and biodiversity
	N4	Ecosystems: Restoring degraded ecosystems on land
	N5	Urban development: Stimulating green industrial areas via the Green Table where knowledge and awareness about biodiversity is the core area of attention
	N5	Urban development: Stimulating use of more green for more health
	N5	European level: More co-operation on the European nature network and biogeographical region where the Netherlands belongs to
	N6	Agriculture: Sustainable increase in agricultural productivity

One of the objectives of nature policy is to include nature more into economic activities. The regional government, responsible for nature policy in the Netherlands, have formulated the objective. One way to enhance the nature-inclusive activities is to promote and upscale green entrepreneurship. This might involve biomass for energy, but that is just one example. From the nature policy, there are three overarching objectives related to biomass: sustainable chains, valuation of natural capital and the inclusion of nature in the economic development of areas (Ministry of Economic Affairs 2013, 2014b). The latter one is also referred to as 'nature-inclusive' economic growth. The specific objectives of sustainable chains include (i) more wood from sustainably managed forests on the Dutch market (N1), protection of nature on landscape level (N2), production of biomass for electricity and heat generation (N7), and increase of Dutch wood production (N10), see **Table 8**. The valuation of natural capital includes the working on closed lops and value creation of our ecosystem services (N8) and providing insights into economic value of our ecosystem services (N9). Inclusive economic growth has five specific objectives which are balancing food production and biodiversity (N3), restoring degraded ecosystems on land (N4), stimulating green industrial areas and the use of green for health (N5), and the sustainable increase in agricultural productivity (N6).

3.2.5 Waste policy

Waste policy is targeted at the useful application of total waste and waste in different sectors. In particular, waste policy identified clear objectives for 2015. The overall share of total waste that had to be applied usefully increased form 83% in 2006 to 95% in 2015. In the residential sector, useful application should have increased from 51% in 2006 to 99% in 2015. The service sector including commercial and public services (i.e. HDO sector) had to increase the useful applied waste from 46% in 2006 to 95% in 2015. For the construction sector, which already achieved a 95% useful application rate for its waste, had to maintain this rate despite the expected increases in its waste stream.

As indicated by **Figure 3** above, waste is an important source of biomass for renewable energy production in the current situation and most likely for the future. Waste policy targets at optimal use of resources, which also relates to biomass (Ministry of Infrastructure and the Environment 2014a, 2014b). There are four specific objectives of waste relating to biomass, see **Table 9**. First of all, prevention of waste (W1), which has a negative impact on the supply of biomass from waste for renewable energy generation. Second, increase the useful application of total waste especially from the residential, services (commercial and non-commercial) and construction sectors (W2). Third, optimize the use of energy content from waste that cannot be recycled (W3). Finally, improve the separation and collection of waste.

Table 9: Objectives in the waste policy

Overarching objectives	Code	Specific objectives
Optimal utilization of resources	W1	Stimulating prevention of waste, in a way that the total waste supply cannot be higher than 68 megatonnes in 2015 and 74 megatonnes in 2021
	W2	Increase the useful application of the total waste, the residential waste and HDO sector, and maintain the high application rate of the construction sector
	W3	Optimal utilization of the energy content of waste that cannot be recycled
	W4	Improvement of waste separation and collection

3.2.6 Water policy

Water policy in the Netherlands consists of three main components: (i) water safety, which is the protection of land and people for flooding from sea-level rise and river discharge), (ii) water supply, which is the provision of sufficient and clean water for economic activities, such as drinking water and irrigation water, and (iii) water quality of surface and ground water. There are two authorities responsible for water policy: the national government and the regional water authorities or regional water boards. The national government is responsible for the rivers and national safety while the regional water authorities are responsible for the regional water systems. There are more than 20 regional water authorities united in the Association of regional Water Authorities. Note that we focus attention on inland water system and do not take into account the marine aspect of water policy. Water policy has two overarching objectives that relate to biomass: Water policy related to flood protection and water supply on the one hand and water quality on the other hand. Flood protection and water supply have five specific objectives (Dutch Water Authorities et al. 2011; Delta Program Office 2018). Cost reduction of water management (Wa1), see **Table 10**. In 2013, Dutch water management costs €7bn per year. It is an objective to reduce the costs with €0.75bn per year. Ensure long-term flood risk reduction and water supply in view of climate change (Wa2). Implementation of the Spatial Adoption Incentive Programme SRA (*Ruimtelijke Adaptatie Programma, RAP*) (Wa3) which is part of the Deltaprogram (SAP) (Delta Program Office 2018). In 2020, the Netherland has to be prepared for flooding by reducing the vulnerability of built-up areas to extreme weather conditions and the impact of a potential flood. The RAP enforces climate-proof and water-resilient planning to become part of future planning. Based on the Climate Adaptation Knowledge programmes in the past, increase awareness of climate risks and implementation of adaptation into practice (Wa4) (Ministry of Infrastructure and the Environment 2016). Maintenance of infrastructure for transport and water accessibility & maintenance of infrastructure are the main policy objectives. However, since 2016 also infrastructural project in relation to water management, spatial planning, climate adaptation and climate compatible energy supply can be co-financed by The Dutch Multi-Year Programme for Infrastructure, Spatial Planning and Transport MIRT

(https://www.government.nl/documents/leaflets/2018/02/07/the-dutch-multi-year-programme-for-infrastructure-spatial-planning-and-transport-mirt---summary).

The objective of good quality of surface and ground water targets from the Water Framework Directive (WFD) are translated into clean and ecological healthy water for ecosystems and sustainable socio-economic use (Wa6), see the second generation of River Basin Management Plans for the Netherlands (Ministry of Infrastructure and the Environment 2015).

Table 10: Objectives in the water policy

Overarching objectives	Code	Specific objectives
Flood protection/water supply	Wa1	Cost reduction of water management/ Increase cost-efficiency in relation to water quality, flood protection, water supply and (re)use of waste water.
	Wa2	Ensure long-term flood risk reduction and water supply in view of climate change
	Wa3	The Spatial Adaptation Incentive Programme (SRA) aims to realize this goal by 2020, so that the Netherlands will indeed by climate-proof by 2050.
	Wa4	Increase awareness, address Climate Risks urgency and implement climate adaptation into policy and law, monitoring and evaluation of climate adaptation policies
	Wa5	Maintenance of infrastructure for transport and water accessibility & maintenance of infrastructure are the main policy objectives. However, since 2016 also infrastructural project in relation to water management, spatial planning, climate adaptation and climate compatible energy supply can be co-financed by MIRT
Good water quality of surface and ground waters	Wa6	Clean and ecological healthy water for ecosystems and sustainable socio-economic use

The water policy is essential to a country as the Netherlands, and its link to biomass is also evident as clean and ecological healthy waters improves the biomass quality. Of importance is also the water infrastructure. Waterways for transport and harbours and their facilities and installations for processing biomass are of great importance. Important aims are formulated around the quantity and quality of the water and water infrastructure.

3.3 The inventory of instruments

3.3.1 Energy/biomass policy

The energy/biomass policy instruments are now facing increased attention due to the renewed focus on climate. Action plans focusing on bio-based solutions are for instance gaining momentum and investment funds are being geared up to this task. Here we focus largely on biomass-related instruments and not energy in general, see **Table 11**.

Table 11: Instruments in energy policy targeted at biomass for energy

Overarching objective	Specific objective	Instrument category	Specific policy instrument
Sustainable use of biomass supply	Resource efficiency	Framework	Eliminating barriers in regulations for the production of biomass. Started with the programme Conflicting Interests (Botsende Belangen) Bio-based Economy' to remove barriers for closing loops and chains
			Transition Agenda: Collaboration on new ways of stimulating more biomass production and usage
			Identifying and pushing bio-based initiatives with an added value for the Dutch economy
		Financial	Investment subsidy SDE+: Mono manure fermentation tender (€150m available for building 200 mono manure digesters)
			Subsidy Renewable Energy (also biomass; annual 50mln)
		Knowledge	Innovation funds in Topconsortium for Knowledge and Innovation (TKI) Bio Based Economy (BBE)
			Innovation contract 2012-2016 Bio-based economy for (1) Bio-based materials, (2) Bio-energy and bio-based chemicals, (3) Integrated bio-refinery, (4) Optimization of production and biomass production, (5) Re-use: water, nutrients and soil, and (6) Economy, policy and sustainability
		Knowledge	Bio-based Industries Joint Undertaking (BBI JU) Research & Innovation actions, demonstrations and Flagships, coordination and support actions (Horizon 2020)
		Knowledge	The transition house: a project organization to stimulate new interactions, integral cooperation, cross sectoral networks, consortia and platform projects. Most important products is viable business cases
		Knowledge	Green Deal Business with Biomass and Bio-based Gas
	Production	Framework	Action Plan Forest & Wood with (1) 100.000 hectares extra forest in the Netherlands, (2) 50% more productivity in existing forest management, (3) Ten regional biomass hubs, and (4) Toolbox for climate smart forestry

3.3.2Agriculture & Food policy

Much of the agricultural policy comes from the EU. Of great interest for biomass is the investment instruments that might support biomass production and usage. There is now a discussion of integrating the agricultural policy with the food policy, making it less focused on traditional production and more oriented towards society at large, including sustainability. In addition, instruments for more sustainable chain management might be supporting for biomass, see the instruments from agricultural policy and food policy in Table 12 and Table 13.

Table 12: Instruments in agricultural policy

Overarching objective	Specific objective	Instrument category	Specific policy instrument
Improving competitiveness	Income of farmers	Financial	Direct Payments
			Young farmer regulation focused on innovative investments (€5.2m per year)
Sustainability	Improvement of ecosystems	Financial	Direct Payments: In 2020 €260 basic subsidy per hectare
			Direct Payments for greening: in 2020 €115 greening subsidy per hectare
			Agricultural nature management in accordance with nature pact (€70m/y)
			Hydrological measures in the Programme Approach Nitrogen in accordance with nature pact (€10m/y)
			Additional measures for construction, management and recovery of landscape elements (€6.4m/y)
	Improvement of water quality	Financial	Management subsidies for water services (blue services) (€4.3m/y)
		Research and Development	Non-productive investments for water quality (€18.2m/y)
			Improvement of water quality through innovation (€2.7m/y)
	Sustainability and resilience	Research and Development	Investing in satellite data for precision agriculture

Table 13: Instruments in food policy

Overarching objective	Specific objective	Instrument category	Specific policy instrument
Achieving worldwide food security	Enforcing international food security & Developing alternative protein sources	Governmental Achievement Agreements	Supporting initiatives that are focused on farmer rights, eco-efficient production and chain development and sustainable area management
Sustainable food chain	Enforcing international food security & Developing alternative protein sources	Knowledge	Supporting international initiatives for knowledge- and capacity development of farmers regarding climate adaptation
	Optimal use of biomass	Governmental Achievement Agreements	Sustainable Food Agenda (Agenda Verduurzaming Voedsel): Make food consumption more sustainable in cooperation with Allantie Verduurzaming Voedsel: voluntary collaboration on optimal usage of biomass

3.3.3Spatial planning policy

Much of the spatial policy consist of frameworks setting out more concrete aims and instruments in a process supported by coordinating agreements with knowledge instruments, see Table 14. These policy parts are then employed by national, regional and local governments engaged in discussions and negotiations on practical solutions among the various interests. It is usually guided towards adjustments and coordination activities with all kind of societal actors are involved. Finding fitting investment funds and subsidies is central to the implementation, and a public-private mix is often an important point of attention and also a clue to achieve a coherent approach.

Table 14. Instruments in spatial planning policy

Overarching objective	Specific objective	Instrument category	Specific policy instrument
Increasing the competitiveness of the NL	Space for the main network of (sustainable) energy supply and energy transition	Frameworks	Governmental coordination arrangement for big energy infrastructure projects
		Frameworks	Governmental procedure from the national strategy *Rijksstructuurvisie Windenergie* op land for the identification of locations (land based wind-energy plants) with a capacity of 100 MW and higher
		Governmental achievement agreements	Governmental agreements with provinces about pointing out locations for large scale wind energy with the purpose of realizing 6000 MW for wind energy on land in 2020
		Knowledge	Knowledge development on the relationship between energy transition and space (with local governments, PBL and CRA)
	Space for the main network for transport via pipelines	Frameworks	National strategy for pipelines (*Rijksstructuurvisie Buisleidingen*)
		Governmental achievement agreements	Agreements with Flanders and Germany about the need for cross-border cooperation for pipelines of national interest
	Robust network	Frameworks	Regulation for reservation areas for new connections and expansions of the infrastructure
Improving and spatially securing the accessibility	Maintaining the main network	Governmental achievement agreements	Multi-year infrastructure (MIRT) agreements on prioritization of mutual investments (2012-2018) in urban regions around mainports and technological business 'brainports and greenports' and their hinter land connections, with a good spatial allocations and co-financing.
			MIRT agreements on coordination between sea harbours, inland harbours and hinterland connections and increasing the societal value of sea harbour
			Agreements about possible adaptation and renewing of main water ways and harbours
			Vision national core network of goods transportation
		Financial	MIRT Infrastructure fund for investments in infrastructure
			Increasing the possibilities for alliances (public-private and public-public) for financing infrastructure
			Using the Infrastructure fund and the Delta fund for management and maintenance of the main infrastructure of roads and water ways
Preserving a liveable and safe environment	Sustainable, safe and efficient use of the subsoil	Frameworks	National water management plan (*Structuurvisie Nationaal Waterplan*) for the surge of mineral extraction in (coastal) waters
	Space for the main network of	Frameworks	Mijnbouwwet (Mine construction law) for the main network of (sustainable) energy supply and energy transition

Overarching objective	Specific objective	Instrument category	Specific policy instrument
	(sustainable) energy supply and energy transition	Frameworks	Law on Expropriation of property (Ontgrondingenwet) for the space for the main network of (sustainable) energy supply and energy transition
		Frameworks	Adapt the Wet Bodembescherming (Law for soil protection)
	Improving the environmental quality (air, soil, water)	Knowledge	Developing methods for utilizing and limiting environmental impacts of subsoil use (Space for the main network of (sustainable) energy supply and energy transition)
		Knowledge	Creating a knowledge agenda soil and subsoil with local governments
		Frameworks	Soil protection with environment management law (*Wet milieubeheer*), Environmental Impact assessment report (*Milieueffectrapportage*) and European guidelines for projects and programmes
		Frameworks	Soil and groundwater: Decision on soil quality (*Besluit bodemkwaliteit*) related to European Water Framework
		Governmental achievement agreements	Improving the environmental quality (air, soil, water) by the continuation and realization of the agreements in '*convenant Bodemontwikkelingsbeleid en aanpak spoedlocaties*'
		Frameworks	Deltawet and Structure vision Room for the rivers (*Ruimte voor de Rivier*)
		Governmental achievement agreements	National/regional governments: spatial protection and development of the reconstruction areas (agriculture/rural)
		Knowledge	Knowledge- and method development for nature, landscape and culture history in MKBA (Societal Costs-Benefit Analysis)

3.3.4Nature policy

The Nature policy instruments are often largely implemented through the regional and local governments, with the involvement of both public agencies as the *Staatsbosbeheer* for forest and nature and a number of NGOs and private landowners, see **Table 15**. The spatial policy and agriculture are never far away when it comes to a coherent approach. Today much attention goes to using both land and resources in a sustainable way. Biomass is now gaining attention in a nature policy that increasingly focusing on natural resource usage as in 'natural capital' and a Bio-based Economy.

Table 15: Instruments in nature policy

Objective	Specific objective	Instrument category	Specific policy instrument
Green economy: sustainability chains	More wood from sustainably managed forests Dutch market: More cooperation chain parties, sustainable production of biomass for electricity/heath	governmental achievement agreements	Green Deal Stimulate Sustainable Forestry (*Bevorderen Duurzaam Bosbeheer*)
			Creating sustainability criteria for solid biomass
	Protection of nature on landscape level in production areas of agro resources	frameworks	Nature Protection law (*Wet natuurbescherming*)
		financial	(Agrarian) Nature Protection Subsidy (*Subsidie Natuurbeheer*) for farmers and private land owners
			Develop a regional cycle approach for making chains more sustainable

Objective	Specific objective	Instrument category	Specific policy instrument
		governmental achievement agreements	Stimulating green innovation via a bottom up approach that brings science, innovative businesses and young people together
			Making efforts to make worldwide multilateral agreements for sustainable wood management
	Increasing Dutch wood production	governmental achievement agreements	Action Plan Forest & Wood (Bos & Hout): (1) Expansion of forest area; and (2) More productive management
Green economy: valuation of natural capital	Valuation of Natural Capital, True Pricing: Upscaling green entrepreneurship and closed loops	governmental achievement agreements	Stimulating that companies will take the value of natural capital into account for a higher value for sustainable resources
Including nature in the development of areas: other areas	Other areas: A stronger focus on nature dynamics	governmental achievement agreements	Stimulating organizations to produce sustainable energy in combination with improving the quality of the environment, nature, and landscape

3.3.5Waste policy

The waste instruments are also becoming a part of the Green Economy by employing the language and approach we know from the Circular Economy, see **Table 16**. Using Green Deals is a part of the approach. Many of the instruments have an international character and creating a EU level playing field and clarity in regulation belongs to the means of working (Ministry of Infrastructure and the Environment 2014a, 2014b).

Table 16: Instruments in waste pilicy

Overarching objective	Specific objective	Instrument category	Specific instrument
Optimal utilization of resources: sustainability	Focus on sustainability at the front part of the waste chain	frameworks	From Waste to Resource (*Van Afval naar Grondstof, VANG)* program
		governmental achievement agreements	Green Development Initiative global register for projects for sustainable land use
			Supporting the Ecosystem Return Foundation
Optimal utilization of resources: sustainability	More sustainable consumption patterns	governmental achievement agreements	Green Deal second hand stores and reparation stores checking if the infrastructure for re-use and reparation of products can be enforced
			Green Deal retail for more sustainable consumption
			Green Deal Circular Purchasing and Circulairondernemen.nl is an online community of the programme Nederland Circular!: stimulating a sustainable circular economy. Also biomass projects, national and international High value use of biotic rest streams.
	More sustainable consumption patterns	framework	Law prohibiting free plastic bags in stores

3.3.6Water policy

Water management is important to biomass in the way that it affects water quality and also the infrastructure for dealing with biomass, see **Table 17**. In 2013 the Dutch water management mounted to €7bn per year. Since then, the objective has been to reduce the costs with €0.75bn year per year.

Table 17: Instruments in water policy

Objective	Specific objective	Instrument category	Specific policy instrument
Optimal utilization of resources: circular economy	Cost reduction of water management/ Increase cost-efficiency water quality/supply and (re)use of waste water.	Governmental Achievement Agreements	Cost allocation agreements, strategy to increase cost-efficiency of water management
		Frameworks	Delta Fund, Delta Commissioner, Delta Programme (Water Safety, Spatial Adaptation, Water Supply)
	Water management, spatial planning, climate adaptation and climate compatible energy supply	Frameworks	Multi-year programme for (co)-financing and subsidies for water management as part of the Multiple year Investment program for Infrastructure, Spatial Planning and Transportation (*Meerjarenprogramma Infrastructuur Ruimte en Transport,* MIRT)
	Maintenance of Infrastructure for transport and water (incl spatial planning)	Governmental Achievement Agreements	decision support for assessing cost-effectiveness and sustainable alternatives
	Clean and ecological healthy water for ecosystems and sustainable socio-economic use	Governmental Achievement Agreements	Measures in the River Basin Management Plans

4 Assessment of policy coherence

4.1 Methodology

Based on the policy mapping exercise, see the policy objectives in Section 3.2, relevant policy objectives have been selected by project expert judgements for each policy domain, i.e. the so-called nexus critical objectives (NCO). A nexus critical objective is defined as the policy objective that according to the stakeholders and the policy analysis is highly relevant for the issues under investigation in the case study and has a potentially high number of interactions with other objectives in the nexus (Munaretto and Witmer 2017). The interaction of these objectives with the biomass policy objectives has been scored. An overview of the selected objectives and the assigned scores is presented in the tables below.

We use a scoring system for measuring policy coherence based on (International Council for Science 2016). Stakeholders were identified based upon the review of policy documents and interviews. The literature and document review was meant to investigate which policies there are in the Netherlands and also to provide input for an assessment of the policy, and it also served the stakeholder interaction by offering input into the discussion. Policy interaction analysis forms an effective tool to map the key issues by identifying synergies and trade-offs in a network setting (International Council for Science 2016). The website of the National government in the Netherlands and other relevant sites were used to search for the key policy documents in a specific field.

Methodology of measuring policy coherence

This study focuses on horizontal coherence as defined by (Nilsson et al. 2012; International Council for Science 2016). In this study the policy documents of different policy sectors were analysed in relation to biomass policy. First, the key documents on bioenergy and biomass production in the Netherlands were listed and analysed. Based on the literature and the main policy documents on biomass production, an inventory of relevant policy sectors that might have impact on biomass production is made. During the analysis of policy documents the researchers checked for other relevant sectors that are mentioned in the policy documents and added them to the table where necessary.

This paragraph is conducted by the use of literature, policy document reviews, interactions with stakeholders and a scoring system based on (International Council for Science 2016). The literature and document review is meant to assess whether the policy framework in the Netherlands provides opportunities or barriers for an intensification of biomass production and also to support the analysis. Policy interaction analysis forms an effective tool to map the key issues by identifying synergies and trade-offs in a network setting. This study builds on the framework that (International Council for Science 2016) to characterize the interactions between different goals. Their framework lays out a seven-point scale of scores of interactions between policy objectives. The scale ranges from -3 to 3, whereby the negative numbers indicate a negative relationship or trade-off and the positive ones indicate positive relationships or synergies, Figure 10. The scale does not have an ordinal range: the scores are all unique. Score -1 'constraining' has a different meaning than score -2 'counteracting'. 'Counteracting' has a bigger negative impact than 'constraining', but the distance between 'counteracting' and 'constraining' is not equal to the distance between counteracting and cancelling.

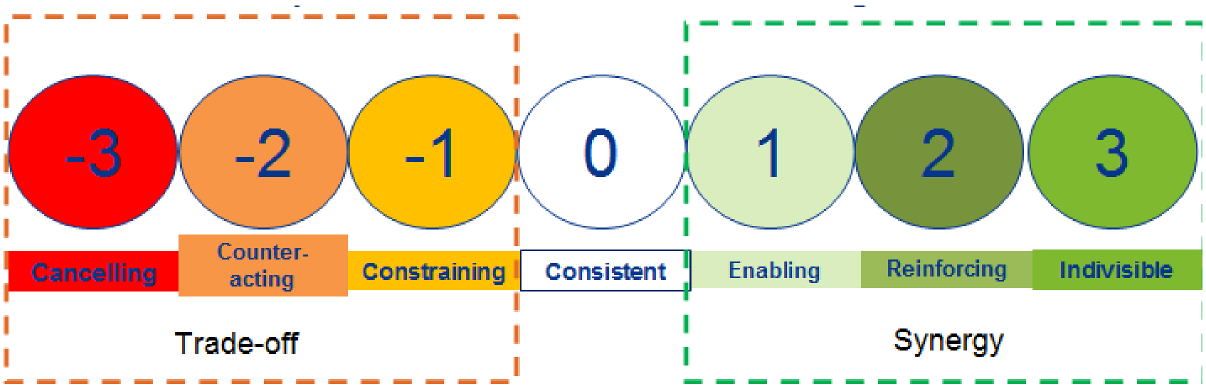


Figure 9: The goal interaction scoring scale. Source: International Council for Science (2016).

The results of the interviews were used to elaborate on the existence of critical relationships between objectives and the interaction with policy instruments. The respondents provided input about policy in practice and this is additional to the findings in the policy documents. The scoring was divided in three levels: First a score conducted by the researcher of the interactions involved. Then the scoring was discussed with two experts from PBL that also performed the scoring. At last, the researcher sat down with experts in certain fields to check the scores. For the scoring the researcher scored the interactions a couple of times with some days in between to see if the initial scores were the same as the last time. Then more research followed on the topics and impacts they could have on other topics on the internet to scientifically support the scores. The difficult scores were checked again with two experts at PBL. The categories (International Council for Science 2016) and definitions are summarized in Table 18.

Table 18: Definitions of the interactions. Source: International Council for Science (2016)

Score	Description	Definition
-3	Cancelling	'... progress in one goal makes it impossible to reach another goal and possibly leads to a deteriorating state of the second.'
-2	Counteracting	'The pursuit of one objective counteracts another objective.'
-1	Constraining	'... the pursuit of one objective sets a condition or constraint on the achievement of another.'
0	Consistent	' one objective does not significantly interact with another (or where interactions are deemed to be neither positive or negative).'
1	Enabling	'The pursuit of one objective enables the achievement of another objective.'
2	Reinforcing	'One objective directly creates conditions that lead to the achievement of another objective.'
3	Indivisible	'... one objective is inextricably linked to the achievement of another.'

4.2 Interactions between nexus critical objectives

4.2.1 Biomass/bioenergy from a supply/production side

For the identification of the policy objectives regarding an increase in national biomass/bio-energy production, two types of policy documents were analysed:

- Vision documents about biomass and the bio-based economy
- Vision documents about (renewable) energy

The core vision of the national government is that there will be potentially enough biomass available to fulfil the Dutch needs for biomass for food, feed, energy, transportation, chemistry and materials, if successful efforts are made to increase the biomass supply and an optimal and efficient utilization of biomass is pursued. Sustainability is an essential condition for the government (Ministry of Economic Affairs and Ministry of Infrastructure and the Environment 2015). In the documents about biomass the focus was not on bio-energy per se, but on the bio-based economy as a whole. The national government claims that it uses a coherent policy for bio-based economy (Ministry of Economic Affairs 2012). This will be tested in the coherence assessment in this study. The expressed ambition for 2030 for the Netherlands is being a front runner in sustainable produced biomass. The aim for the Dutch agricultural sector is to keep its leading position as efficient producer of resources. Besides, the production of biomass might give the management of nature and landscape a stronger financial basis see the Vision Biomass 2030 (Ministry of Economic Affairs and Ministry of Infrastructure and the Environment 2015). This Vision Biomass 2030 indicated five factors that are important for biomass production for non-food purposes are stated:

- Efficiency of food production
- Development of the global diet
- Agricultural productivity
- Costs of production, transport and processing of biomass
- Development of bio-refinery technology

Four out of five topics (in bold) are directly or indirectly addressed by policy (in food policy, agricultural policy and in the biomass vision document). In the analysis of the policy documents, nine biomass objectives were distinguished. The objectives and their explanation can be found in **Table 19**. The objectives that have spatial implications (B1, B2, B8, B9) are not specifically focused on the Netherlands. The Vision Biomass 2030 mentioned that further increase in productivity in agriculture and forestry for instance, needs to be realized at national, European and global scale (Ministry of Economic Affairs and Ministry of Infrastructure and the Environment 2015). This research, however, focuses on the feasibility of reaching those objectives on a national scale.

4.2.2 Biomass versus agricultural policy

It is no surprise that the objective concerning agricultural productivity (B1) interacts with all the agriculture objectives, see **Table 19**). The trade-offs that are identified are the conditions the CAP puts on agriculture in its Member States regarding the preservation of ecosystems. They compete directly for land, and therefore put a condition on an increase in productivity.

Table 19: Interaction scores for biomass and agricultural policy objectives

		Agricultural policy objectives affected								
Biomass policy objectives affecting		A1	A2	A3	A4	A5	A6	A7	A8	A9
Increasing productivity of agriculture (use of residues)	B1						-2	2	-2	3
Increasing productivity of forestry (use of residues)	B2							2	-1	
Increasing efficiency via bio-refinery and co-production	B3									
Improving generation of biomass from residues	B4					1		1		
Combatting waste during harvesting and processing	B5					1		1		
Stimulating development of alternative ways of producing resources without using soil and biomass	B6									
Closing and optimizing loops (cascading)	B7									
Production of aquatic biomass	B8									
Use of degraded soils for biomass production	B9					1	1	1	1	
		Biomass policy objectives affected								
Agricultural policy objectives affecting		B1	B2	B3	B4	B5	B6	B7	B8	B9
Crop diversification	A1	1								
Maintaining permanent grassland	A2	-1								
Conservation of 5% of area for ecological interest	A3	-1								
Compliance with sustainability and environmental criteria	A4	-1								
Financial support for farmers	A5	1								1
Improvement of water quality	A6	1	1							
Economic development of rural areas	A7	2	1							1
Restoring, preserving and enhancing ecosystems related to agriculture and forestry	A8	2	2							1
Increasing sustainable agricultural production	A9	3								1

Crop diversification (A1) in agriculture can help increase the yield of agricultural production see paragraph 6 “Improvement of agricultural methods and productivity” in the Chapter 6 “Conservation of Tropical Rainforest” of the online Rainforest Primer document (Schochet 2018). Good water quality (A6) can have a positive impact on the productivity of agriculture. Economic development of rural areas (A7) can be both beneficial for agricultural productivity and forestry productivity, if that money is invested in technology or innovation to increase the yield. Since agricultural practices are in general more profitable than forestry ones, the impact of economic development on agriculture is expected to be higher than on forestry. A good condition of ecosystems (A8) is an objective of the CAP that can have a different focus per country. For the Netherlands this focus is on water and soil systems and biodiversity. Soil quality is essential for both forest and agricultural production. A good water system is beneficial for both. Biodiversity has a positive effect on tree productivity as well (Paquette and Messier 2011; Zhang et al. 2012). Agricultural objectives A5, A7, A8 and A9 can all trigger the use of degraded soils for biomass production (B9).

When looking at the impact of biomass objectives on the agricultural ones, there are more interactions. An increase in productivity can have negative side effects. The agricultural productivity in the Netherlands is already high and its intensive nature puts high pressure on certain ecosystems (European Commission 2016a). The pressure on ecosystems can be seen in the trade-offs with good water quality (A6) and restoring, preserving and enhancing ecosystems (A8).

Forests provide a significant contribution to water quality by minimizing soil erosion and filtering water pollutants (Hamilton 2008). An increase of productivity in forests, however, means shorter optimum rotation lengths of trees and larger annual clear-cut areas. Although forest fertilization can increase nutrients in the surface water, several studies showed that an increase in forestry productivity does not have a significant impact on water quality (Binkley et al. 1999; Weslien et al. 2009). In this case there is chosen for the score 0, since B2 focuses specifically on an increase in forestry productivity.

As mentioned above, A8 focuses on water, soil and biodiversity. 'Increases in productivity and reductions in rotation length may also have major consequences for biodiversity, primarily because they would shorten the mean time available for recovery after clear- cutting' (Weslien et al. 2009, p. 334). However, the effect on biodiversity is very dependent on the type of plantation forest and their ecological context (Carnus et al. 2006). Thiffault et al. (2011) conclude that 'there are no consistent, unequivocal and universal effects of forest biomass harvesting on soil productivity' (p. 278). Because of the context dependency of the forestry productivity and the different ecosystems of which objective A8 consists, a combination of minus one and zero is given.

Improving generation of biomass from rest streams (B4) and reducing waste in the harvesting and processing (B5) have positive economic effects (A5 and A7). Growing biomass on degraded soils (B9) can in theory be profitable, since these soils now do not provide any income. It also affects the ecology and water quality in a positive way (A6 and A8) (Goran et al. 2015).

4.2.3 Biomass versus food policy

The interactions between the biomass objectives and food objectives are mostly synergistic, see Table 1. Food production and forestry compete for land. However, an increase in forestry productivity implies that more forest can be produced on the same amount of land. This does not have to conflict with international food security. Reducing food waste (F2, F6) helps closing resource loops (B7). An optimal utilization of biomass (F7) is inextricably linked to the process of cascading (B7). Reducing food waste from the production side (F6) is essentially the same as reducing waste during harvesting and processing (B5).

Table 20 presents the scores for the effect of progress in the biomass objectives on the food objectives. These are mostly synergistic as well. With a growing world population food production needs to increase, but we do not have an unlimited amount of land available. An increase in agricultural productivity (B1) is a necessary condition to achieve international food security (F1). Progress in international food security (F1) can be enabled by progress in reducing waste (B5, B7), innovation (B6), other types of protein sources (B8) and more land for growing biomass (B9). A high quality and efficient food production (F3) can be enabled by an increase in productivity (B1). The only trade-off between the food and biomass objectives is between B1 and the use of renewable energy and low emissions in the food production process (F4). An increase in productivity means more energy usage for harvesting and processing, which results into more emissions.

Table 20: Interaction scores for biomass and food policy objectives

		Food policy objectives affected						
Biomass policy affecting		F1	F2	F3	F4	F5	F6	F7
Increasing productivity of agriculture (use of residues)	B1	3		1	-1			
Increasing productivity of forestry (use of residues)	B2							
Increasing efficiency via bio-refinery and co-production	B3							3
Improving generation of biomass from residues	B4							1
Combatting waste during harvesting and processing	B5	1		3			3	1
Stimulating development of alternatives for producing resources without using soil and biomass	B6	1						
Closing and optimizing loops (cascading)	B7	1						3
Production of aquatic biomass	B8	1				2		
Use of degraded soils for biomass production	B9	1						

		Biomass policy objectives affected								
Food policy objectives affecting		B1	B2	B3	B4	B5	B6	B7	B8	B9
Enforce international food security	F1									
Reducing food waste from consumer side	F2							1		
High-quality efficient food production	F3									
Low emissions in food production process	F4									
Development of alternative protein sources	F5									
Reducing food waste from producer side	F6					3		1		
Optimal utilization of biomass	F7							3		

An increasing efficiency in bio-refinery technologies (B3) is necessary to establish an optimal use of biomass. B5 has the most interactions in Table 20. Reducing waste during harvesting and processing enables enforcing food security (F1) and an optimal use of biomass (F7). It is a necessary condition for an efficient food production (F3) and is similar to F6. Production of aquatic biomass such as algae and seaweed might contribute a lot to development in alternative proteins (B8), but much of this work is still **subject to research** https://www.nioz.nl/en/expertise/seaweed-research-centre.

4.2.4 Biomass versus spatial planning policy

Biomass policy and land use policy rarely interact, with only three possible trade-offs and five synergies, see **Table 21**. Space for the main network of sustainable energy supply and energy transition (L1) does not have a direct impact on the biomass objectives. This is because the national government only reserves space for large-scale electricity productions with a capacity of more than 500 MW. These are all wind energy projects. Reserving space for biomass or solar projects is the responsibility of municipalities (Ministry of Infrastructure and the Environment 2012).

Table 21: Interaction scores for biomass and spatial planning policy objectives

		Spatial planning policy objectives affected								
		L1	L2	L3	L4	L5				
Increasing productivity of agriculture (use of residues)	B1		2							
Increasing productivity of forestry (use of residues)	B2		-1							
Increasing efficiency via bio-refinery and co-production	B3									
Improving generation of biomass from residues	B4									
Combatting waste during harvesting and processing	B5									
Stimulating development of alternative ways of producing resources without using soil and biomass	B6									
Closing and optimizing loops (cascading)	B7									
Production of aquatic biomass	B8									
Use of degraded soils for biomass production	B9	1	2		2					
		Biomass policy objectives affected								
Spatial planning policy objectives affecting		B1	B2	B3	B4	B5	B6	B7	B8	B9
Space for the main network of sustainable energy supply and energy transition	L1									
Improving environmental quality (air, soil, water)	L2	2	2							
Space for conservation and enforcement of (inter)national unique culture historical	L3									
and natural properties	L4	-1								
Space for water safety	L5									

Table 21 shows the interaction between energy/biomass policy and spatial planning policy with respect to biomass. An improvement of soil and water quality (L2) is very beneficial for an increase in both forestry and agricultural productivity (B1, B2) (see also Section 4.2.2: Biomass versus agriculture). Space for water safety (L4) is an important topic in the Netherlands and has cost agricultural land in history, when agricultural grounds were converted to river foreland (*uiterwaarden*). It puts a condition on farming productivity, for example because farmers can only let their cattle graze in a specific time of the year when the river forelands are dry.

Biomass affects land use/spatial planning objectives more than the other way around. An increasing productivity in agriculture (B1) can counteract the improvement of environmental quality (L2). Intensive agriculture and usage of heavy machinery can harm the soil (Brus and van den Akker 2018). An increase in forestry productivity (B2) can also negatively impact environmental quality, but forest itself provides good environmental quality (see also section: Biomass versus agriculture).

Biomass production on degraded soils (B9) has a lot of positive impacts on land use and spatial planning. Degraded soils are not useful by itself, but can provide space for sustainable energy (L1). Space for water safety (L4) and growing biomass can go hand in hand (Boosten et al. 2016).

4.2.5 Biomass versus nature policy

Table 22 shows the interaction between energy/biomass and nature policy. Protection of nature (N2) and balancing biodiversity and food production (N3) cause potential trade-offs with an increase in agricultural productivity (B1). Restoring degraded ecosystems on land (N4) can directly create conditions for an increase in agricultural and forestry productivity (B1, B2). More wood from sustainable forests on the Dutch market does not directly interact with an increase in Dutch forestry productivity (B2). Stimulating initiatives for function combinations of nature and bio-based economy (N5) can give forestry a boost because trees provide nature services and are an important resource in the bio-based economy. However, an increase in productivity is not directly enabled through it.

Forests provide a lot of services to ecosystems such as regulation of the hydrologic cycle and protection of soil resources (Bonan 2008). If these values are economically more valued, the price of wood as a resource will go up and this can lead to an increase in productivity. Increasing the Dutch wood production (N10) can happen in two ways: increasing the size of forests in the Netherlands or increasing the productivity (B2).

Looking at the potential impact of biomass objectives on the nature ones, a couple of trade-offs between biodiversity, restoring ecosystems and nature protection take place (see also section Biomass versus agricultural policy). An increase in bio-refinery efficiency (B3) directly creates conditions for working on closed loops, because biomass can be used more optimally. Improving generation of biomass from rest streams (B4) enables sustainability of biomass (N7), since rest streams are in general a sustainable source of biomass. It also enables working on closed loops (N8), just as combatting waste during harvesting and processing (B5). Growing biomass on degraded soils (B9) can help restoring them (N4) and it can stimulate function combinations of nature and the bio-based economy (N5).

Table 22: Interaction scores for biomass and nature policy objectives

		Nature policy objectives affected									
Biomass policy objectives affecting		N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
Increasing productivity of agriculture (use of residues)	B1		-1	-1	-2		3				
Increasing productivity of forestry (use of residues)	B2				-1						3
Increasing efficiency via bio-refinery and co-production	B3								2		
Improving generation of biomass from residues	B4							1	1		
Combatting waste during harvesting and processing	B5								1		
Stimulating development of alter-native ways of producing resources without using soil and biomass	B6										
Closing and optimizing loops (cascading)	B7								3		
Production of aquatic biomass	B8										
Use of degraded soils for biomass production	B9				2	2					
		Biomass policy objectives affected									
Nature policy objectives affecting		B1	B2	B3	B4	B5	B6	B7	B8	B9	
More wood from sustainable forests on the Dutch market	N1										
Protection of nature on landscape level in production areas of agro resources	N2	-1									
Balancing biodiversity and food production	N3	-1									
Restoring degraded ecosystems on land	N4	2	2								
Stimulating initiatives for function combinations of nature and BBE	N5										
Sustainable increase in agricultural productivity	N6	3									
Production of biomass for electricity and warmth is sustainable	N7										
Working on closed loops	N8							3			
Providing insight into the economic value of our ecosystem services	N9		2								
Increasing Dutch wood production	N10		3							1	

4.2.6 Biomass versus waste policy

The interactions that take place between the biomass objectives and waste objectives are all synergistic, see **Table 23**. The biomass policy focuses a lot on waste and rest streams, which explains the sometimes indivisible relationships. In a closed loop, no waste exists. This is why prevention of waste (W1) is inextricably linked to closing and optimizing loops (B7). The same goes for improving the useful application of the total waste with a higher share of recycling (W2). Improvement of waste separation and collection (W4) directly creates conditions for improving generation of biomass from rest streams (B4) and enables closing and optimizing loops (B7).

Table 23: Interaction scores for biomass and waste policy objectives

		Waste policy objectives affected								
Biomass policy objectives affecting		W1	W2	W3	W4					
Increasing productivity of agriculture (use of residues)	B1									
Increasing productivity of forestry (use of residues)	B2									
Increasing efficiency via bio-refinery and co-production	B3		2	3						
Improving generation of biomass from residues	B4		1	1	1					
Combatting waste during harvesting and processing	B5	3								
Stimulating development of alternative ways of producing resources without using soil and biomass	B6									
Closing and optimizing loops (cascading)	B7	3	3							
Production of aquatic biomass	B8									
Use of degraded soils for biomass production	B9									
		Biomass policy objectives affected								
Waste policy objectives affecting		B1	B2	B3	B4	B5	B6	B7	B8	B9
Stimulating the prevention of waste	W1							3		
Improving the useful application of the total waste with a higher share of recycling	W2							3		
Optimal usage of the energy content of waste that cannot be recycled	W3									
Improvement of waste separation and collection	W4				2			1		

The impact of biomass objectives on waste objectives is presented in **Table 23**. The process of bio-refinery makes it possible to re-use the certain types of materials that are in the biomass. Making this more efficient (B3) increases the useful application of biotic waste streams (W2). Besides that, bio-refinery technologies (B3) are necessary for an optimal utilization of the energy content of biomass (W3). Improving generation of biomass from rest streams enables W2, W3 and W4. Combatting waste during harvesting and processing (B5) is a prevention of waste (W1).

4.2.7 Biomass versus water policy

Increasing productivity of agriculture with more use of residues in agriculture (B1) makes it easier to reduce costs for the water quality (Wa1), a measure that also counts for aquatic biomass (B8). It is also likely to stimulate more awareness for (the usefulness of) biomass (Wa4). In addition it might stimulate clean and ecological healthy water for ecosystems and sustainable socio-economic use (Wa6). Increasing productivity of forestry use of residues (B2) is likely to stimulate more awareness, see **Table 24**.

More and improved use of biomass in general (B4) makes it easier to reduce costs for the water quality (Wa1) and also more awareness. And combatting waste during harvesting and processing is likely to improve the water quality (and awareness). Also the closing and optimizing of loops (cascading; B7) increases the focus, learning and awareness (Wa4).

However, less money spent on water quality and use of waste water (Wa1) might lead to less water quality and make it harder to use residue from agriculture (B1), forestry (B2) and aquatic biomass (B8). It might also hamper the resource efficiency through cascading (B7). This is then a possible outcome if we only consider a budget reduction without involving other measures taken to improve quality. As such, it mainly serves as a factor to keep in mind.

Efforts to enhance the water supply (Wa2) might be good for agriculture and also for using residues. Cleaner and more ecological healthy water for ecosystems and sustainable socio-economic use (Wa6) is one of those aims that will be good for agricultural and forestry residue use, and it might trigger further awareness of the use of biomass.

In general we see that the interactions between the biomass objectives and water objectives are not all synergistic. Possible contradictions are built into Wa1 versus Wa2, as cost reductions might hamper flood risk reduction.

Table 24: Interaction scores for biomass and water policy objectives

		Water policy objectives affected								
Biomass policy objectives affecting		Wa1	Wa2	Wa3	Wa4	Wa5	Wa6			
Increasing productivity of agriculture (use of residues)	B1	1			1		1			
Increasing productivity of forestry (use of residues)	B2				1					
Increasing efficiency via bio-refinery and co-production	B3									
Improving generation of biomass from residues	B4	1			1					
Combatting waste during harvesting and processing	B5	1			1					
Stimulating development of alter-native ways of producing resources without using soil and biomass	B6				1					
Closing and optimizing loops (cascading)	B7				1					
Production of aquatic biomass	B8	1			1					
Use of degraded soils for biomass production	B9									
		Biomass policy objectives affected								
Water policy objectives affecting		B1	B2	B3	B4	B5	B6	B7	B8	B9
Cost reduction water quality, flood protection, water supply and (re)use of waste water.	Wa1	-1	-1		1	1		-1	-1	
Ensure long-term flood risk reduction and water supply in view of climate change	Wa2	1	1							
Reduce vulnerability of built-up areas to weather conditions/ flood/climate-change	Wa3									
Increase climate awareness and adaptation policy/practices	Wa4								1	
Maintenance of infrastructure for transport and water accessibility	Wa5									
Clean and ecological healthy water for ecosystems and sustainable socio-economic use	Wa6	2	2		1	1			2	

4.2.8 Summary of most critical interactions between objectives

To identify the critical objectives, all the objectives per row and per column in the overview matrices were counted. **Table 25** shows the amount of interactions (divided in trade-offs and synergies) per sector, distinguishing between B as the affecting objective (B-->X) and B as the affected objective (X-->B).

This study explores the effects of different policies on an increase in biomass production. This is why the interactions with B as the affected objective are considered to be more critical than the other way around. B1 is the most affected biomass objective and the most affecting biomass objective, and is involved in the most trade-offs. It is therefore considered critical. It is affected by all the agricultural objectives and therefore the impact of the agricultural means on B1 will be assessed in a descriptive manner. B2 is the second-most affected biomass objective. It is the most affected by nature and agricultural objectives. Because the agricultural instruments are already explored in relation to B1, the impact of the policy means of the nature sector on B2 will be discussed. Objective B7 is considered less relevant in this study, because the reason for the high amount of interactions is the presence of similar objectives in the waste, food and nature policy (W2, F7 and N8).

Table 25: Interaction scores per combination of sectors (B and X)

Sectors	Trade-offs	B->X	X->B	Synergies	B->X	X->B	Total interactions
B & A	6	3	3	25	12	13	31
B & F	1	1	0	13	9	4	14
B x L	2	1	1	6	4	2	8
B x N	6	4	2	16	9	7	22
B x W	0	0	0	12	8	4	12
B x Wa	4	0	4	21	11	10	25
Total	**19**	**9**	**10**	**93**	**53**	**40**	**112**

Biomass and agriculture have the most interactions and biomass and land use/spatial planning the least. Biomass is the most affected by agricultural objectives, with three trade-offs and thirteen synergies. Biomass objectives affect the food ones the most, in mostly a synergistic way. There are more interactions with biomass as the affecting objective than with biomass as the affected objective.

The next step was to assess which objectives are relevant for this research. The biomass objectives that are most affected are B1, B2 and B7. The objectives that affect biomass the most are A7 and A8. The biomass objectives that are affecting the other nexus objectives the most are B1, B5 and B9. F1, F7 and N8 are the nexus objectives that are affected the most by biomass objectives.

4.3 Interactions between nexus critical instruments and objectives

In Section 3.3, we presented the lists of policy instruments of the different nexus elements. Here we define the nexus critical instruments (NCI). A nexus critical instrument is defined as the policy instrument that according to the stakeholders and the policy analysis is highly relevant for the issues under investigation in the case study and has a potentially high number of interactions with the nexus critical objectives.

Based on the lists of instruments in Section 3.3, we identified the nexus critical instruments for biomass promotion in the objective to achieve a low-carbon and resource-efficient economy in the Netherlands in 2050. In particular, this section describes how the NCIs contribute to or conflict with the nexus critical objectives.

4.3.1 Most relevant energy/biomass-related instruments

Table 26: Biomass/energy-related instruments and their effects on nexus elements

Code	Heading	Description/context
Biomass/Renewable Energy		
Ba	Regulation barriers	Eliminating barriers in regulations for the production of biomass
Bb	Action Plan Forest & Wood	with (1) 100.000 hectares extra forest in the Netherlands, (2) 50% more productivity in existing forest management, (3) Ten regional biomass hubs, and (4) Toolbox for climate smart forestry
Bc	Investment Subsidy SDE+ Stimulation Sustainable Energy Production	Investment subsidy SDE+: Stimulation sustainable energy production (*Stimulering Duurzame Energieproductie*)
Bd	Innovation funds	Innovation funds in Topconsortium for Knowledge and Innovation (TKI) Bio Based Economy (BBE). In combination with the Horizon 2020 Biobased Industries Joint Undertaking (BBI JU) Research & Innovation actions, demonstrations and Flagships, coordination and support actions
Be	Subsidy Renewable Energy	The Subsidy Renewable Energy is also for biomass
Bf	Transition Agenda Biomass	Collaboration on new ways of stimulating more biomass production and usage
Bg	Green Deal From Biomass to Resource and Energy	Action to improve the biomass chain management and strengthen the ability to use biomass.
Agriculture		
Aa	CAP funding: Direct Payments basic	EU basic support to farmers. Huge impact on farming.
Ab	CAP funding: Direct Payment greening	EU 'green' direct payment for agricultural practices, beneficial for the climate and the environment Farmers who use farmland more sustainably and care for natural resources as part of their everyday work benefit financially.
Ac	Agricultural Nature Management	Subsidy for farmer engaged in nature management on their own grounds.
Land		
La	Multi-year infrastructure (MIRT) agreements	On prioritization of mutual investments in infrastructure urban regions (mainports, technological business 'brainports and greenports') and hinterland (spatial allocations and co-financing).
Nature		
Na	Green Deal Stimulation Sustainable Wood	Green Deal Stimulation Sustainable Wood (Bevorderen Duurzaam Bosbeheer) more wood from sustainably managed forests on the Dutch market: (1) Getting chain parties in wood sector together; (2) Fair agreements on the use of plant genetic material; and (3) sustainable production of biomass for electricity and heat

Code	Heading	Description/context
Waste		
Wa	VANG From waste to Resource	Programme for more recycling of (also) bio-waste and better integration of the waste chain management

Here we identify the relevant nexus critical instruments for biomass and assess the interactions. They are selected in an expert judgement by the researchers, on the basis of being the most important ones for biomass, considering input from the stakeholders involved. In general, the instruments cover the reduction of regulation barriers, current investment and planning instruments and one agenda setting instrument. **Table 26** contains the heading of the instrument and a brief description/context.

We considered 'more renewable energy' as a way to achieve the objective of a 49% reduction of fossil emissions in 2030, thus only Renewable Energy is here used as a NCO.

Table 27 contains the scoring of direct effects of the nexus critical instruments and nexus critical objectives (-1/+1). We are most interested in assessing (preferably) direct effects. It is about the most relevant instruments, and not about possible future ones. As the instruments Bc-g all are oriented towards more investments in production of and new ways of applying biomass, including the planning and financing of the renewal, we have assessed them as one. That does in principle apply to Bb as well, but Bb is limited to forest.

Table 27: Top 13 of instruments related to biomass and their effects on NCOs

Instruments/objectives	B1	B2	B3	B4	B5	B6	B7	B8	B9	Renewable energy
Ba	+1	+1	0/-1	+1	0	0	+1/-1	+1	+1	+1
Bb	0/+1	+1	0	+1	+1	0	+1	0	0	+1
Bc-g	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Aa	-1/+1	-1/+1	0	0/+1	+1	0	0	0	0	0
Ab	0/+1	+1	0	+1	0/+1	0	0	0	+1	+1
Ac	-1/+1	0/+1	0	1	0/+1	0	0	0	0/+1	0/+1
La	0/+1	0/+1	0/+1	0	0	0	0/+1	0/+1	0	0
Na	0/+1	+1	+1	0	+1	0	+1	0	0	+1
Wa	0	0	+1	+1	0	0	0	0	0	+1

Table 28 contains the reporting of the justifications of interactions between the NCIs and NCOs. We then look closer at how the instruments from **Table 27** affect the biomass and renewable energy objectives.

Table 28: Explanation of the score

NCI-> NCO	Score	Description
Ba->	+1/0/-1	Positive score on more biomass production, but less regulation might have negative impact on the quality
Bb->	0/+1	Forestry has no effect on aquatic biomass or farmers without forests. But it has positive effects on forest production and better chain management and processing of wood (i.e. solid biomass)
Bc-g	+1	The investment schemes and strong focus on the whole biomass chain makes such investments the major contributor to biomass.
Aa->	-1/+1	Agriculture as in CAP has a strong potential and some practical positive effects but stakeholders do not see its present practice as very stimulating to biomass.
Ab	0/+1	The greening has positive effects on the quality of biomass by soil/environmental measures. On the quantity, it could be diverse effects.
Ac	-1/+1	More nature on agricultural grounds means less agriculture: the effects on biomass is therefore not to be stated upfront. it could go both ways.

La->	0/+1	Infrastructure and spatial planning set out conditions for processing biomass and improve the chain management. But stakeholders hope for improvements as they see the focus on biomass as limited.
Na->	+1/0	This green deal supports solid biomass production and chain management
Wa	0/+1	Concerns waste collection and recycling; a more integrated approach.

In the following sections we look closer at the interactions between the instruments and the objectives. We focus on the following five interactions. These are based on the list above (and the project analysis including the stakeholder engagement) although the discussion might go beyond the scope of the instruments above:

- Impact of biomass instruments (Ba-g) on the NCO
- Impact of agriculture instruments (Aa-Ac) on the NCO
- Impact of land/spatial policy instrument (La) on the NCO
- Impact of nature instrument (Na) on the NCO
- Impact of waste instrument (Wa) on the NCO

4.3.2 Impact of biomass instruments on the NCO

Lessening the burdens of regulation barriers and stimulating green growth

Lessening the burdens of regulation barriers has been an important part of the work for the Dutch government. The central government does warn for limits to the removal of regulation as it might come at the cost of less quality of residues. But the government does continue the work on the regulation as it is seen as a part of the shift to sustainable economic growth, or 'green growth'. For this, a programmatic approach is launched where stimulating sustainable innovations and business conduct for the purposes climate, water, soil, raw materials and biodiversity. The national government is engaged in accelerating the process and removing barriers for companies, NGOs, community organizations and other government bodies. The Green Deal approach is part of this approach and stakeholder engagement is essential according to the government, see http://www.greendeals.nl/green-deals/. A Green Deal is a mutual agreement or covenant under private law between the central government and a coalition of companies, civil society organizations and local and regional government. The Green Deal approach is meant to supplement existing instruments as legislation and regulation, market and financial incentives, and measures to stimulate innovation. Green Deals bring more coherence into the policy by improving the collaboration between the government, companies, NGOs and all kind of other stakeholder organizations. The Green Deals improve the interaction and enhances the mutual gains. From 2011 to 2014, 176 Green Deals were closed in the Netherlands, involving a total of 1,090 participants. In general, Green Deals cover nine themes: energy, the bio-based economy, mobility, water, food, biodiversity, resources, construction and the climate.

More collaboration and the broadening up of investment subsidies

The biomass instruments are increasingly being geared up to more collaboration among the stakeholders, and so have the use of investment programmes and chain management. Stakeholders welcome this change and has quite some hope for a more biomass oriented future. But they also argue that the investment subsidies should be broadened up and that the policy is still too vague and that the new policy takes too much time. Dutch producers of biomass are also against the amount of imported biomass, which is against their own business model.

4.3.3 Impact of agriculture instrument on the NCO

CAP Direct Payments: strong effect on farming – limited effect on biomass

The EU policy CAP does not mention biomass. The direct payment funding do however make it theoretically attractive for farmers to make an effort for more greening of their land. Agriculture as in CAP has a strong potential and some practical positive effects but stakeholders do not see its present practice as very stimulating to biomass. Stakeholders argue that CAP should be broadened up more for the a bio-based economy and less focus on traditional production. We do note here that few of these stakeholders were farmers, thus some bias is to be excepted.

CAP Direct Payments Greening: better quality of biomass – the quantity is not given upfront

The CAP Direct Payments Greening provides a better quality of the biomass as it makes agriculture more environmental friendly. Farmers using farmland more sustainably with more care for natural resources as part of their everyday work benefit financially. However, the quantity of the biomass is not given up front. The measurements for the greening of agricultural land imposed by the CAP acquire space. Part of the land can therefore not be used for agricultural production. The net effect on biomass is thus not clear. Seen from an ecological point of view, the greening efforts might have a positive impact on productivity in the long term, because greening agricultural land contributes to healthy ecosystems and healthy ecosystems contribute to agricultural productivity. With these subsidies many farmers might not be able to keep up and make them leave and by that decrease the agricultural productivity in the Netherlands. The agricultural policy has both objectives that have a synergistic effect on the biomass ones and objectives that put conditions on the biomass ones. Synergistic objectives (A1, A5, A6, A7 and A9) vary between financial incentives that can cause investments in improving productivity or more money for resources like seeds, machines, fertilizer etc. (A5, A7) and natural conditions that have a positive impact on production such as good water quality (A6) and crop diversification (A1). An increase in sustainable production (A9) automatically means productivity has gone up. The trade-offs (A2, A3, A4 and A8) all have to do with compliance with regulations and conditions that create competition for land. To comply with the conditions and the environmental criteria from the CAP (A2, A3, A4 and A8) there are stimulating funds as well.

The Direct Payments is a basic subsidy that farmers obtain per acre. In order to receive the full amount of this payment they have to comply with good agricultural and environmental conditions and legislative requirements that concern, among other things, health affairs and animal welfare (A8). Failure to do so results in a cut in the level of support. On top of the basic direct payment there is a payment for greening. Greening obligations are crop diversification (A1), maintenance of permanent grassland (A2) and ecological focus areas (A3) (Ministry of Economic Affairs 2017). Farmers are fined if they do not reserve land and space for the greening obligations mentioned above. As long as the greening payments exceed the revenue from agricultural production, farmers will make use of these payments. However, agricultural productivity in the long term is likely to profit from good ecosystem quality (e.g. soil and water), since this is necessary for growing crops.

Agriculture nature management: effect on biomass ambiguous

Of the total of almost 67,500 agriculture companies in the Netherlands, about 12,500 farmer companies did agrarian nature management (average 2011-2013) as a part of their business. Today the agrarian nature management subsidies demand cooperation among farmers for subsidy. The agrarian nature management organizations cover in total about 500,000 hectares of ground in the Netherlands, see https://www.groeneruimte.nl/dossiers/agrarisch_natuurbeheer/#san. The net effect of agrarian nature management on biomass cannot be measured, as it reduces agriculture production but increases 'nature production'. And both could lead to more biomass. But there is increasing attention to how such residues of nature could add to the green economy by 'green chemistry' and suchlike, see also Section 5.2.

Finally, we could here also have discussed the other instruments in agriculture, such as the young farmer support on innovative investments (€5.2m per year) or the subsidy for investments in development and innovation roll out of €9.6m per year, or the fund for a guaranteed support for market introduction for risky innovations. These also have a potential for being supportive to biomass quantity and quality. They are however rather small grants compared to the others.

4.3.4 Impact of land/spatial policy instrument on the NCO

Awaiting the new law with more freedom to act local and regional: net effect on biomass uncertain

For the spatial policy instruments it is to be said that much is awaiting the major change following in the wake of the proposed new Omgevingswet (Law on the spatial surroundings). This new law, which is expected to be in force in 2021, is supposed to carry less administrative burdens such as red tape (through simplified procedures), more freedom to act for regional and local governments, and more inclusion and space for non-governmental organizations. Spatial policy is important to biomass as it establish conditions for where activities are allowed and the rules of conduct. The main effect on biomass will probably be the (proposed) increase in freedom to develop areas. Whether the net effect on biomass will be positive is yet to be seen. But as of today, stakeholders tend to be reluctant, as much of the policy to them seems rather vague and not very predictable.

MIRT: establishing conditions for biomass

It is mainly the investment instrument in the planning tool MIRT for infrastructure that offers the most concrete effect on biomass. The Netherlands has a well-functioning infrastructure suited for biomass transport and processing. The large harbour of Rotterdam and many waterways are examples of such infrastructure. Much of the relevant infrastructure planning runs through MIRT, and this goes for biomass as well. More political and policy attention to biomass will be reflected in the MIRT, by the plans for transportation, storage, processing, pipelines, tanks etc.

4.3.5 Impact of nature instrument (Na) on the NCO

Nature: sustainability criteria for solid biomass in the making

The policy instrument of the nature policy are more diverse than the ones of the agricultural policy. There are 'soft' means such as stimulating knowledge and awareness. These means are not considered to have a substantial impact on biomass objectives. Important work has however been conducted on the establishment of sustainability criteria for solid biomass (Nm1) which were created in 2015 for the investment subsidy SDE+. There are critical voices, as reported in chapter two, strongly questioning the actual sustainability and thus the quality of the criteria: https://www.nrc.nl/nieuws/2018/11/16/biomassa-stoken-is-een-ramp-voor-het-klimaat-a2755398. The legal framework for the criteria is however still in development. A study had concluded that using production forest would be the best way to ensure sustainability (de Jong et al. 2012) The criteria now distinguish between seven categories, of which the four are related to forestry:

1. Wooden biomass originating from a big forest management area of 500 acres or more;
2. Wooden biomass originating from a smaller forest management area (smaller than 500 acres);
3. Rest products originating from multifunctional forests without clear-cut areas or areas where new trees are planted ('verjongingsgebied') that are bigger than 5 acres;
4. Rest products from the agro-food or wood processing industry. These are secondary residues such as sawdust and bark.

The sustainability criteria focus on different topics within three domains: climate and bio-energy, sustainable forest management and Chain of Custody (see for details the English version of the Netherlands Enterprise Agency (https://english.rvo.nl/). For the wooden biomass from forests (category 1 and 2) all the criteria are applied. For smaller forest areas the sustainability can be proven on the level of a bigger region in which the small forest is located. This is because of the administrative burden the certification puts on owners of small forests. In case of certification the pellet mill is the first party that needs to be certified. For rest products from category 3, a limited amount of sustainability criteria needs to be applied. It is difficult to estimate the impact of these criteria on an increase in forestry productivity. The criteria put conditions on e.g. use of soil. In the long term, however, sustainable use of soils and ecosystems will be beneficial for productivity.

The Action Plan for Forest and Wood: more production of solid biomass

The Action Plan for Forest and Wood (*Actieplan Bos en Hout*) (Nm2) was published in 2016 and is a common effort of forest owners, wood producers and wood processors, the paper and cardboard industry, pallet companies, the recycling industry, construction companies, bioenergy producers and nature- and environmental organizations to realize an optimal chain (Staatsbosbeheer et al. 2016). It contains goals of 25% more forest area and 50% more productive and sustainable forest management that together need to result in 50% more yield (Staatsbosbeheer et al. 2016). This is an increase in productivity and therefore this action plan has an enormous positive impact on B2. The subsidy for nature management Nm3 (*Subsidie Natuurbeheer*) also covers forest and the subsidy is provided by the provinces for certified owners and leaseholders for nature terrains. To be eligible for this subsidy the area must be bigger than a certain threshold amount of acres. This threshold varies per province. The subsidy is meant as a compensation for the management of nature terrains and making them accessible for the public. The subsidy period is six years (see for details the English version of the Netherlands Enterprise Agency (https://english.rvo.nl/). The impact of this subsidy on an increase in forestry productivity is probably not significant and this is the reason we did not count it in our top 13.

The Action Plan for Forest and Wood also had a predecessor in the Green Deal Enforcing Sustainable Forest Management or (Green Deal 150 *Bevorderen Duurzaam Bosbeheer*) (Nm4), which was finished in 2013. Its aim was to enforce worldwide sustainable forest management. Part of the plan was to increase the share of sustainable energy on the Dutch market (N1) by stimulating the demand for sustainable wood. An impact study showed that this Green Deal was not very effective, but that awareness about sustainable wood was raised (Doornebosch et al. 2015). Sustainable wood in this case means wood with a sustainability certificate. This can be wood produced from all over the world, so it does not give a specific boost for Dutch wood production and thereby an incentive for forestry productivity in the Netherlands.

There are however some stimulating pilots related to The Action Plan for Forest and Wood in areas that combine solutions for problems regarding water and nature (N5), which can go hand in hand with producing biomass. In the national Delta programme attention is paid to spatial adaptation, where it is assessed how areas can be designated (i.e. officially categorized) as water robust and climate resilient. Dynamic and productive nature such as willow forest and reed is considered to be suitable for water storage (Boosten et al. 2016). In this case extra wooden biomass will be planted. Stimulating organizations to produce sustainable energy in combination with improving the quality of the environment, nature, and landscape (Nm6) is a very broad means and can mean a lot of different forms of energy. Since certain types of biomass can enrich the landscape and have positive environmental impacts such as cleaning the air and water in the case of trees, it is a good candidate for a combination of sustainable energy and improvement of the quality of the environment, nature, and landscape. Stimulating area coalitions to create synergy between water management, agriculture, sustainable production of energy and nature (Nm7) is also a related instrument that links the means of the Water Framework Directive with the means of the CAP.

4.3.6 Impact of waste instrument on the NCO

The VANG programme From waste to Resource

The National Waste Management Plan in the Netherlands programme contains rules and instruments for the waste in Netherlands. Here however we emphasize the VANG programme From waste to Resource (*Van Afval naar Grondstof*, VANG), as this is launched as a part of the new approach towards a Circular Economy. VANG is the Dutch programme for more recycling of (also) bio-waste and better integration of the waste chain management. With this programme more bio-waste from households is collected and better managed. The further use of it will depend on the chain management attached to the programme.

It is the municipality that decides its own waste programme. But all public authorities must take into account the National Waste Management Plan when dealing with aspects of waste management (Ministry of Infrastructure and the Environment 2014a). They have to take into account environmental aspects when making policy plans and issuing decisions. In the case of waste management, the National Waste Management Plan is always the frame of reference. For the Environment Minister, the National Waste Management Plan is the yardstick for issuing collection permits for certain categories of (hazardous) waste decisions on notifications of the proposed import, export and transhipment of waste based on the EU Waste Shipments Regulation, see https://rwsenvironment.eu/subjects/from-waste-resources/national-activities/national-waste/ .

4.4 Assessment of vertical interactions between policies

In this section we analyse the vertical interactions between the policies (global/EU). This has been carried out by two researchers and it has been checked by a third researcher. For this purpose, the researchers have also used input from the interviews with stakeholders, the stakeholder workshops and literature to identify the important vertical interactions between policies considered to be important in increasing the total potential biomass supply in the Netherlands. Table 29 summarises the vertical actions identified by the stakeholders. In this assessment the focus is on biomass and its conditions.

Since 2016, the Netherlands has put much effort into the SDG 2030 Agenda - Sustainable Development Goals (2015). The national government has worked on the translation of the SDGs into national policy (http://www.sdgnederland.nl/sdgs/). This resulted in two reports so far titled the Netherlands develops sustainably (*Nederland Ontwikkelt Duurzaam*) (Ministry of Foreign Affairs 2017, 2018). The reports said that eight ministries made an inventory of the state of affairs of the national policy regarding the SDGs. The conclusion of the 2017 report was that the Netherlands were behind on formulating climate and energy objectives (Ministry of Foreign Affairs 2017). The climate plan of the government reported on in chapter 3 has taken care of the lack in objectives.

In climate and energy policy, the challenges are not the objectives but the practice, stakeholders argue. Two general problems regarding the vertical interactions are the lack of clarity with respect to the usage of biomass and the many rules and regulations. Together, these issues make the EU policies hard to deal with in practice: applications for policies on nature (as *Natura 2000*), agriculture (*CAP*) and water (*Water Framework Directive*). The many rules and regulations from various policy sectors that entrepreneurs and investors in bio-energy have to deal with do however not only stem from the EU, but also from the national regional and local governments. The circular economy requires space to act, stakeholders argue, but at the same time rules are needed in order to achieve clarity on a level playing field. This is a dilemma. The EU Commission has already acknowledged these challenges and it is part of the revision of the Renewable Energy Directive: there are too many process steps and permit issues with a lack of clarity. The Commission is working on better and simplified regulations, but the Commission also states that it has only non-binding sustainability criteria, see
https://ec.europa.eu/energy/en/topics/renewable-energy/biomass.

Table 29: vertical interactions between national and international (EU/global) policies

Higher-->lower	
Higher level policies successfully implemented at lower scale	
SDG 2030 Agenda - Sustainable Development Goals	In terms of agenda setting and the first steps towards implementation, the Dutch government is on track with ambitious plans and approaches (transition agendas and stakeholder dialogue)
	Critical notes from the SDG on the sustainability of agriculture
Paris Agreement	On track with ambitious plans
EU Renewable Energy Directive	New ambitious Cabinet plans for energy and climate and major efforts to engage many public and private stakeholders for further concretizations of the plans.
Bird and Habitat Directive (legal framework for Natura 2000)	The legal framework is well developed and the designated areas are defined and allocated. Decentralization a boost for provinces to engage in management plans in the making
CAP Common Agriculture Policy	CAP is the leading policy for agriculture
Water Framework Directive	Increased Cabinet efforts through the Delta plan, improved soil and water quality and extra budget (€275m for water quality Natura 2000). Also through the Rural Development Plan (CAP); Deltaplan Agrarian Water Management (Deltaplan Agrarisch Waterbeheer)
Higher level policies partly implemented at lower scale	
Bird and Habitat Directive (Natura 2000 implementation)	Management plans still in development, with discussions on how to implement Natura 2000
Lower-->higher	
Lower level policies fully supported by higher level policies	
Lower level policies only partly supported by higher level policies	
Biomass 2030 plan	-Lack of clarity regarding the usage of biomass in the Natura 2000 policy, the CAP, the Water Framework Directive; -Too many rules and regulations makes the EU policies hard to deal with in practice: applies for policies on nature (as Natura 2000), agriculture (CAP) and water (Water Framework Directive); - no clear and binding sustainability criteria; -Natura 2000: Opportunities to combine the restoration of nature with the economy is argued to be limited. - Biomass is sometimes identified as waste and then strict policies apply for processing and transportation. For example, manure, covered by the EU Nitrate Directive.

An important part of these challenges for biomass is that it is often unclear to stakeholders how the EU policy on agriculture, nature, energy, waste and water apply to biomass. Biomass is sometimes defined as waste and then strict policies apply for processing and transportation. This goes for manure, which is part of the EU Nitrate Directive. Those stakeholders that are active in the biomass sector would like to have more clarity and also more support from policy. We received these signals at our workshops but a similar message was sent by participants at the international conference "The role of low carbon fuels in decarbonising transport: the emerging consensus from international initiatives", in April 2018. This was a collaboration between the Biofuture Platform, the European Commission, IRENA, below50 and ART Fuels Forum, with the participation of IEA and FAO. The conference in Brussels focused on the upcoming biofuels policy framework, part of the Renewable Energy Directive for the post 2020 period, RED II http://biofutureplatform.org/wp-content/uploads/2018/04/Key-Messages.pdf.

The key messages were that large-scale bioenergy is needed to help combat climate change, feedstock are available to meet the bioenergy need sustainably. Conversion technologies are also available to meet the need. Policy support and international collaboration on investments will be required including evidence-based ways to reward the positive externalities offered by low carbon fuels, as well as specific support to reduce the costs of innovative conversion technologies at industrial scale, such as second generation plants. Regulatory issues were also stressed and it is argued that an evidence based, feedstock neutral approach to assess sustainability and environmental performance like the California´s Low Carbon Fuel Standard and Brazil´s RenovaBio was recommended 'above arbitrary regulatory distinctions, such as the division between conventional (food-crop based) and advanced (non-food-crop based) biofuels, as such a division could impede innovation and the development of both, and may not produce the best outcome'. Minimizing the risk of emissions from indirect land use change resulting from biofuels production was also supported.

With regard to the Water Framework Directive, the Cabinet has increased the efforts of the implementation through the Delta program, improved soil and water quality and extra budget (€275m) (Delta Program Office 2018). Also better monitoring and evaluation has been announced (staatvanonswater.nl).

Conclusion: coherence often at the level of policy-making and objectives – less for policy practice

The conclusion here is that the vertical interactions between policies are rather coherent, but more so at the level of policy-making and objectives than policy practice. This is in line with other research in the field (Nilsson et al. 2012; McCormick and Kaberger 2007). Problems concerning the vertical integration of policies emerge mainly in the implementation phase. Challenges for biomass is the interaction between policies relating to generating energy from biomass versus policies supporting the cascading of biomass in the so-called bio-based economy. Higher value applications of biomass are still in an early stage of development and R&D and innovation policies are key to the future. From an environmental point of view, the process of cascading is beneficial. But looking at the many different biomass sources in 2015 the category household and industrial waste forms more than one third of the total biomass production used for energy. The reduction of waste means less waste that can be burned to get energy. Still, a relatively ambitious renewable energy target needs to be fulfilled soon of which bio-energy forms a substantial part.

For further vertical coherence it is important to keep working on sustainability criteria for both solid and gaseous biomass and for biofuels used in transport and bio-liquids through for instance revisions of the Renewable Energy Directive. An European harmonized sustainability system for biomass might support more and better usage of biomass.

5 Policy arrangements and coherence

5.1 Formal and informal arrangements

In general, the Dutch government has been engaged in a lengthy multi-stakeholder approach to tackle many of the Nexus-issues we cover here, see an overview in Table 30. Formal and informal arrangements are adopted to address conflicts, negotiate trade offs and exploit synergies in practice. The Dutch policy-making has in recent years worked closely with stakeholders to improve policy achievements through a variety of arrangements. In 2011 the process of identifying conflicting interests and an corresponding assessment of how to deal with such conflicting interests in the bio-based economy, including biomass mounted to a publication. In this publication the government also explained what it could do or not do regarding these challenges. In the text, however, it seems that conflicting interests are almost the same as obstacles in general. The government emphasised that communicating why it would act on a certain obstacle is important. Some obstacles faced by the business community are for instance about strict rules. But the government made it clear that such rules are made for a reason, as in safety, and will not be loosened up. Some measures were out of the reach for the government, as they concerned market issues for business to handle. But this way of working on obstacles and conflicting interests also led to follow-ups, such as the Transition House and Front Runner Office.

Many of the obstacles that were picked up by the government were related to procedures and administration, and also (the clarity of) legal definitions. For such obstacles a new arrangement was installed, the Acceleration Team, where market parties are signalling issues to the Program Department (*Programmadirectie*) Biobased Economy. This has led to shorter procedures and improvements in the Investment Subsidy SDE+.

In 2016 an Energy Dialogue started for sharing views further and more direct on energy issues. More consultation followed in the run-up to the National Agreement on the Circular Economy, signed by 180 organizations. This also led to a Transition Agenda Circular Economy and after additional consultations and negotiations, the new Cabinet response to the climate challenges in 2018.

Table 30: Arrangements

Arrangement	Enabling and limiting factors	Result
Formal governmental project: Conflicting interests in policy (SIRA consulting 2011). Carried out by consultants	Inventory of conflicting interests and obstacles + how to deal with them in the policy for the bio-based economy (including biomass)	Government cleared out whether or not the issues had to be resolved: improved implementation
Formal arrangement for consultation: The Transition House for the Biobased Economy	A meeting place for a better connection between knowledge and business.	Improves the ability to see and report (to government on) opportunities, limitations and obstacles and to enhance the (mutual) understanding.
Formal arrangement: Front Runners Office (*Koplopersloket*)	Stimulation of innovative action	Establishing innovations or improving practice might very well strengthen the NCO achievement
Formal government project: Acceleration Team Green Gas (*Versnellerteam Groen Gas*	Market parties signalling problems and solutions in national policy. Network link with the Foundation Green Gas (*Stichting Groen Gas Nederland*, Programmadirectie Biobased Economy:	Shorter and better procedures & licensing; improvements of investment subsidy SDE+.
Formal arrangement for 3 months and then informal continuation: Energy Dialogue: consultation from April 2016	All parties share their views on the future energy system and to contribute to the design of the policy agenda.	Input for the Energy Policy Agenda. Instrumental in fostering awareness of the energy transition in the Netherlands
Formal governmental process: National Agreement on the Circular Economy (*Grondstoffenakkoord*)	Joint ambitions for steps to utilise raw materials more effectively, by reducing our dependency on non-renewable, raw materials and less waste and pollution.	Indirectly effect by its agenda setting power. New is the link to a social agenda for effects on the labour market (prospects for healthy, honest work).
Formal governmental process: Transition Agenda Circular Economy	A major project with a multi-stakeholder approach (180 signatures). For the implementation of the Natural Resource Agreement;	Agenda transformed to action by stakeholder working groups.
Formal Cabinet Approach Climate (Ministry of Economic Affairs and Climate 2018)	Clear objectives for the future. Built on further consultation on how to proceed.	Framework with objectives and for better collaboration and a more integrated approach.
Formal arrangement: Climate Governmental Consultation 2018	Interdepartmental Management Table (*Regietafel Interbestuurlijk Programma*): Cabinet, provinces (IPO), municipalities, (VNG), and the Dutch Water Authorities (UvW).	More focus on the climate effects of the policy, sharpening the focus.
Informal arrangement: the 2018 consultations with organizations and businesses.	The ministry felt well served with many good ideas for instant reduction of CO_2 emissions.	Agenda forming by establishing consensus and enthusiasm.

5.2 Success and failure

The question of defining success and failure is not very straightforward. To illustrate this we can refer to a joint venture of the private company DSM, a global company in health, nutrition and materials with and the nature organization Natuurmonumenten. They partnered up to use biomass from nature in 2013. But they met resistance from the Foundation Critical Forest Management (*Stichting Kritisch Bosbeheer*) and the media/public, as cutting trees is not always popular. This is thus a mixed example of success in partnering up but it fails in establishing public support. Here we define success more in governance terms than in actual implementing results, as much concerns rather recent developments. Where we have information of the latter we will use it. The project guidance emphasis examples of successful (or not) arrangements (Munaretto and Witmer, 2017).

5.2.1 Success and failure in general

In **Table 31** we present a number of successful arrangements and initiatives including their main success factors.

Table 31: Success stories

Type of arrangement	Description	Success factors
Consultative dialogue arrangements 2011-2019	Various arrangements: from identifying conflicting interests in 2011 to the more recent Transition Agenda and Climate Consultation	Improving the governance through a better common understanding of opportunities and limitations of biomass. Building trust.
The Acceleration Team Green Gas	Market parties signalling problems and opportunities. For example, it led to adjustments of legal definition of biomass; Organic waste is not part of the waste law	Stands for a better and upscaled link between business and the policy agenda. Legal changes were central.
GrasGoed: Natural Green as Resource (Natuurlijk Groen als Grondstof in 2017):	Green residues as fuel, soil improvements, animal feed, fibres for packaging, roads. Belgium-Dutch initiative. 11 partners.	Enthusiastic collaboration and joint financing
Cluster Bio Energie Oost-Nederland.	Collaboration of people from a range of sectors: knowledge sector, industry, energy,.	Enthusiastic broad scale of parties creating and working on innovation
Chemelot Innovation and Learning Labs CHILL:	Education, research, production of bio-based products	Joint public-private collaboration for knowledge development
The 'Jumpstart Monomestvergisting' (single manure fermentation)	Collaboration led by Green Gas Netherlands: initiator Taskforce Jumpstart, with the national government, LTO en FrieslandCampina.	Became a part of the SDE+ investment subsidy, for accelerating the roll-out of the technique and price reductions
Biomass Alliance (Alliantie)	Since 2013 a collaboration among originally 10 now 12 partners for knowledge and practical business cases	An 'engine for biomass management' by collaboration on knowledge and regional government and agencies
Sugars from wood: biomass used for bio raffinage from 2017. Based on Avantium's Zambezi-technologie. Five large companies: Factory: Avantium (chemical technology)	Staatsbosbeheer delivers woodchips. Energiehout B.V. (Staatsbosbeheer is 100% owner) coordinates the delivery. AkzoNobel provides the necessary infrastructure, acids, utilities, expertise. RWE delivers resources for the Zambezi process. Chemport Europe supports initiatives for strengthening the role of North Netherlands.	Combining knowledge into a business plan based on collaboration. Breakthrough technology is used. More collaboration and partnerships in development

In general we can say that the political willingness to engage in an enduring dialogue with the stakeholders is a strong element of the Dutch approach. We have seen this ongoing dialogue within the arrangements mentioned in Section 5.1. Ever since 2010, much work has been carried out to improve the knowledge base and dialogue among the stakeholders involved. Both the government and the other stakeholders have all made investments in time and effort. The stakeholders emphasized that the Dutch government has made major efforts the last 8 years to identify and tackle incoherencies and other obstacles to policy achievements. The government has triggered private leadership within for instance Green Deals and the Top Sector Policy, which is viewed to be necessary as much is considered beyond the reach of the government (market issues). Joint learning processes and consultations, such as the project Conflicting Interests (SIRA consulting 2011), the Energy Dialogues in 2016 and the Transition Agenda in 2018, have contributed to more awareness, a better agenda setting and a shared view on how the stakeholders can employ the resources in a joint way. All these efforts have helped to improve the governance of biomass. The project Conflicting Interests is of particular interest as it allowed business and others to present their questions of concern or interest to the government and the government replied on how they viewed this issue (SIRA consulting 2011). They explained on every issue what they could or would do, or why they could not act. They explained that a level playing field in the EU context had to take place and not the national level. One factor of success stems from the Acceleration Team Green Gas. The Team gained access to the policy agenda in order to achieve procedural and legal changes. An important concrete success factor of this work was that biomass is no longer seen as organic waste anymore: it is not subjected to the Waste Law. As a result, barriers of expensive permit requests are avoided, and biomass becomes more interesting as a resource for business. We add here that there are critical voices, as shown in chapter two, who argue that the policy is just a paper reality without a CO2 tax.

5.2.2 Concrete examples of success

One of the concrete success stories is CHILL, the public-private innovation oriented learning lab. CHILL is a collaboration between what is called the founding fathers SABIC, DSM, Leeuwenborgh Opleidingen, Arcus College, Zuyd University of Applied Sciences, and Maastricht University. As a centre of expertise and innovative professional skills, CHILL helps to shape and expand the top sector policy in the Netherlands by offering an innovative learning, work, and research environment where companies (from start-ups to multinationals) and knowledge institutes (from intermediate vocational education institutes to universities) can work together to develop new knowledge and products, see https://www.chillabs.nl/en/about-chill/.

Another more technical success was the Jumpstart of the Single Manure Fermentation. It was originally too expensive to be eligible for normal SDE+ investment subsidies, but receives special attention in this program. Eventually it was launched as a separate category in the SDE+ subsidy to accelerate the roll-out of this technique and realize a reduction of the cost price.

The Biomass Alliance is since 2016 working on a pilot *“Van Berm tot Bladzijde”*, which translates into something like From the Road side to the Book page. This is a partnership where 18 parties in Oosterbeek join forces to exploit grass like biomass for the production of cardboard.

GrasGoed is an initiative using Natural Green as Resource (*Natuurlijk Groen als Grondstof*), which uses organic residues as resource for the road maintenance of the provincial N272 road, fuel, soil improvements, animal feed, and fibres for packaging. The factor of success was the enthusiastic collaboration land owners, nature organizations, businesses, knowledge institutes in the joint EU Interreg/EFRO project of the Dutch province Noord-Brabant and the Belgian province Antwerp.

The 2017 business initiative Sugars from Wood is a new business plant to use biomass for bio refinery. It is based on Avantium's Zambezi-technology. Five large companies work on this factory: Avantium provides the chemical technology; Staatsbosbeheer delivers the woodchips; Energiehout B.V., where Staatsbosbeheer is a 100% owner, coordinates the delivery. AkzoNobel provides the necessary infrastructure, acids, utilities, expertise. RWE delivers resources for the Zambezi process. Chemport Europe supports initiatives for strengthening the role of the North of the Netherlands. The success is related to the way these companies were able to combine knowledge into a business based on collaboration and building on a breakthrough technology. An interesting aspect is also that the collaboration is not 'complete', as the partners still are looking for more collaboration with new partners. They aim to continue the development of the business idea.

5.2.3 Biomass 2030: effort to unify biomass as a policy issue

We concluded in chapter 2 that biomass is not much of a single policy issue with a clear demarcation but an issue that touches into various types of policy. The government has recognized this characteristic and also acknowledged how urgent the climate challenge is, the need to replace fossil energy, concerns about the scarcity and unwanted competition for biomass and the need to look closer at all stages of the value chain. The resulted in the policy vision 'Biomassa 2030' (Ministry of Economic Affairs and Ministry of Infrastructure and the Environment 2015). It is devoted to improve the links between various sectors and issues and establish an agenda. The development of bio-refinery technology is an example, as it links nature, waste, agriculture, energy and economy in general and it is an important factor for the further development of biomass production. There are however worries among stakeholders on inadequate financing but bio-refinery is now one of the six programmes appointed by the private sector, science and government within the knowledge and innovation agenda and one of the work packages of the *Topsectorenbeleid*, the Top Sector Policy.

5.2.4 Top Sector Policy: joint public-private policy

The joint public-private Top Sector Policy are areas in which the Dutch businesses and research centres excel globally. In these top sectors businesses, universities, research centres and the government work together in Topconsortia for Knowledge and Innovation (TKI) on innovation and knowledge, to reinforce this position in the global economy (https://english.rvo.nl/). One of them is the TKI BBE. This consists of a Workpackage BioEnergy & BioChemicals, carried by the innovation contracts of the top sectors Energy and Chemistry . This innovation contract states that bio-energy plays a key role as mobilizer of biomass streams and as an integral part of cascading and bio-refinery concepts. It adds to that that the development of bio-refinery is essential for economic viable systems. **See further:** https://www.biobasedeconomy.nl/2012/01/16/innovatiecontract-biobased-economy/ . The investments in research and development are divided between the public and the private sector. The budget that is needed for the period 2015- 2023 has been established to be €485m, of which the public sector will contribute €263m and the private sector €211m. Companies in the private sector have committed to this amount by signing letters of intent (TKI-BBE, 2015). Thus, the innovation contracts include bio-refinery techniques and the government seeks partnerships with private parties to co- finance these developments. Thus far we can say that the new approach based on public-private collaboration is a success factor.

5.2.5 Improving biomass from rest streams: future for manure?

An issue that is not addressed specifically in the policy documents, but is considered to be important for links between energy, agriculture, biomass, nature and economy is the potential of manure for energy production. Small-scale valorisation of manure does not only produce energy but is especially important for methane reduction. A stakeholder from the agricultural sector argued that micro fermenters running on own manure are an option and this is really developing. This is due to the Nutrient Action program and the CAP: farmers with manure surpluses have to process part of their manure surpluses (i.e. option of transporting to nutrient demanding areas decrease). Biogas can be generated from manure by anaerobic digestion; which results in two outputs: biogas and digestate. Digestate can be used as input for the production of fertilizer for instance. For manure, there are two fermentation processes namely:

- Manure-fermentation (*monomestvergisting*) : this is a technique where manure is transported to a heated silo. In this way, the fermentation process that has started in the bodies of the livestock animals can be continued by bacteria in the silo. This releases methane emissions that can be captured and converted into energy;
- Manure co-fermentation ('Mestcovergisting'): in this process, up to 50% of biomass (mostly crop residues) is added to manure. One of the reasons why co-fermentation is interesting is that the digestate is not considered as manure (or waste) but as organic manure. So the regulations for using digestate are more relaxed and there are more alternatives. The amount of energy from co-fermentation processes is much larger than from fermentation processes, which can make the cost of energy production from co-fermentation lower than from fermentation. However, the amount of digestate after the fermentation process is higher.

The Netherlands has been dealing with a manure surplus for years, and farmers need to get rid of their manure. Four types of barriers play an important role in the upscaling of manure fermentation in the Netherlands: (i) the liability and robustness of the technique of fermentation, (ii) the high investment that needs to be made and (iii) the digestate that is left after the process of fermentation. This digestate still contains all the nutrients, but cannot be classified as fertilizer according to regulations. Loops cannot be closed in this way and farmers still need to get rid of this digestate, which is expensive. Finally (iv), there are cheaper alternative options for farmers such as the transportation of manure to areas with nutrient deficiencies (according to NAP policy).

Manure for bioenergy production is slowly getting attention in policy-making. The Jumpstart Manure fermentation (*Jumpstart Monomestvergisting*) initiative has been launched as a separate category in the SDE+ subsidy. The goal of this programme is to accelerate the roll-out of this technique and realize a reduction of the cost price. Manure fermentation was too expensive to be eligible for normal SDE+ subsidies, but receives special attention in this programme (Ministry of Economic Affairs 2016b). Another aspect of manure fermentation is the prevention of the release of methane in the atmosphere. Methane is a very strong greenhouse gas (United States Environmental Protection Agency, n.d.). By generating the methane out of manure through fermentation, this will not be released to the atmosphere. This is beneficial for the environment.

Another type of rest stream that is not specifically addressed in the policy documents is cuttings from landscape management. Several stakeholders argue that this has much potential: “Cuttings from nature and roadsides are streams that do not cost much, so if you have techniques for it, you can do a lot with it.” (Interview). On the question what barriers prevent an increase in biomass production in the Netherlands, almost all respondents mentioned the image and reputation of biomass to be a big problem: “The Dutch people are very critical about bio-energy. The discussion about co-firing in coal plants plays a big role in this […] We suffer from that. People think: if you do something with a tree, it is for energy production. But it is always about something else, where energy is only a side product from rest streams. We have to tell that story a lot […] This image is really a bottleneck at the moment” (Interview). This is also the main conclusion from the first stakeholder workshop of the project.

An interesting objective that gives direction to the policy for biomass production is “to stimulate the development of alternative ways to produce resources without using soil and biomass, for example artificial photo synthesis” (Ministry of Economic Affairs, 2012). This objective implies no use of biomass, but a substitution for it in the form of solar energy. This shows the lack of space there is to produce biomass in a small and dense country like the Netherlands and the need for innovation to make up for this. Of the nine objectives regarding an increase in biomass production that are extracted from the policy documents, only the use of degraded soils for biomass production (B9) takes space. While talking to stakeholders, it appeared that degraded soils are very rare in the Netherlands. This is therefore not a feasible option with a high potential. Although manure has a relatively high theoretical potential, the government does not focus much on it in the policy documents. The Jumpstart Fermentation (*Jumpstart Monomestvergisting*) has been created in 2016 after a long process of lobbying. It aims to tackle two of the three important barriers that are still hampering upscaling of manure fermentation. The issue with digestate will stay. One could argue that investment in manure fermenting and subsidies for it, can have the perverse effect of maintaining or even increasing the amount of livestock which has a very negative impact on the environment. However, with the current manure surplus in the Netherlands, regulations on the amount of cows and manure are very strict and an increase in manure is therefore very unlikely.

5.2.6 Failure: solutions not yet achieved

The notion of 'failure' is just as troublesome as 'success'. We see failure here as challenges where efforts have been made to solve problems but the solutions are not yet achieved. The main types of failure are the negative image of biomass, the complexity of the sector, the many administrative rules and regulations and a lack of clarity on the usage of biomass. The latter is related to unclear sustainability criteria for biomass and uncertainty for longer term investments.

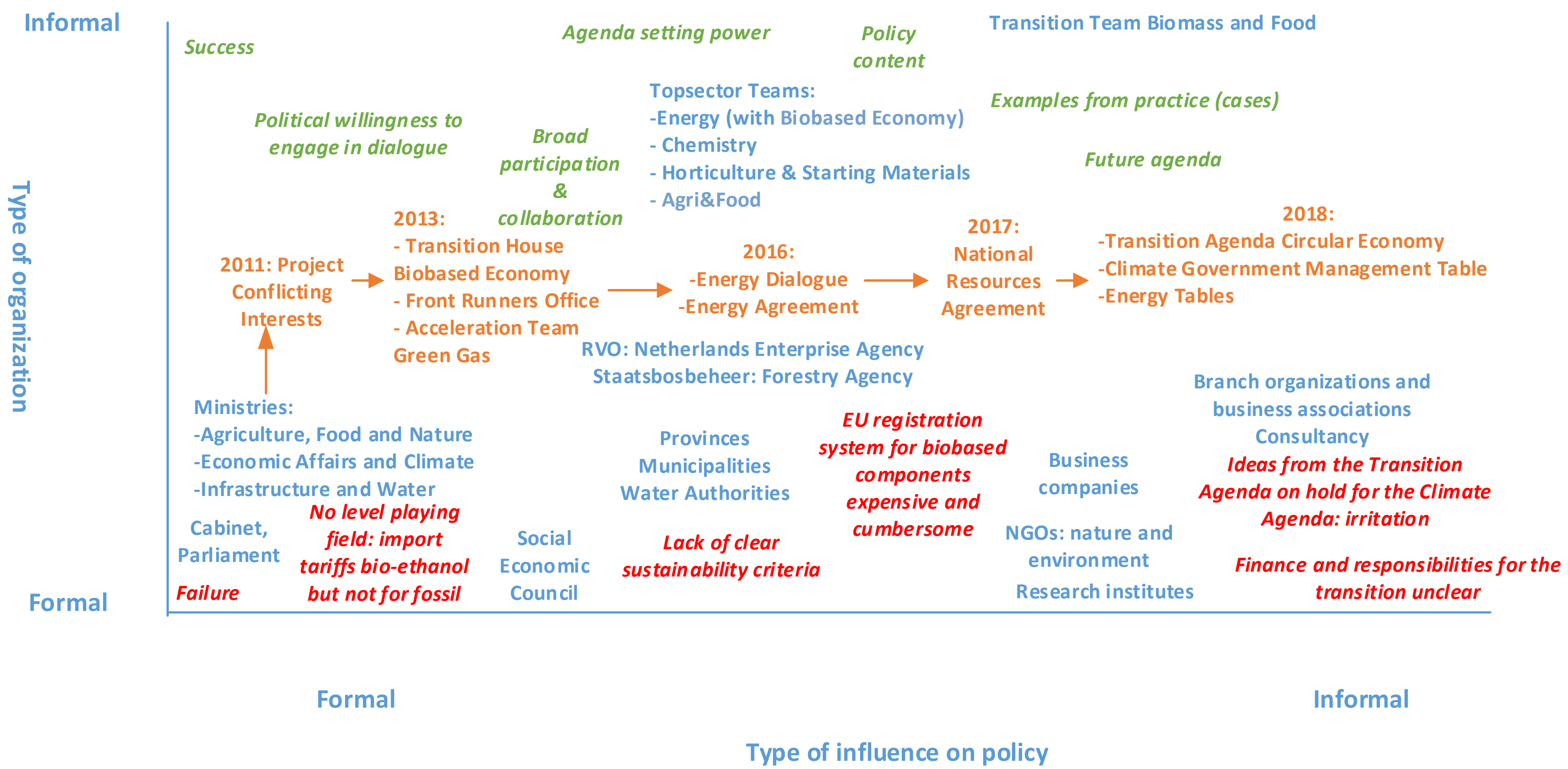
One of the problems is that the biomass 'sector', is hardly a unified sector at all, stakeholders argue. It is diverse and it is not well organized and this puts restrictions to the coherence and the ability to find each other in mutual beneficially activities. Interviews also reveal that *“the rules and regulation system in the Netherlands is dramatic. I know installations that needed seven years to get a permit. This is very costly”* (interview). This type of criticism goes beyond the lengthy procedures, it also covers the rigidity of the rules. An example that was given is about the ashes of type C wood (wood that is treated to prolong its lifespan) which cannot be used for anything else according to regulations and need to be deposited somewhere, which costs money (interview). Another example mentioned is the following: if a stream is classified as waste, it still has to be processed as manure. The opposite is true for digestate of manure after co-fermentation. The residue is regarded as biomass and not as manure/waste which has to be processed. Stakeholders in the interviews and workshops concluded from these examples that a circular economy requires a quite different type of space for legal interpretations or different types of rules. The government is very aware of the regulatory barriers that exist and tried to tackle many of them in the project Conflicting Interests (SIRA consulting 2011). In this programme, 69 barriers were identified that were posed by regulations. Some of them are solved, but some of them cannot be solved. Examples of barriers that cannot be overcome are the permit procedure for new installations, and digestate that is considered to be manure.

Table 32: Failures

Arrangement	Description	Failure factors
Both formal and informal arrangement: work on trade rules Import tariffs/trade barriers	import tariffs for bio-ethanol but not for fossil.	No level playing field. Leads to uncertainty and less investments
Both formal and informal arrangement: Work on sustainability criteria in the EU	A lack of sustainability criteria	Hampers the clarity, damaging to the image of the sector
Formal arrangement: REACH bio-based components	A registration system for tens of thousands components	Time consuming and expensive system. But: all components in the EU must be registered, no change is to be expected.
Formal/Informal arrangement: implementation of initiatives from the transition agenda	Quite a number of the initiatives launched during the process of making a Transition Agenda are on hold due to the making of the Climate Agenda	Leads to delay and complaints as good initiatives are not carried out. Business is also less patient than government.
Informal arrangement: self-organizing capacity biomass companies	The self-organizing and networking capacity of biomass companies not yet optimal	Leads to sub-optimal usage of many opportunities. Lack of tradition in collaboration.

Hand in hand with a strong critical opinion and for some stakeholders a biased image of biomass is the vagueness and the ignorance about this topic among people. This frustrates the expansion of biomass production. Many businesses/farmers also do not have the knowledge of biomass and its market and they are also often rather traditional. “A poultry farmer is not a biomass producer” (Interview).

Another topic frequently mentioned by stakeholders is the need for more research and innovation for biomass production, also on the links between policies. The private sector does not have a long-term perspective, and investments for the long term are not interesting for them. EU research could be useful for this end. The respondents see a need for a stronger responsibility for the government in this. 'Funds for innovation have decreased. This is especially difficult for bio-based projects. It becomes difficult to establish big projects like AlgaeParc and this leads to smaller, fragmented projects and that's a pity' (interview). Another respondent argued that 'in this phase there is a role for the government to stimulate and co-finance the right developments. According to the Topsector policy the market needs to take the lead and has been attributed a very important financial role. But in practice this is disappointing' (interview). What is especially important according to the respondents, is a robust and continuous long-term policy regarding research and innovation. This will provide certainty for investors. The following figure shows the success and failure factors linked to the policy process.


Informal
Success
Agenda setting power
Policy content
Transition Team Biomass and Food
Topsector Teams:
-Energy (with Biobased Economy)
- Chemistry
- Horticulture & Starting Materials
- Agri&Food
Examples from practice (cases)
Political willingness to engage in dialogue
Broad participation & collaboration
Future agenda
Type of organization
2013:
- Transition House Biobased Economy
- Front Runners Office
- Acceleration Team Green Gas
2011: Project Conflicting Interests
2016:
-Energy Dialogue
-Energy Agreement
2017: National Resources Agreement
2018:
-Transition Agenda Circular Economy
-Climate Government Management Table
-Energy Tables
RVO: Netherlands Enterprise Agency
Staatsbosbeheer: Forestry Agency
Branch organizations and business associations
Consultancy
Ministries:
-Agriculture, Food and Nature
-Economic Affairs and Climate
-Infrastructure and Water
Provinces
Municipalities
Water Authorities
EU registration system for biobased components expensive and cumbersome
Business companies
Ideas from the Transition Agenda on hold for the Climate Agenda: irritation
Cabinet, Parliament
No level playing field: import tariffs bio-ethanol but not for fossil
Social Economic Council
Lack of clear sustainability criteria
NGOs: nature and environment
Research institutes
Finance and responsibilities for the transition unclear
Formal
Failure
Formal
Informal
Type of influence on policy

5.3 A view to the future

The most recent and relevant policy development now regards the climate policy plans (Ministry of Economic Affairs and Climate 2018). The policy is ambitious as shown by the main objectives:

1. In 2030, a 49% reduction of Greenhouse gases based on 1990 emissions
2. In addition, the Netherlands will take the lead in the EU to achieve a 55% emission reduction goal of Greenhouse gases.
3. End the electricity production from coal by 2030
4. Install a minimum price for CO2 in the electricity production
5. Agriculture and land use: deliver (bio)resources for other sectors and contribute to negative emissions.

The government employs both formal and informal arrangements to pursue these aims. A formal consultation arrangement is now being launched to coordinate the efforts: the Intergovernmental Program Climate and Energy (*interbestuurlijk programma*). The government has also used informal arrangements in order to realize the ambitions, as consultations with organizations and businesses. According to the ministry, this delivered enthusiastic reactions, with many good ideas and plans for the reduction of CO_2 emissions. The ideas, the minister emphasizes, included what the partners themselves would do, not just what others should do (Ministry of Economic Affairs and Climate 2018).

Since the installation of the Cabinet in 2017, the Ministry of Economic Affairs and Climate is the responsible governmental actor in this matter. In the letter, the Minister emphasizes that the whole society must contribute to the solutions. Everybody must be held accountable for their own actions and the consequences for the climate. The government is stimulating and ensuring the collective character of the plan. It will encourage, remove obstacles and change the rules of the game whenever necessary, but the government is also clear on the limits of governmental action. The government cannot decide everything and it makes a call for the creative minds and innovative entrepreneurs. But it will firmly steer at one central goal: the 49% reduction of Greenhouse gases in 2030 based on 1990 emissions. The national programmes on Circular Economy and the Transition Agendas from the Natural Resource Agreement will be a part of this work. However, the new ambition must not stand in the way for the objective from the Energy Agreement to be CO_2 neutral in 2050. A joint approach is the essence, with a coherent and integrated plan for the public interest involved.

Table 33: Instruments for achieving a low-carbon economy

Objective	Instruments	Specific instruments
The Netherlands aims for a 49% reduction of Greenhouse gases in 2030 based on 1990 emissions	Administrative	Governmental Consultation on an intergovernmental programme (*Regietafel Interbestuurlijk Programma*): with the Cabinet, the municipalities, (VNG), the provinces (IPO) and the Dutch Water Authorities (UvW). Every region will have a plan
	Frameworks	Intergovernmental programme for collaboration
	Knowledge	A study by PBL on the effects, including whether a broadening of the investment subsidy SDE+ is a suitable solution.
		PBL is asked to conduct a study on cost-efficient measures
		Pilots and demonstration projects will be developed (as for CCS, housing)
		Technological research
		New policy instruments: regarding the energy mix; stakeholders are invited to discuss norms, regulations, self-regulation, prices, knowledge dissemination.
	Information	5 Sector Tables: platforms for Industry; Mobility; Building; Electricity; Agriculture and Land Use: Consultation with stakeholders (business/NGOs) new roles and responsibilities and innovative solutions
	Information	Climate Consultation (*Klimaatberaad*): monitoring the general progress.
The Netherlands will take the lead in the EU to achieve a 55% emission reduction goal for Greenhouse gases.	Administrative	Take initiative to achieve collaboration with other North-western EU countries.

6 Conclusions and policy recommendations for improving policy coherence

6.1 Conclusions

The overall research question of the SIM4NEXUS case study of the Netherlands is the following:

What is the role of biomass in the realization of a low-carbon and resource-efficient economy in the Netherlands in 2050?

We also have the following sub-questions:

- Which sectors and policy domains are important for the use of biomass in the Dutch transition towards a low-carbon and resource-efficient economy in 2050?
- What are the main policy goals and policy instruments for these policy domains, and how coherent are these? How are they connected to EU and global policies?
- Which stakeholders are involved and what are their positions, roles, power and relationships?
- Which arrangements are made to address policy coherence, synergies, trade-offs in practice?
- What success stories and failure factors can be distilled from experiences in this case?

Conclusion to the overall question

What is the role of biomass in the realization of a low-carbon and resource-efficient economy in the Netherlands in 2050?

There is a substantial policy role for biomass in the realization of a low-carbon and resource-efficient economy in the Netherlands in the future. Biomass is an essential part of the renewable energy mix because of its potential for significant CO_2 reductions against moderate costs. The use of biomass is very likely to increase over time (after 2030) with the target of 49% CO_2 reduction. Also the role of biomass in terms of importance will then increase as the use of biomass is important in both the energy sector and the higher end of the circular economy (cascading). Many of the high-end applications are likely to come from this growing bio-based economy. The Dutch government acknowledges the opportunities and importance of the bio-based economy for the Netherlands and it has a special bio-based policy programme. An increase in productivity in agriculture and forestry alone is not enough to increase the biomass supply. Conversion technologies, innovation, and acceptance of the public are important subjects that need attention as well. Although electricity can be made from wind and solar power, transport and industry (process industry) need biomass as well. Import of biomass will play a major role, but also domestic rest streams, solid bio-waste and new developments as seaweed from the North Sea. The role of biomass now is mainly substantial where other renewables are less suitable, as industrial heating, high value resources (chemical industry), the transport sector (shipping, aviation, trucks) and as back-up for the regular electricity production.

The PBL (2018) concludes that biomass indeed could be useful as energy for reducing CO2-emissions. It does not require major changes to the energy system, it is not complex, short term effects are achievable and the technology is relatively inexpensive. However, the future supply of biomass is uncertain and it is in particular unclear whether there will be biomass for other purposes than those that are seen as a priority, which is essentially where there are no sustainable alternatives. This means that biomass will not be available for cities, electricity, transportation of persons. The problem is that there is no international biomass market that comply with the Dutch sustainability criteria from the recent Energy Agreement. Strategies to enhance the domestic supply of biomass could then now become interesting.

What sectors and policy domains are important for the use of biomass in the Dutch transition towards a low-carbon and resource-efficient economy in 2050?

Biomass represents a very diverse 'sector' that involves many parts of the economy (and policy), such as waste, energy, food, feed, agriculture, land use, spatial planning, nature and water. Even other parts of the economy and policy are also important. The present framing of biomass as a part of the bio-based economy means that biomass is part of large portions of the economy. Of particular interest and importance are the energy sector and the chemical (high-end) sector. For the future, there are considerable uncertainties involved as it is not clear how much biomass will contribute to the greening of fuel, on land, water and air.

What are the main policy goals and policy instruments for these policy domains, and how coherent are these? How are they connected to EU and global policies?

The waste policy and biomass policy are very synergistic. When it comes to nature and agriculture, the policies seem coherent on the level of objectives, but the nature policy does not have any means to increase sustainable agricultural productivity and the agricultural policies' means to protect nature are not very effective. A nature inclusive agriculture is in the best interest of both sectors. To reduce the conflict between nature and agriculture it is good to focus on the synergies between the two of them and explore the possibilities for better integrated policies. Sustainable biomass production could play a role in such a process.

Coherence often at the level of policy-making – not policy practice

The results show a lot of synergies in comparison to only a few trade-offs. This is in line with what (International Council for Science 2016; McCormick and Kaberger 2007) found in their studies on policy interactions in the EU: policies are often coherent at the level of objectives and less at the implementation phase. This picture has been confirmed in this research. Being willing and able to tackle key barriers is pivotal to coherence between biomass/bio-energy, waste, agriculture, nature, food and spatial planning.

Biomass is seen as an important means for substituting carbon from fossil materials and it can be used for several non-food purposes. A challenge for the policy coherence is that biomass is used for both generating energy from biomass and also for higher value usage in the (chemical) industry. The concept of cascading is here the key concept. Bio-energy is one of the lowest value applications of biomass. Higher value applications of biomass are still in an early stadium of development but they are gaining interest with the focus on a bio-based economy. With more innovation this is likely to change over time. From an environmental point of view, the process of cascading is important and beneficial. But looking at the division of biomass sources in 2015 the category household and industrial waste forms more than one third of the total biomass production used for energy. Reducing waste means less waste that can be burned to get energy. Still, a relatively ambitious renewable energy target needs to be fulfilled soon of which bio-energy forms a substantial part.

Synergy between food and biomass

The objectives of food and biomass are mostly synergistic. This is because the government focuses on generating biomass from rest streams and not on the cultivation of energy crops. Regarding the Dutch biomass production, there are no biomass sources that can provide an oily basis for making fuels except pyrolysis. By importing these sources, problems of competition with food and indirect land use change are shifted to other countries. To prevent negative environmental impacts, the EU has imposed sustainability criteria on biofuel production in the Renewable Energy Directive in 2009. Critics pointed out that a potential policy failure lies in applying sustainability regulation to a single sector in a single region (e.g. Frank et al., 2013). The European Commission proposed in November 2016 a revised Renewable Energy Directive that includes updated sustainability criteria for solid and gaseous biomass and for biofuels used in transport and bioliquids. And the Dutch government states in Biomassa 2030 that the possibilities for one overarching sustainability framework for all resources (including biomass) is explored. In addition to that, efforts are made to create a European harmonized sustainability system for biomass. But most stakeholders argue that the sustainability criteria are not yet clear and also not-binding.

Agriculture, nature and biomass: more synergy potential

The agricultural policy does not focus much on biomass as its core business is producing food and not rest streams. The focus is however increasing, as illustrated by the stimulation of area coalitions between farmers, provinces and other regional partners to establish or make use of synergy between water management, agriculture, sustainable production of energy and nature. Both policy-makers and others are increasingly aware of potential synergies between different sectors. Many industrial and environmental actors argue that CAP could be used more actively to stimulate such synergy instead of focussing on hectares and production. This discussion is however very sensitive in a political way, as it might result in a CAP that is open for more actors than just farmers.

The objective of a sustainable increase in agricultural productivity in the nature policy is interesting as agriculture and nature often are in conflict with each other. At present, much attention is paid to the linkages between nature and agriculture. Using an economic language is becoming common with the language of natural capital, a nature inclusive economy and green entrepreneurship in the nature policy. But this is also rather a dilemma for policy, as it aims for both using the economic potential of nature as well as conserving nature, and many legal issues play a role (Broekmeyer et al. 2017). The potential conflicts between nature and agriculture is as such acknowledged in policy, but incorporating objectives of one sector in the other does not mean these conflicts are actually solved. For example the measures of the CAP, created to achieve the greening objectives, are not effective according to several studies (Solazzo et al. 2016; Westhoek et al. 2012). 'Biomassa 2030' states that 'there is a need for a focused policy to realize an increase in productivity of agriculture and forestry' (Ministry of Economic Affairs and Ministry of Infrastructure and the Environment 2015). Without a focused policy on increasing biomass supply, the supply is likely to remain on the lowest side of the range in available potential. In the policy documents about nature, there are clear objectives on increasing forestry productivity and exact numbers and ambitions on this are captured in "Action Plan Forest and Wood". In the agricultural policy documents, the objective to increase agricultural production sustainably is there, but no concrete measures for increasing productivity are present. In short, there are more opportunities for synergies between agriculture, nature, biomass and also water, a finding that is acknowledged both in policy (Biomass 2030) and research (Popp et al. 2014; Boosten et al. 2016).

Which stakeholders are involved and what are their positions, roles, power and relationships?

The Dutch way of policy-making is featured by extensive consultations among public actors and also public-private actors. As all relevant public and private actors are given access to the consultation it is clear that one can only work towards alliances for the achievement of influence. A trend in involvement is the development of more and more public-private partnerships for concrete projects. The Biomass Alliance is an illustrative example, as it is a temporary project organization focusing on new business models for biomass where the number of partners is growing. These partners can then team up in consultations with the government. The Cluster Bio Energy East Netherlands is another example: it is a cross-sector innovation cluster carried forward by enthusiasm. To illustrate the amount of organizations involved, the National Agreement on the Circular Economy has been signed by 180 organizations.

Which arrangements are made to address policy coherence, synergies, trade-offs in practice?

Since 2011, a series of arrangements have been set up to address coherence, synergies, trade-offs in the biomass practice. The 2011 arrangement to identify conflicting interests and how to deal with these in the bio-based economy (including biomass) was important to establish insights into the problems faced by stakeholders and what the government could do or not do regarding these problems. The business community could for instance claim that rules were too strict and the government could then explain why some rules would not be loosened up for, say, safety reasons, and others were out of the government's reach, as they concerned market issues for business to handle. However, many obstacles were also solved, as slow procedures and complex administration, or new more suitable legal definitions. It also led to new arrangements. The Transition House offered a way to ventilate business challenges, the Front Runners Office improved innovation ideas, the Acceleration Team Green Gas from 2013 worked on better procedures and licenses. Market parties could with these arrangements signal issues to the Program Department (*Programmadirectie*) Biobased Economy. This has led to shorter procedures and improvements in the Investment Subsidy SDE+. In 2016 an Energy Dialogue started for sharing views further and more direct on energy issues. More consultation followed in the run-up to the National Agreement on the Circular Economy. This also led to a Transition Agenda Circular Economy and after additional consultations and negotiations, the new Cabinet response to the climate challenges in 2018.

In general, the Dutch government has been engaged in a lengthy multi-stakeholder approach to tackle many of the Nexus-issues we cover here.

What success stories and failure factors can be distilled from experiences in this case?

One of the success factors in the Netherlands has been the (inter)active and ongoing dialogue between public and private stakeholders. Such a dialogue fits the (policy) culture where it is common to share both problems and opportunities in a direct way. Besides, the Netherlands has favourable conditions for bio-based investments because of its strategic location with big harbours, a good infrastructure, high quality knowledge institutions, a well-educated population and strong agricultural, chemical and energy sectors. Innovation is seen as a key factor, and both public and private parties aim to invest both at the national and international level. Another success factor is the willingness to stimulate investments through public programmes for research, investments and business development for the short and long term. We should also mention the partnerships on cross-sector innovations carried forward by enthusiasm as a success factor. We have mentioned an example as the Cluster Bio Energy East Netherlands.

With the strategy plan Biomass 2030 the government bundles much of the public aims, opportunities and stakeholder interaction into a joint framework regarding the biomass supply and/or production. The term 'optimizing' captures much of the approach of the government for an increase in biomass supply: objectives such as optimizing generation of biomass from rest streams and optimizing closed resource loops form important parts of the policy on increasing biomass production. Furthermore, the objectives about increasing agricultural productivity, increasing forestry productivity, development of aquatic biomass and use of degraded soils were not specifically focused on implementation on national scale, but also on implementation on European and global scale. The concrete success stories in chapter 5 are mostly about partnerships working on joint management for (using) new technologies or developing new business models.

When it comes to failure, stakeholders argue that the negative image of bio-energy is considered to be hampering the development of bio-energy projects. Although a strategy document such as Biomassa 2030 clearly explains why it is worth investing and stimulating bio-energy, with all its positive and negative impacts. However, such a document has a limited reach and it is not enough to change the image of biomass. The sector is very diverse if not fragmented, and partly because of that, many stakeholders also finds the policy to be fragmented. They also report too much administrative red tape as a problem. In addition they tend to view the ambitions for a national supply of biomass for energy as not clearly expressed in the Dutch policies. An underlying factor is also the inability to establish a level playing field. A lack of clear sustainability criteria is often seen as a major factor.

6.2 Policy recommendations

A long-term vision for innovation and research is necessary to stimulate the role of biomass and the transition to a low-carbon economy. Many concrete suggestions are being made and should be followed up, and not only focus on the effect of CO_2 but also on the other even more harmful greenhouse gas, i.e. methane. Generating energy from manure could for instance have a win-win potential. Animal agriculture, nonetheless, is in general a very resource inefficient and polluting type of agriculture. More and continued focus on competition for land for feed and bio-energy purposes is also necessary, as it is not only one of the global problems but also a national, regional, local and personal problem for many. Development of the human diet is also an important and multi-scale influencing factor on the development of biomass for energy. There are now almost no policy measures trying to limit the consumption and production of meat and dairy. For a country famous for its cheese and cows this is, however, a very controversial and sensitive topic, even more sensitive than bio-energy. Policy interventions such as a meat tax is likely to cause strong opposition of the public.

This research studied the biomass supply in the Netherlands. The policy documents and the stakeholder interviews mentioned that it is important that biomass is only used for certain applications in which there is no alternative, such as heavy transport and high warmth processing in the industrial sector. Via the investment programme SDE+, however, also other applications and forms of biomass are supported. Further research is necessary to find out to what extent biomass is used in applications for which there are other renewable options and how the transition to the utilization of biomass in applications for which there are no alternatives can be stimulated.

The policy analysis showed that there are no severe trade-offs or barriers on national level that obstruct the intensification of the biomass production in the Netherlands. An increase in agricultural productivity is involved in almost all of the conflicts. These trade-offs vary between constraining and counteracting. The most significant dilemma touched upon in this study is the need for an increase in productivity of agricultural land for a number of purposes on one hand and the aim for reducing emissions and nature and ecosystem preservation on the other.

Although the policies at the level of objectives are mostly synergistic, the potential of biomass in the Netherlands has not been fully exploited yet. The question in this case should not be any longer whether the policies are coherent enough to realize an increase in biomass supply in the Netherlands, but if the policy means are effective enough. Stakeholders indicated that innovations need an extra financial boost and that the image of bio-energy slows things down because possible investors are insecure and citizens protest against new local bio-energy initiatives. Furthermore, the laws and regulations around investments in bio-energy and setting up projects are still frustrating the development of biomass projects in the Netherlands.

The Netherlands will always have to import biomass for energy purposes, since national supply cannot keep up with the demand. Importing biomass can have negative consequences on the environment in the countries where it is produced if the production is not done sustainably. Import also has a negative impact on the public opinion as many do not trust the sustainability of the biomass sources. To be able to consider bio-energy as a sustainable form of renewable energy, stringent sustainability criteria need to be pursued to prevent negative environmental impacts and to realize a significant CO_2 emission reduction. A dialogue with critical voices from academia and NGOs would enrich the policy.

Explaining the details about bio-energy more explicitly on the website might already improve the image and reputation of biomass that is dominating the current societal debate

6.3 Limitations of the study

A policy analysis takes a snapshot of a specific moment in time. To increase the relevance of this study, prospect documents for pathways for the future have been used in the analysis. “Policies have generally unpredictable, uncertain, contextual and contingent impacts at various spatial/organizational levels, frequently, giving rise to undesirable 'surprises' in both the short and the long run or proving to be perverse” (Briassoulis 2004). Policies can have other outcomes in the implementation phase than initially expected. The fact that the government has certain ambitions or goals (objectives), does not mean this will and can be reached if they do not use the right measures for achieving them.

Although this research tried to give a comprehensive overview of policy sectors related to biomass production, some things may have been overlooked. The policy documents have been read and searched several times to reduce this risk. Furthermore, the selection of objectives for the scoring assessment is subjective. The criteria established beforehand on being tangible and being related to biomass still leave room for subjective interpretation. In some cases an objective was picked that eventually did not interact with the biomass objectives.

The scoring system introduced by International Council for Science was something relatively new with little empirical applications, which proved at times difficult to apply (International Council for Science 2016). For example, during the analysis it was found that objectives that have two or more different components are impossible to score because of their ambiguous meaning. This was solved by simply dividing the objective into two or leaving a less relevant component out of it. The scoring is a subjective process in which the researcher decided the score. To minimize bias, some scores were checked by colleagues/experts.

In the scoring assessment only direct interactions were identified. What is important when looking at direct interactions is not forget the bigger picture. Innovation and knowledge awareness might not have direct effects on things, but are crucial processes in the development of biomass and bio-energy supply in the Netherlands.

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Annex: Glossary on definitions

Glossary of definitions

Definition	Description
Policy goals	Policy goals are the basic aims and expectations that governments have when deciding to pursue some course of actions. They can range from abstract general goals (e.g. attaining sustainable development) to a set of less abstract objectives (e.g. increase energy efficiency) which may then be concretized in a set of specific targets and measures (e.g. achieve 10% renewable energy share).
Policy means	Policy means are the techniques/mechanisms/tools that governments use to attain policy goals. Similar to goals, means range from highly abstract preferences for specific forms of policy implementation (e.g. preference for the use of market instruments to attain policy goals); to more concrete governing tools (e.g. regulation, information campaigns, subsidies); to specific decisions/ measures about how those tools should be calibrated in practice to achieve policy targets (e.g. a specific level of subsidy in the renewable energy sector).
Policy process/ policy cycle	the policy process, often referred to as policy-cycle, is a set of interrelated stages through which policy issues and deliberations flow from inputs (problems) to outputs (policies). A typical model of the policy process includes: *agenda-setting* (problem recognition by the government); *policy formulation* (proposal for solution in the government); *decision-making* (process of selection of solution); *policy implementation* (how government puts solution into effect); *policy evaluation* (monitoring results, which may lead to reconceptualization of problems and solutions).
Policy interactions	Cause-effect relationship between policies and occurs when the content of one policy (goals, means, implementation practices) influences the performance of another policy such as the achievement of its objectives or the implementation of its instruments. Type of interactions between policy objectives:
	• Cancelling: Progress in one objective makes it impossible to reach another objective and possibly leads to a deteriorating state of the second. A choice has to be made between the two (trade-off). • Counter-acting: The pursuit of one objective counteracts another objective. • Constraining: The pursuit of one objective sets a condition or a constraint on the achievement of another objective. • Consistent: There is no significant interaction between two objectives. • Enabling: The pursuit of one objective enables the achievement of another objective. • Reinforcing: One objective directly creates conditions that lead to the achievement of another objective. • Indivisible: One objective is inextricably linked to the achievement of another objective.
Policy conflict and related trade-offs	Policy conflicts manifest when goals and instruments of one policy are in contrast with goals and instruments of another policy. When conflicts arise, choices should be made about the related *trade-offs.* This implies choosing to reduce or postpone one or more desirable outcomes in exchange for increasing or obtaining other desirable outcomes in return. This choice requires political compromise.

Definition	Description
Policy synergies	Policy synergies manifest when the combined efforts of two or more policies can accomplish more than the sum of the results of each single policy separately. Policies reinforce each other.
Policy coherence	An attribute of policy referring to the systematic effort to reduce conflicts and promote synergies within and across individual policy areas at different administrative/spatial scales.
Nexus as analytical approach	A systematic process of inquiry that explicitly accounts for water, land, energy, food and climate interactions in both quantitative and qualitative terms with the aim of better understanding their relationships and providing more integrated knowledge for planning and decision making in these domains.
Nexus as governance approach	As governance approach, the WLEFC-nexus approach provides guidance for policy decisions through an explicit focus on interactions between water, land, energy, food and climate policy goals and instruments in order to enhance cross-sectoral collaboration and policy coherence, and ultimately promote resource efficiency and the transition to a low carbon economy.
Nexus as a discourse	As emerging discourse, the WLEFC-nexus approach emphasizes the synergies, conflicts and related trade-offs emerging from the water, land, energy, food and climate interactions at bio-physical, socio-economic, and policy and governance level, and encourages agents to cross their sectoral and disciplinary boundaries.
Nexus approach	A systematic process of scientific investigation and design of coherent policy goals and instruments that focuses on synergies, conflicts and related trade-offs emerging in the interactions between water, land, energy, food and climate at bio-physical, socio-economic, and governance level
Nexus Critical Objective (NCO)	It is the policy objective that shows high (potentially the highest) number of interactions with other objectives in the WLEFC-nexus (issue density) and that is most relevant to achieve resource efficiency and low carbon economy in Europe in the long-term.
Nexus Critical System (NCS) or hotspot	A nexus critical system includes a nexus critical objective and the policy objectives that directly interact with it (meaning only first order interactions) as well as the policy means for the achievement of the NCO and of the other objectives directly interacting with it. It is the node in the WLEFC-nexus with a high density of interactions, where trade-offs and synergies are likely to coexist, and for which an integrated approach for the identification of nexus compliant solutions is required.
Nexus compliant solutions	Nexus compliant solutions and policies are those managing trade-offs and exploiting synergies.
Serious Gaming	Serious gaming is a method for exploring high-stake problems in which key uncertainties depend on people's choices and actions. The main purpose is education and training where users' learning goals are established. Serious games are experimental, rule-based, interactive environments, where players learn by taking actions and by experiencing their effects through feed- back mechanisms that are deliberately built into and around the game. Serious games can be computer based.

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Policy Analysis

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Contents

Executive Summary

This document gives an overview of the investigated nexus sectors and key research questions in the Swedish case study (Figure 1). It reports on the mapping of the nexus-related policy space in Sweden, mainly focusing on policy priorities, goals and means concerning the nexus components land (in particular forest land), water, energy (mainly from forest biomass) and climate. For each component, the socio-economic context is described using indicators, graphs and statistical data. The report further includes a sector-wise summary of stakeholder power and interest on decision-making, and highlights the key actors to be mobilized in the Swedish case study.

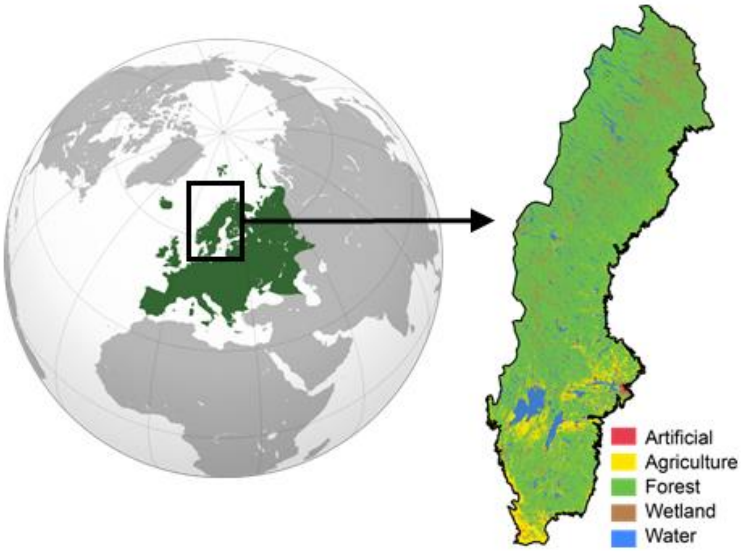


Figure 1: Sweden's geographic location and different land cover types.

1 Introduction

1.1 Case Study Description

Sweden is a country in northern Europe (Figure 1) bordered by Norway in the west, the North Sea in the southwest, the Baltic Sea in the east and Finland in the northeast. Sweden is well known for being a heavily forested country with uncounted lakes and rivers. It is perhaps not surprising that forestry and forest products are of great importance to the national economy. In addition, more than half of Sweden's electricity is generated from renewable sources such as hydropower and forest biofuels. However, changing climate conditions are expected to heavily affect both water resources, forest ecosystems and their interlinkages. Forests depend on water, but have, at the same time, the potential to regulate water availability and quality. On top of that, both forest and water resources directly control the available potential to generate electricity from forest biofuels or hydropower. These interactions of forest, water, climate change, and bioenergy (Figure 2) as an overarching issue promise to be of crucial importance in future years.

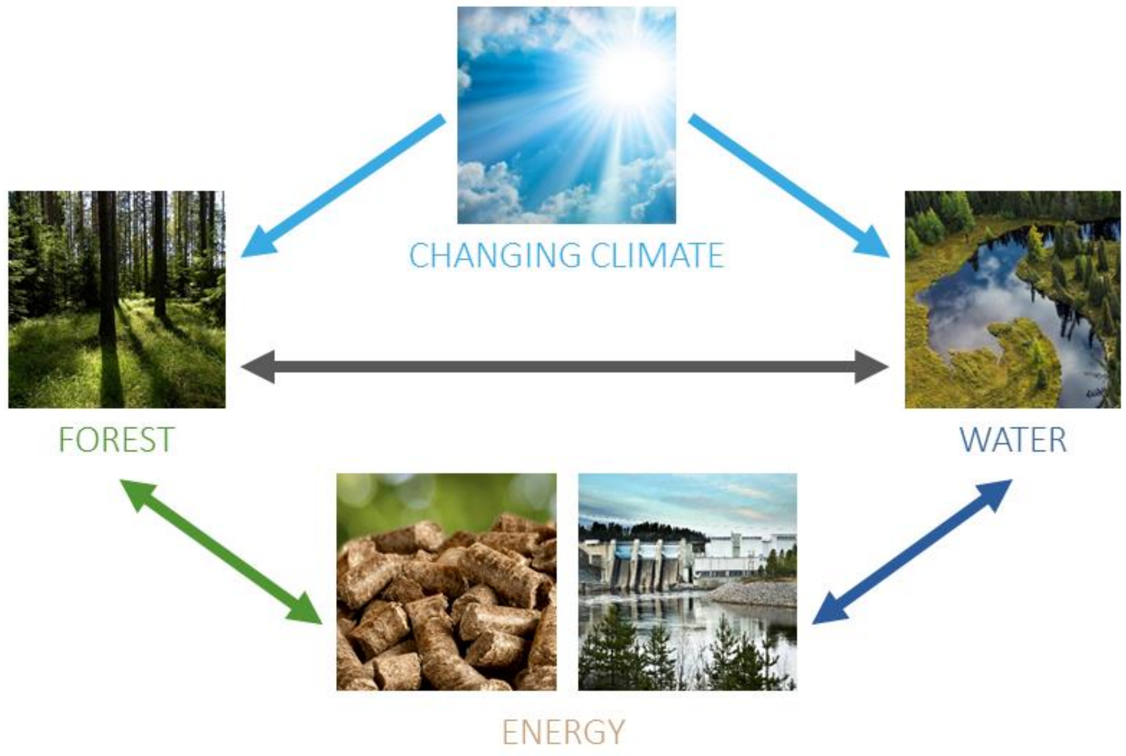


Figure 2: Overview of the forest-water-energy interconnections under changing climate conditions in the Swedish case study.

Sweden currently has two major initiatives of interest to these nexus sectors: (1) ***The Generation Goal*** and (2) ***The Environmental Objectives*** (Swedish Environmental Protection Agency, 2017).

The ***generational goal*** – the overall goal of Swedish environmental policy – defines the direction of the changes in society that need to occur within one generation if the country's environmental quality objectives are to be achieved. One of its targets is to increase the share of renewable energy and use energy efficiently with minimal impact on the environment. This goal is already achieved (Swedish Environmental Protection Agency, 2017), because Sweden managed to reach its goal of a 50 per cent renewable energy share several years ahead of the Swedish government's 2020 schedule, in 2012. Swedish bioenergy use has grown from 40 TWh/year in the 1970s to around 140 TWh in 2012 (Andersson, 2012). Bioenergy was the leading factor in Sweden's 9 percent decrease in greenhouse gases between 1990 and 2010, while gross national product increased by 50 percent. According to Andersson (2012), bioenergy's success also rests on the long-standing tradition of using natural forest resources while also protecting and developing them. Sweden's total forest stock has increased each year despite the rapid expansion in biomass use for energy.

The sixteen ***environmental quality objectives*** describe the state of the Swedish environment which environmental action is to result in. These objectives are to be met within one generation, i.e. by 2020 (2050 in the case of the climate objective). Objectives related to the forest and water sectors include:

- Reduced Climate Impacts (to be met by 2050)
- Flourishing Lakes and Streams (to be met by 2020)
- Good-Quality Groundwater (to be met by 2020)
- Sustainable Forests (to be met by 2020)

According to present forecasts (Swedish Environmental Protection Agency, 2017), these environmental objectives will not be met in time. In fact, the objectives of reducing climate impacts even shows a negative trend in the state of the environment, because greenhouse gas emissions are still rising. This clearly shows that the current environmental initiatives are not sufficient to achieve society's agreed environmental objectives for water and forests. For example, about three quarters of the largest river systems are affected by fragmentation from water regulation causing negative ecological consequences. In addition, the growing demand for bioenergy has led to an intensification of the forest industry through extensions of managed forest land, introduction of fast-growing tree species, increasing use of fertilization and increasing felling rates. The effects of such new management strategies for increased biomass production on forest species, soil resources and water quality at landscape scales are, however, not well understood and not addressed adequately. In addition, Sweden is at the time of writing facing recurring problems of declining groundwater levels causing an increased risks for forest fires, drinking water shortages and low water levels. This has triggered a new debate on the forest cover - water yield relationship (i.e., on whether trees 'use' or 'supply' water), which is attracting increasing attention in Swedish media.

These issues will be addressed by the Swedish case study. Together with stakeholders, the question as to whether the goal of becoming a fossil-free nation interferes with some of the national environmental objectives will be discussed.

1.2 Nexus Sectors Investigated

1.2.1 Climate Sector

Temperature and precipitation are projected to increase more in high-latitude regions such as Sweden than in the rest of Europe (IPCC, 2014; Jacob et al., 2014). By the end of this century the annual average temperature is projected to be 2-6 °C higher than for the period 1961-1990, while the average annual precipitation is projected to increase by 10-40% (Sjökvist et al., 2015). Extreme short-term precipitation events (in particular short torrential showers) are projected to become more intensive (Sjökvist et al., 2015). Due to the fact that high-latitude ecosystems have adapted to low natural energy flows, they are relatively more sensitive to a given shift in climate, physical and biogeochemical conditions, which could intensify regional and seasonal environmental responses (Roots, 1989).

To enhance the preparedness and capacity to respond to such climate change impacts, the EU Adaptation Strategy (European Commission, 2013) aims to make Europe more climate resilient. The strategy stresses that many economic sectors, including forestry, are directly dependent on climatic conditions and are already facing the consequences of a changing climate. Challenges are related to both physical climate impacts and mutual dependencies across environmental systems, as well as to policy failures and knowledge gaps. Adaptation strategies are seen as the most effective instrument when assessing impacts, vulnerability and adaptation options and thus to face the projected impacts of climate change across sectors.

1.2.2 Landuse Sector (Forests)

Within the boreal region, Fennoscandia represents an extreme in terms of the degree and extent to which landscape dynamics are influenced by land management (Gauthier et al., 2015). For example, more than two thirds of Sweden are currently covered by forests, of which the majority is subject to forestry (SLU, 2015). The country has a long history of using its natural forest resources, while also protecting and developing them (Andersson, 2012). Total forest industry output was approximately 23 billion Euros in 2011 (Skogsstyrelsen, 2014), while the export value of forestry and the forest products industry was 13 billion Euros. The total number of employees in large-scale forestry has declined significantly in recent years, while, at the same time, the role of forest entrepreneurs (and their employees) has become increasingly important (Skogsstyrelsen, 2014).

Forests play an important role in terms of diverse and multifunctional benefits to people in Sweden. In addition to the economic output that is generated by the forestry sector, forests also deliver social and environmental functions. For instance, forests support biodiversity, provide opportunities for recreational activities (‘freedom to roam’, which is a general public right codified in law), allow for mushroom and berry picking, sequester atmospheric carbon, improve air quality, and regulate water quantity and quality.

Forestry in Sweden is currently regulated by the 1993 Forestry Act (The Swedish Parliament, 1993), which states that “the forest is a national resource”, which “shall be managed in such a way as to provide a valuable yield and at the same time preserve biodiversity”.

The forestry sector is subject to alterations in the light of developments in energy, governance and landuse systems, climate politics, and taking account of an increasing competition between economic, environmental and recreational functions (Sandström et al., 2011). The growing demand for bioenergy has led to an intensification of the forest industry (Helmisaari et al., 2014), in particular through extensions of managed forest land, introduction of fast-growing tree species and increasing use of fertilization (Rytter et al., 2013). In the future, more intense forestry practises require technological and logistical improvements to render an economically sustainable production and to reduce the negative effects on our environment (de Jong et al., 2014).

1.2.3 Water Sector

1.2.3.1 Quantity: Hydrological Regimes

Swedish hydrological regimes (Figure 3) are generally characterized by rather low winter streamflow with a dominating snowmelt-driven spring flood peak (mainly in central and northern Sweden), followed by low summer flows and/or a somewhat lower precipitation-induced flood peak in the fall (mainly in southern Sweden). In a future climate, however, streamflow is projected to change to a more even regime with dominating large winter streamflow and no spring flood peak at all (Arheimer and Lindström, 2015; Donnelly et al., 2013; Teutschbein et al., 2011, 2015). Annual water availability in general is expected to increase as a result of increasing precipitation. There are, however, large seasonal variations: especially during summer months, water availability is likely to decline as a results of increasing evaporation rates in large parts of the country (Eklund et al., 2015). In southern Sweden, water shortages during summer increasingly affect the drinking water supply, both in terms of quality and quantity.

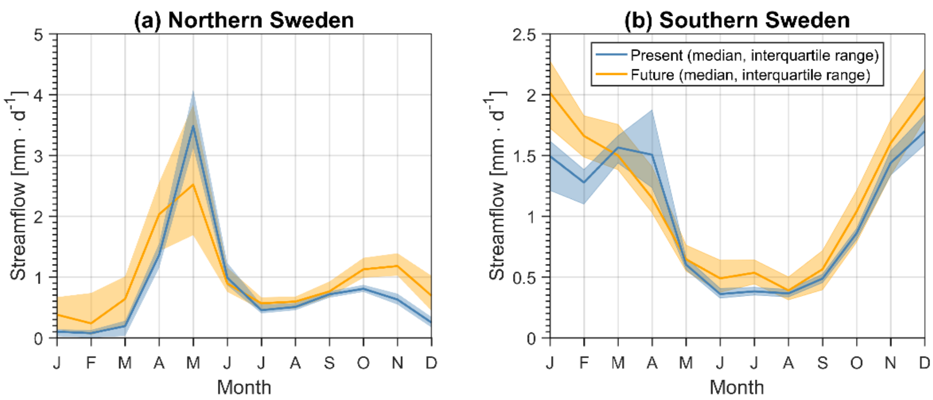


Figure 3: Projected changes in hydrologic regimes representative for (a) northern Sweden and (b) southern Sweden.

To achieve good quantitative status of surface water bodies including streams, the Water Framework Directive (European Parliament and Council of the European Communities, 2000) established a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater.

1.2.3.2 Extreme Events: Floods & Droughts

Hydrological extreme events, which are defined by the departure of surface and subsurface water supplies from average conditions at various points in time (WMO, 2006), can cause severe habitat damage, problems for agriculture, forestry, industry, building infrastructure, energy production and water supply (Swedish Commission on Climate and Vulnerability, 2007). In Sweden, past changes in climate and land cover have had a major impact on streamflow patterns (Destouni et al., 2013). In a changing climate, shifts in meteorological conditions are expected to even further perturb regional hydrology, and thereby also the occurrence, frequency and duration of both floods and droughts. In fact, climate models project that extreme floods are expected to occur less often in northern inland Sweden and the northern coastal areas, while most the rest of the country is likely to suffer from more common extreme floods in a future climate (Eklund et al., 2015). Concurrently, more days with low river flows (i.e., hydrological droughts) are expected in southern and central Sweden.

Although Sweden has historically been a region abound with water, it is not exempt of droughts: the 2003 summer drought severely impacted the European continent, including Scandinavia (NVO, 2011). There was, however, large spatial variability in hydro-climatic patterns across the country, which indicates the complex interplay of meteorological and topographic features and the resulting hydrological impacts at the catchment scale. Events such as the European-wide 2003 drought could become more frequent in coming decades, and, thus, the early recognition of critical drought conditions is essential for drought risk management with large economic and social benefits. Yet, most available hydrological climate change impact studies concerning Sweden neglect hydrological droughts. To make matters even more concerning, interviews among Swedish municipalities and drinking water producers revealed that only 12% specifically considered potential effects of droughts on drinking water in their risk assessment (Norén et al., in preparation). Thus, there is now an urgent need to estimate water availability in a changing climate and a developing society.

Mitigating the effects of floods and droughts are addressed both in the Water Framework Directive (European Parliament and Council of the European Communities, 2000) and the Floods Directive (European Parliament and Council of the European Union, 2007).

1.2.3.3 Quality: Nutrient Loads

Multiple ongoing global changes have reshaped the pools and fluxes of biogeochemical elements in terrestrial and aquatic ecosystems. Of these, dramatic increases in the loading of bioreactive nitrogen (N) and phosphorus (P) to terrestrial ecosystems during the 20th century have drawn particular attention (Galloway et al., 2008) and are linked to multiple environmental problems, ranging from declines in species diversity to stratospheric ozone loss (Gruber and Galloway, 2008). Large quantities of anthropogenically mobilized N and P are also flushed from land to water (Seitzinger et al., 2005), contributing to freshwater and marine eutrophication (Bouwman et al., 2013; Conley et al., 2009), and connecting mounting water quality concerns to hydrological patterns that are themselves sensitive to climate drivers (IPCC, 2014). Concurrent to these global changes, warming temperatures, longer growing seasons, and rising atmospheric CO_2 concentrations may lead to increased plant growth (Richardson et al., 2010), greater nutrient uptake and accumulation in terrestrial ecosystems (Luo et al., 2004), and reduced nutrient losses to surface waters in some cases (Lucas et al., 2016).

The Water Framework Directive (European Parliament and Council of the European Communities, 2000) aims at enhancing the status of aquatic ecosystems and reducing discharges/emissions/losses of priority substances. Surface water and groundwater bodies are further protected from pollution by the Nitrates Directive (Council of the European Communities, 1991b), the Urban Waste Water Directive (Council of the European Communities, 1991a) and the Groundwater Directive (European Parliament and Council of the European Union, 2006).

1.2.4 Energy Sector

Sweden's total energy supply in 2015 was 557 GWh. The most important energy sources (Figure 4) are nuclear fuel (33 %), crude oil and petroleum products (24%), biofuels (23%) and hydropower (12%). For the past decades, Sweden has invested heavily in alternative energy sources and is now in the front line of renewable energy use. The interaction between abundant natural resources, high oil prices, public concern for the environment, broad policy support, and strong incentives led to a transformation of Sweden's oil-dependent energy system (Andersson, 2012). Despite a large per capita energy consumption, Sweden's economy is today one of the least dependent on fossil fuels and has one of the lowest carbon emission rates. Thus, Sweden has set a model in terms of a resource-efficient and low-carbon economy that much of the world could emulate.

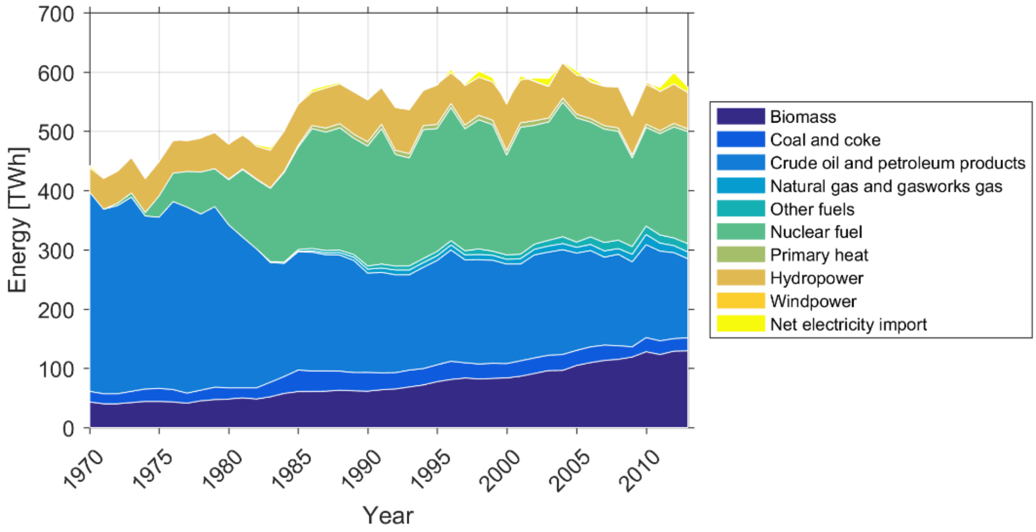


Figure 4: Total energy supply by energy commodity 1970-2013 based on data provided by Statistics Sweden.

The energy sector is targeted in the Europe 2020 strategy (European Commission, 2010) and the Swedish 2020 Climate and Energy Goals (The Swedish Parliament, 2006), which both set out targets for reducing greenhouse gas emissions, increasing shares of renewable energy and improving in energy efficiency (Table 1).

Table 1: Overview of European and Swedish climate and energy targets

	Sweden 2020	Europe 2020	Europe 2030
Reductions in Greenhouse Gas Emissions	40%	20%	40%
Share of Renewable Energy	50%	20%	27%
Improvements in Energy Efficiency	20%	20%	27%

1.2.4.1 Biofuels

Biofuels play a major role in industry, district heating, and to an increasing degree also in electricity production and transport (Figure 5). Biofuel is a collective term for several different types of fuels, including densified and undensified wood fuels, black liquor, biofuels from agriculture, combustible waster, bioethanol, biodiesel and biogas. The biofuel market in Sweden is presently growing at a rate of 3 TWh per year, which equals 1.5×10^6 m3 of wood (de Jong et al., 2014). At present, the two leading biofuel sources are undensified wood (41%) and black liquor (33%), followed by densified wood (8%) and municipal waste-bio (7%). The increasing use of biofuels for electricity and heat production has caused a rising demand for wood fuels (Energimyndigheten, 2016), which has been satisfied through increased extraction of forest biofuels (de Jong et al., 2014). The market is expected to grow further in the near future (Energimyndigheten, 2013) and the supply of forest biomass for energy could potentially increase by 70% (Andersson, 2012).

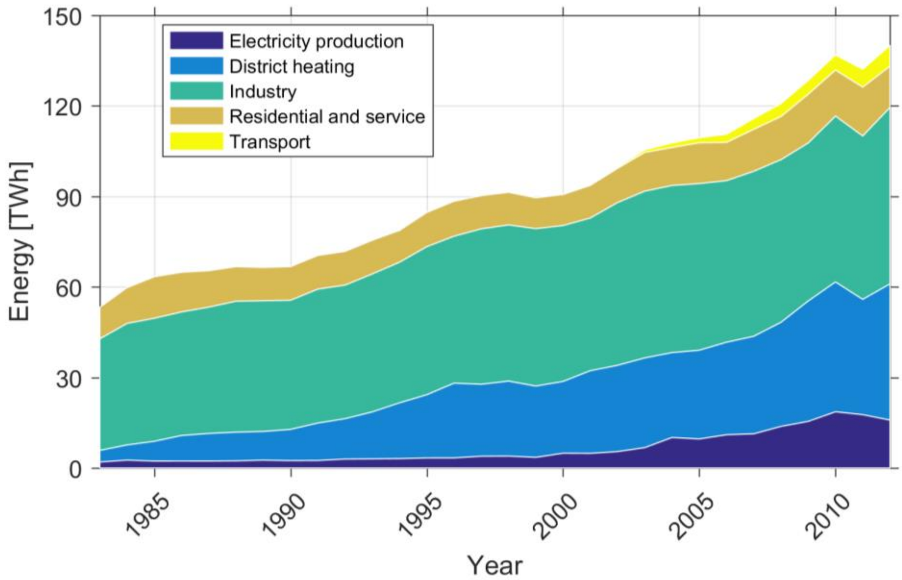


Figure 5: Use of biofuels, waste and peat by sector 1983–2012

1.2.4.2 Hydropower

Sweden is the largest hydropower producer in the EU and the tenth biggest in the world, generating on average 67 TWh of electricity per year. Most hydropower is produced in northern Sweden. The annual hydropower output varies depending on seasonal precipitation: during the past 15 years, hydroelectric output varied from 53 TWh in 2003 (European summer drought) to 79 TWh in 2000 (particularly wet year). Swedish hydropower provides a valuable source of renewable energy and is able to balance the national electricity grid (Rudberg, 2013). However, about three quarters of the largest river systems are affected by fragmentation from water regulation (Rudberg, 2013), causing negative ecological consequences. Swedish law prohibits hydropower constructions in four of the biggest streams and a number of smaller rivers, and, thus, limits further expansion of hydropower.

1.3 Key Research Questions

1.3.1 Landuse Sector (Forests)

In the future, the extended growing season that arises from warmer temperatures, in particular in the North, means that some areas will become increasingly available and attractive to forestry. This warming might also imply a shift in vegetation types and a shortening of the presently rather long rotation periods of typical boreal forests. Consequently, one of the key questions is whether the extraction of forest biomass can be further increased in the future without negative consequences for other forest functions and for water availability/quality. Typical forestry practices have an impact on soil, water, climate and biodiversity (de Jong et al., 2014) and, thus, a main challenge is to manage trade-offs between economic, environmental and recreational functions (Sandström et al., 2011).

1.3.2 Water Sector

In southern Sweden, water shortages during summer increasingly affect the drinking water supply, both in terms of quality and quantity. Increasing temperatures, shifts in seasonality and more streamflow (especially during winter) are likely to cause higher nutrient loads in Swedish boreal streams (Teutschbein et al., 2017). In addition, a continued intensification of the forest industry (Helmisaari et al., 2014), in particular extensions of managed forest land and increasing use of fertilization (Rytter et al., 2013), may increase the risk of nutrients leaching from watersheds

(Sponseller et al., 2016). Consequently, key research questions in the water sector relate to how future climate change, streamflow shifts and changing forestry practices might affect (drinking) water availability and quality.

1.3.3 Energy Sector

As the market for biofuels further grows, the question arises as to whether the supply of forest biomass for energy can further be increased. The competition between forests, water and energy resources is further intensified by changing climate conditions. Knowledge gaps and considerable uncertainties on how environmental systems will change and on their impacts are major challenges. In addition, large uncertainties remain in terms of the effect of future seasonal shifts in water availability (e.g., more streamflow during winter, but expected longer drought period during summer) on hydropower, which highlights the need for further research.

2 Socio-Economic Context

2.1 Landuse Sector (Forests)

Relevant socio-economic indicators in the forestry sector include:

- Standing tree volume in Swedish productive forests
- Tree dry weight biomass for growing stock
- Volume of hard dead wood
- Number of people employed in the forestry sector
- Value of forest sector production and export

In the past decades, ***standing tree volume*** (Figure 6a) and ***tree dry weight biomass for growing stock*** (Figure 6b) have increased, despite a rapidly increasing felling rate (SLU, 2016).

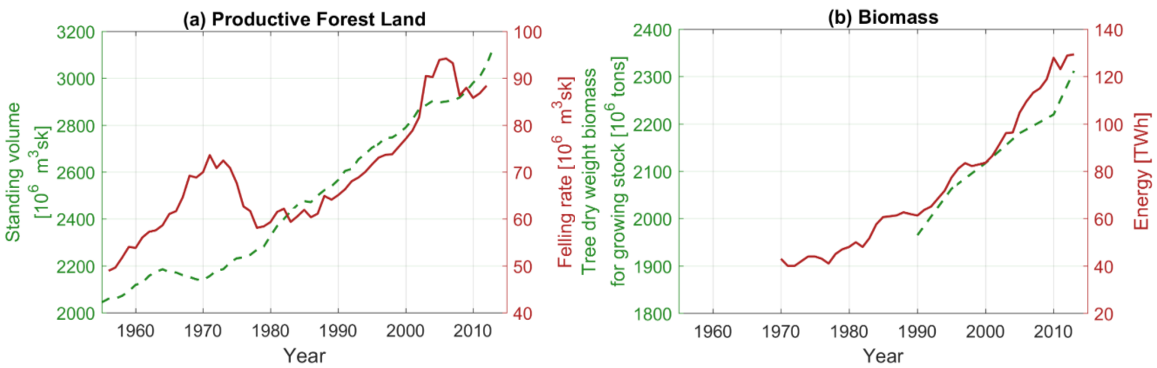


Figure 6: Swedish forest statistics including annual standing volume and felling rates for the productive forest land (a) and tree dry weight biomass for growing stock and energy produced by biomass (b) based on data provided by SLU (2016) and Energimyndigheten (2016).

The ***volume of hard dead wood*** per hectare on productive forest land has increased steadily since the late 1990's (Figure 7). It is considered as an indicator for the degree of environmental consideration in conjunction with felling.

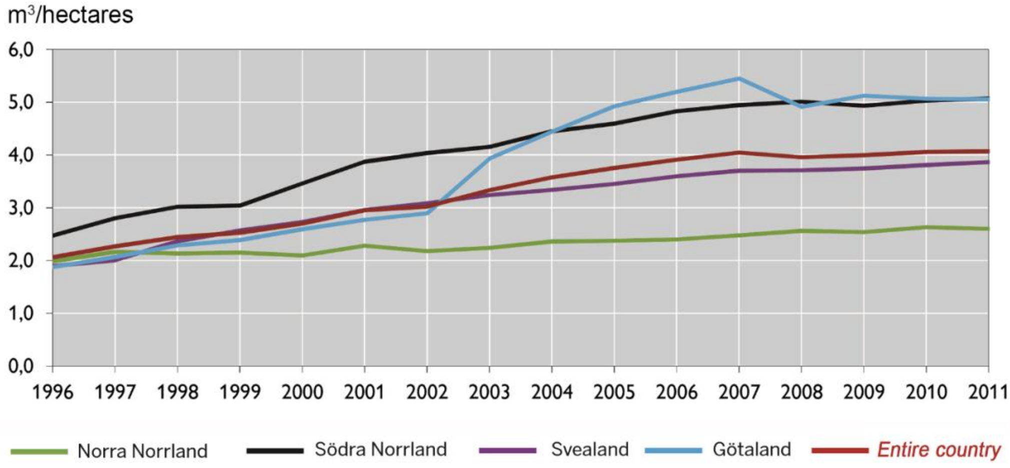


Figure 7: Volume of hard dead wood on productive forest land for different regions and the entire country based on a 5-year moving average. Figure modified from SLU (2015).

The ***number of people employed in the forestry sector*** has decreased considerably during the 1980's and 90's (Figure 8). Since 2000, the total number of employments in the sector have been stable at a level of roughly 15,000-16,000 annual work units.

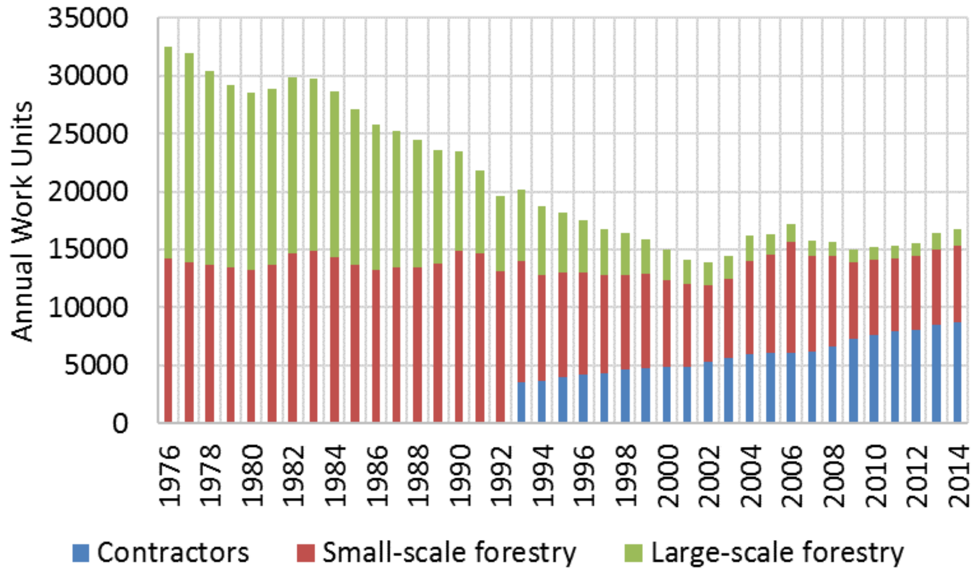


Figure 8: Swedish employment statistics in the forest industry for the period 1975-2015 shown in annual work units based on a 3-year moving average.

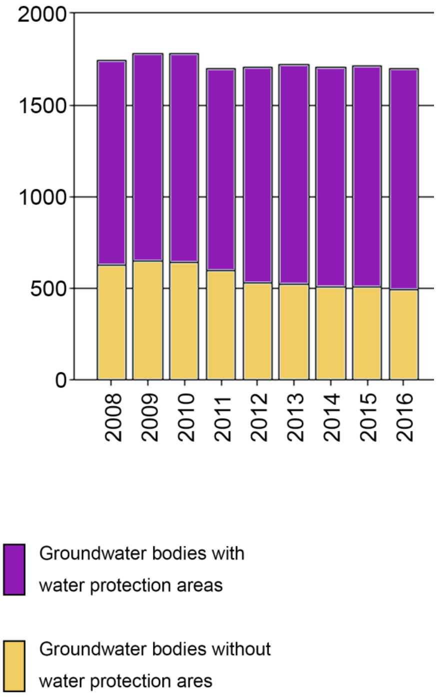


Figure 11: Comparison of the

The ***values of forest industry production and export*** have increased over time since the year 2000 (Figure 9). The gross output (i.e., production value) has increased by roughly 22%, while export values have increased by 19%.

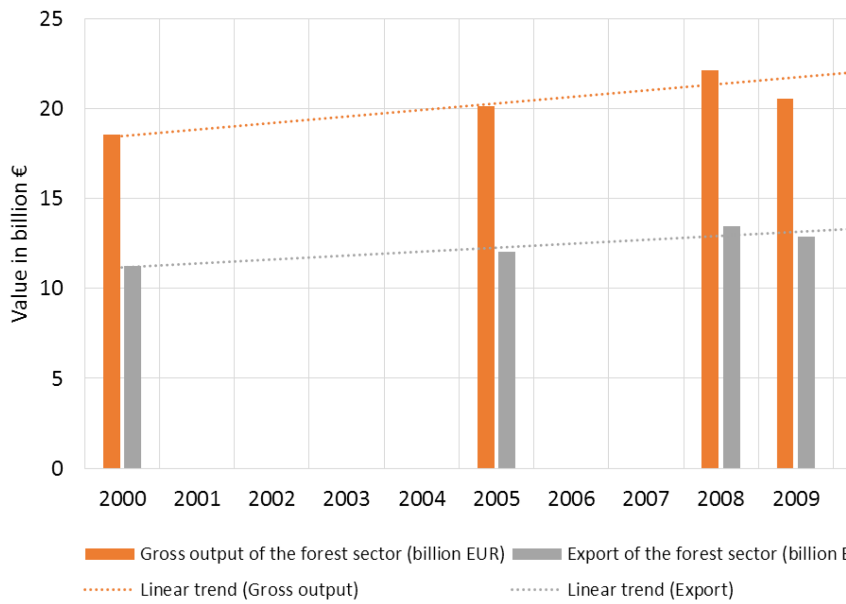


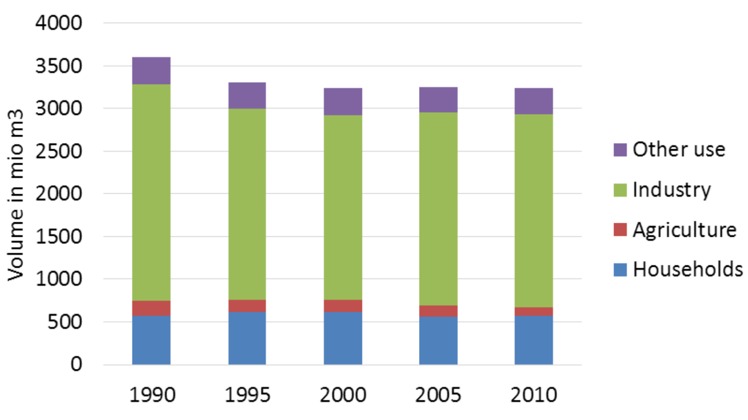
Figure 9: Comparison of gross output (orange) and export (gray) of the forest sector in billion Euros.

2.2 Water Sector

Relevant socio-economic indicators in the water sector include:

- Water use per sector
- Protected freshwater areas
- Water withdrawals
- Risk for floods (and droughts)

Water use per sector decreased slightly in the early 1990's and remained since then relatively constant over the past two decades (Figure 10). In the future, it might be possible that an increasing population leads to higher water use.



More than two thirds of municipal groundwater bodies have ***water protection areas*** (Figure 11). However, creating new water protection areas is a rather slow process and the total number of water protection areas has not increased in recent years.

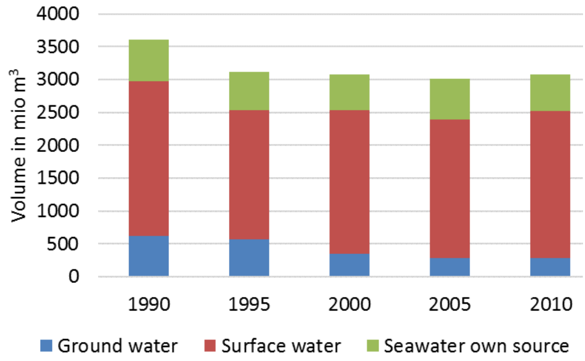


Figure 12: Water withdrawals by type of water in Sweden 1990-2010

Total water withdrawals declined somewhat in the early 1990's (mainly because of reduced surface water withdrawals) and remained relatively constant since then (Figure 12). Groundwater withdrawals declined continuously during the past 2 decades, while surface water withdrawals increased.

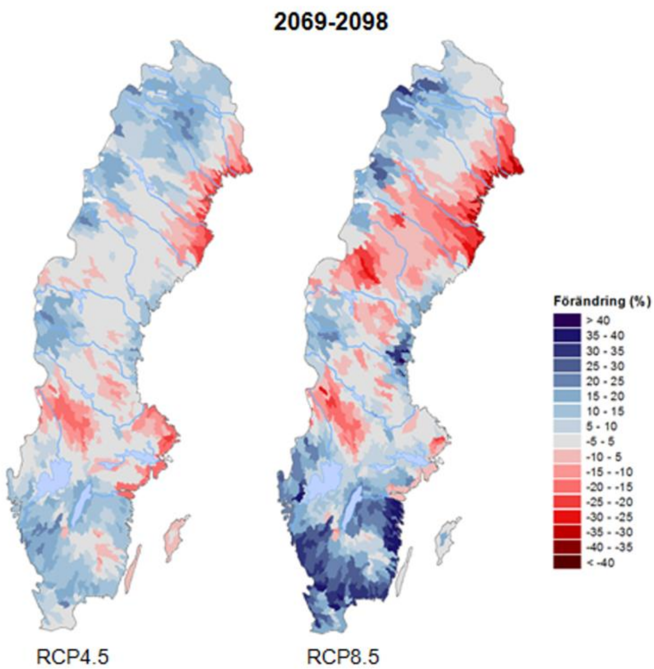


Figure 13: Projected future change in the magnitude of 100-year floods for the RCP4.5 (left) and the RCP8.5 (right) scenario. Figure obtained from https://www.smhi.se/kunskapsbanken/framtida-

The ***risk for flooding*** is projected to grow in many parts of the country (Figure 13). The magnitude of 100-year floods is expected to increase in the future especially in southern Sweden, where flooding occurs mostly as a consequence of heavy rain (during all seasons). In contrast, flooding in northern Sweden is mainly a consequence of snowmelt during spring. Since there will likely be less snow on the ground in the future, flooding in these northern regions is expected to decrease.

2.3 Energy Sector

Relevant socio-economic indicators in the energy sector include:

- Energy use
- Energy produced from solid biofuels
- Energy produced from hydropower

Total annual ***energy use*** per person in Sweden varied from 42 to 45 MWh during the 1990's and early 2000's, reaching its top in 2003 (Figure 14). Since then the energy use has been declining by ~17%.

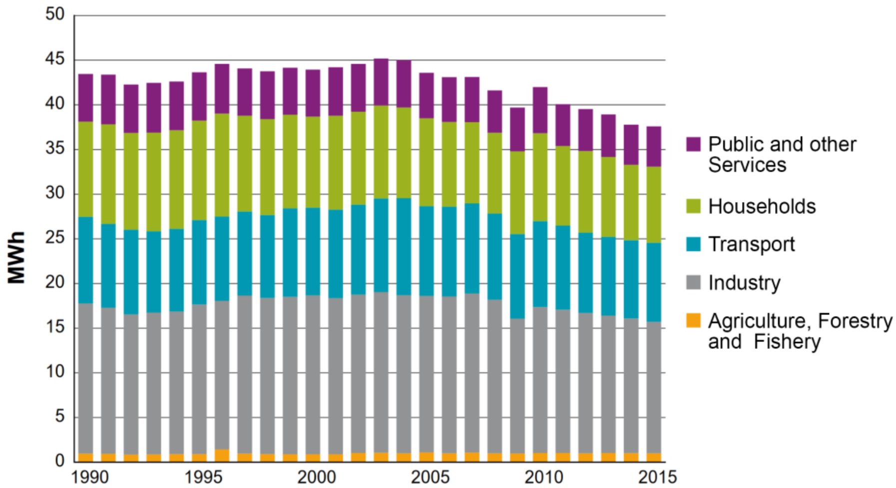


Figure 14: Sectorwise energy use per person in Sweden. Figure modified from the Swedish Environmental Protection Agency (2017).

The ***energy produced from solid biofuels*** (i.e., wood and black liquor) has increased by more than 200% since 1970, while the ***energy produced from hydropower*** does not show a marked trend (Figure 15).

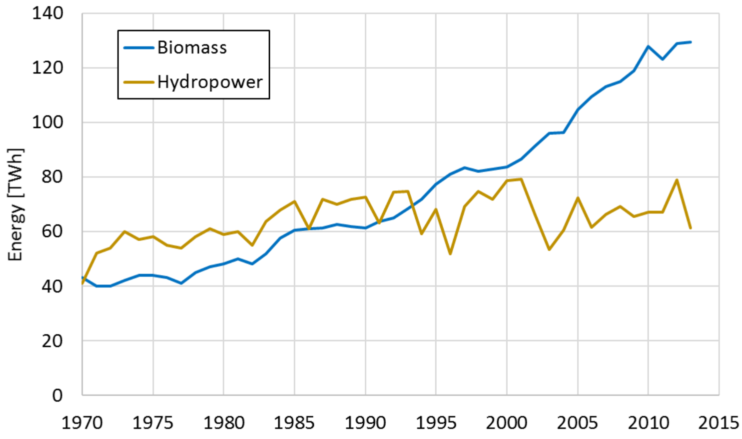


Figure 15: Energy produced form hydropower and biomass in Sweden 1970-2013

3 Mapping of Stakeholders

A list of organizations relevant for the sectors under consideration in the Swedish case study was created based on expert judgement. To identify the most relevant stakeholders and their influence in the policy process, they were clustered into actor groups (i.e., types of organizations) that have similar roles in the policy arrangement (Table 2): (1) businesses, (2) common interest associations, (3) local federations, (4) local governmental organizations, (5) regional governmental organizations, (6), national governmental organizations, (7) non-governmental organizations (NGOs), (8) research organizations and (9) trade associations.

Table 2: List of potential stakeholders grouped by the type of organization

ID	TYPE OF ORGANIZATION	ORGANIZATION
1	business	Bergvik Skog AB
2	business	Boxholms Skogar AB
3	business	E.ON vattenkraft
4	business	Fortum
5	business	Holmen Energi
6	business	Holmen Skog AB
7	business	Persson Invest Skog AB
8	business	Rebio
9	business	SCA Skog AB
10	business	SeKab
11	business	Skellefteå Kraft
12	business	Skogssällskapet förvaltning AB
13	business	Statkraft
14	business	Stockholm Vatten
15	business	Sveaskog AB
16	business	Uppsala University Foundations Management of Estates and Funds (Uppsala Akademiförvaltning)
17	business	Uppsala Vatten
18	business	Vattenfall
19	common-interest association	Agroforestry
20	local governmental organization	Sweden's 290 municipalities
21	local federation	Norrvatten
22	local federation	VA Syd
23	national governmental organization	Ministry of the Environment and Energy
24	national governmental organization	Swedish Environmental Protection Agency (Naturvårdsverket)
25	national governmental organization	The National Food Agency (Livsmedelsverket)
26	national governmental organization	The National Property Board of Sweden (Statens fastighetsverk)
27	national governmental organization	The Swedish Agency for Marine and Water Management (Hav och Vatten)

ID	TYPE OF ORGANIZATION	ORGANIZATION
28	national governmental organization	The Swedish Energy Agency (Energimyndigheten)
29	national governmental organization	The Swedish Forest Agency (Skogsstyrelsen)
30	national governmental organization	The Swedish Fortifications Agency (Fortifikationsverket)
31	national governmental organization	The Swedish Geological Survey (Sveriges Geologiska Undersökning)
32	NGO	Forest Stewardship Council (FSC)
33	NGO	Swedish Programme for the Endorsement of Forest Certification (PEFC)
34	NGO	Swedish Society for Nature Conservation
35	NGO	The Royal Swedish Academy of Agriculture and Forestry (Kunglig Skogs- och Lantbruksakademin)
36	NGO	The Swedish Forest Society Foundation (Skogssällskapet)
37	NGO	The Swedish Forestry Association (Föreningen Skogen)
38	regional governmental organization	Water authority Bothnian Bay (Vattenmyndigheten i Bottenvikens vattendistrikt)
39	regional governmental organization	Water authority Bothnian Sea (Vattenmyndigheten i Bottenhavets vattendistrikt)
40	regional governmental organization	Water authority Northern Baltic Sea (Vattenmyndigheten i Norra Östersjöns vattendistrikt)
41	regional governmental organization	Water authority Skagerack and Kattegat (Vattenmyndigheten i Västerhavets vattendistrikt)
42	regional governmental organization	Water authority Southern Baltic Sea (Vattenmyndigheten i Södra Östersjöns vattendistrikt)
43	research	Nordic Association for Hydrology (NHF)
44	research	Stockholm International Water Institute (SIWI)
45	research	Swedish Energy Research Centre (Energiforsk)
46	research	Swedish Hydrological Council (Svenska hydrologiska rådet)
47	research	The Forestry Research Institute of Sweden (Skogforsk)
48	trade association	Lantmännen Agroetanol
49	trade association	Mellanskog
50	trade association	Norrskog
51	trade association	Swedish Forest Industries Federation (Skogsindustrierna)
52	trade association	Swedish Hydropower Association (Svensk Vattenkraftförening)
53	trade association	Swedish Petroleum and Biofuel Institute (SPBI)
54	trade association	The Federation of Swedish Family Forest Owners (LRF Skogsägarna)
55	trade association	The Swedish Bioenergy Association (Svebio)
56	trade association	Water Regulation Enterprises (Vattenregleringsföretagen)

The stakeholder list (Table 2) contains eighteen ***businesses***, comprising a number of different hydropower, biofuel and forest-owing companies. One ***common interest association***, i.e., a group of individuals who voluntarily formed an organization to promote agroforestry, was identified. The list further includes two ***local federations*** formed by municipalities to manage local drinking water concerns, 290 municipalities belonging in the group of ***local governmental organizations***, five ***regional***

governmental organizations coordinating the work within the Swedish water districts, and nine ***national governmental organizations*** mainly consisting of Swedish government agencies that act independently to carry out policies. Furthermore, six ***NGOs*** dealing with forest issues and nature conservation, five ***research organizations*** in the forest, water and energy sectors, as well as nine ***trade associations*** were identified.

The division of resources between these actors naturally leads to differences in power and influence. As a starting point for looking at the relative position of the stakeholder and their power relations, actor groups were mapped to visualize their sizes, influence, roles and relationships (Figure 16). In addition, a power-interest grid per sector was generated (Figure 17) to visualize which stakeholders are key players that should preferably be fully engaged and which stakeholders only play a minor role.

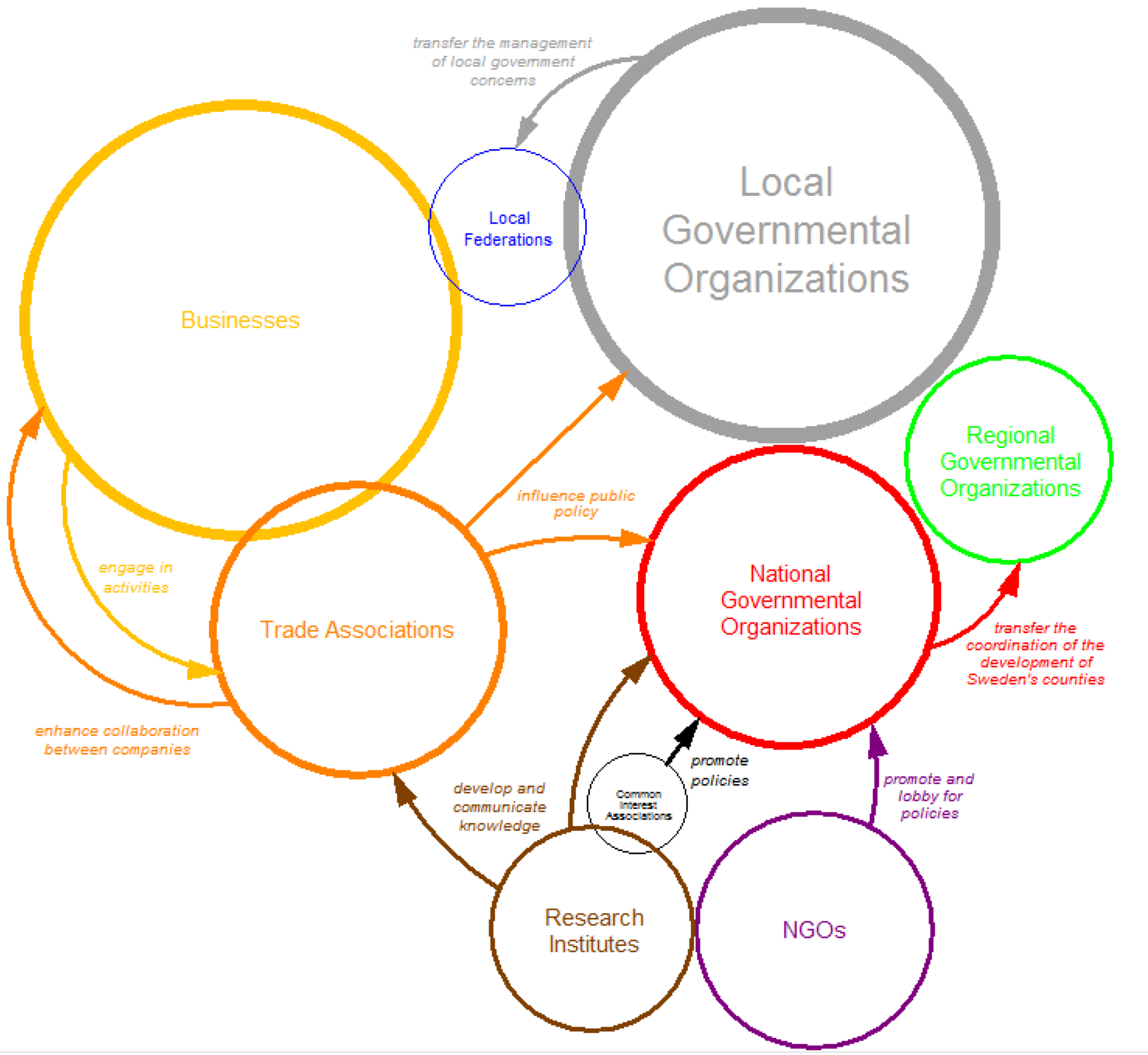


Figure 16: Map of relevant stakeholder groups and their relations. The size of the circles indicates the size of stakeholder groups, different colors represent different groups, the distance/overlap between circles indicates the relationship between the groups. Arrows indicate the main direction of the relationship.

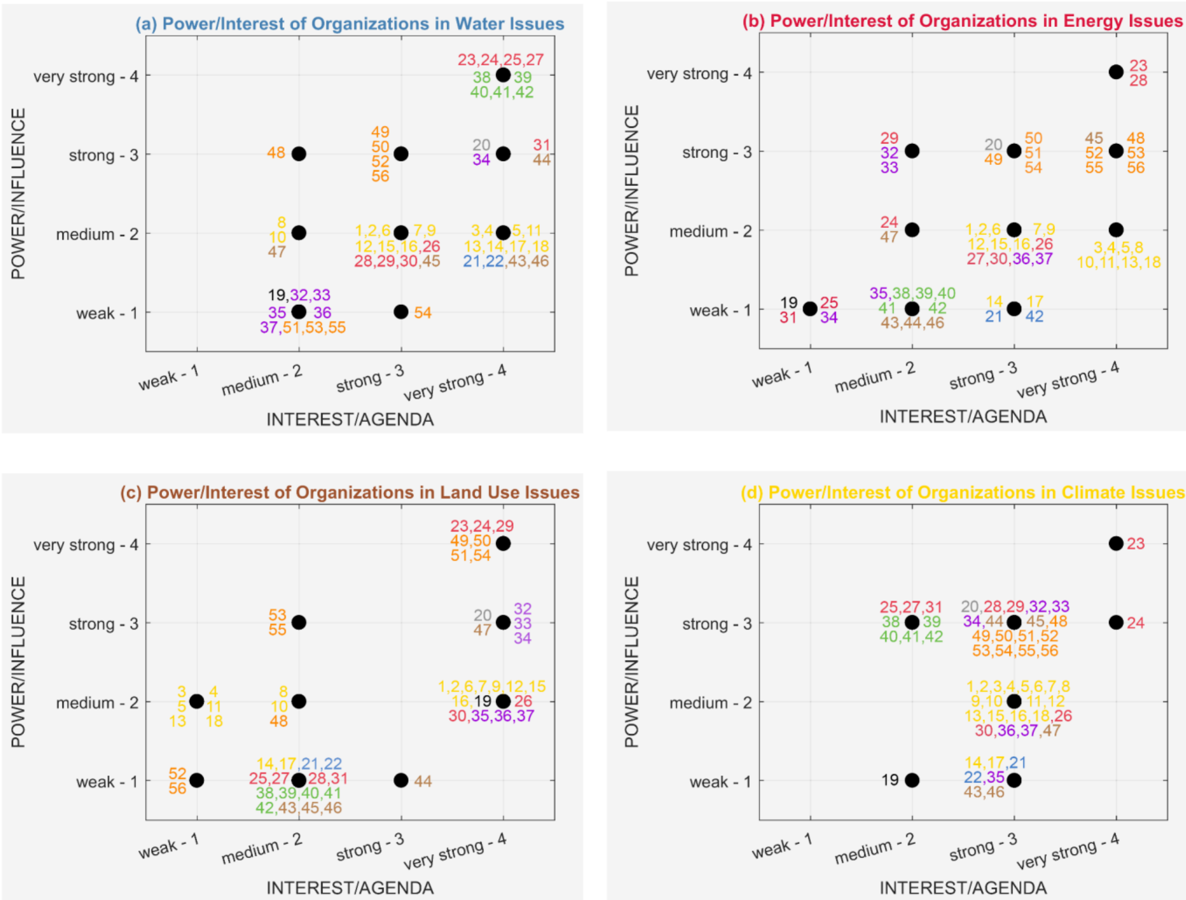


Figure 17: Power-interest grid of potential stakeholders in (a) the water sector, (b) the energy sector, (c) the land use sector, and (d) the climate sector.

Key stakeholders with high power (strong to very strong) and high interest (strong to very strong) were identified for each sector separately based on the power-interest grid (Figure 17). Ten stakeholders, which play a major role in more than two sectors, emerged (Table 3).

Table 3: Key stakeholders with high power and interest in more than 2 sectors (F = forest/land use, W = water, E = energy, C = climate)

ID	ORGANIZATION	F	W	E	C
Key actors in all 4 sectors					
20	Sweden's 290 municipalities	x	x	x	x
23	Ministry of the Environment and Energy	x	x	x	x
24	Swedish Environmental Protection Agency (Naturvårdsverket)	x	x	x	x
49	Mellanskog	x	x	x	x
50	Norrskog	x	x	x	x
Key actors in 3 sectors					
34	Swedish Society for Nature Conservation	x	x		x
51	Swedish Forest Industries Federation (Skogsindustrierna)	x		x	x
52	Swedish Hydropower Association (Svensk Vattenkraftförening)		x	x	x

ID	ORGANIZATION	F	W	E	C
54	The Federation of Swedish Family Forest Owners (LRF Skogsägarna)	x		x	x
56	Water Regulation Enterprises (Vattenregleringsföretagen)		x	x	x

4 Mapping of Policy Goals/Instruments

4.1 Key Policy Objectives and Instruments

The key policy objectives of the climate, water, forest and energy sector focus on long-term sustainable and efficient use/management of our natural resources (i.e., surface water, groundwater, forests, trees, etc.) and on mitigating climate change and its consequences. Key instruments include *administrative instruments* (e.g., regulations), *economic instruments* (including fees, flexible mechanisms, taxes and subsidies), *information* (e.g, education, consultation or guidance), *research & development*, and *voluntary actions* (such as certification or agreements).

4.2 Inventory of Policy Documents

The following subsections include inventories of relevant policy documents for each sectors under consideration (Table 4-Table 7) as well as horizontal policies (Table 8).

4.2.1 Documents in the Climate Sector

Table 4: Inventory of policy documents in the climate sector

Type of Document	Title of Document	Short Description	Life Span
Climate Policy	Act (SFS 2017:720) on Climate	This Act establishes that the Government's climate policy must be based on the climate goals and specifies how work is to be carried out.	2018-NA
	A Climate Policy Framework for Sweden (Gov. Bill 2016/17:146, passed in parliament 15 June, 2017)	This framework contains new climate goals, a Climate Act and plans for a climate policy council for the purpose of creating a clear and coherent climate policy.	2018-NA
	Ordinance (SFS 2015:517) on Aid to Local Climate Investments	Financial support may be granted under this Ordinance with the purpose of sustainable reduction of greenhouse gas emissions.	2015-NA
	Ordinance (SFS 2016:385) on Financial Support for Municipal Energy and Climate Advisors	Financial support may be granted under this Ordinance to support the coordination and development of municipal energy and climate advice.	2016-NA
Emission Policy	Act (SFS 2004:1199) on Emission Trading Ordinance (SFS 2004:1205) on Emissions Trading	These documents govern the conditions for trading the right to release greenhouse gases (emission allowances).	2005-NA

4.2.2 Documents in the Landuse Sector (Forests)

Table 5: Inventory of policy documents in the forest sector

Type of Document	Title of Document	Short Description	Life Span
Forestry Policy	Act (SFS 1979:429) on Forest Maintenance Ordinance (SFS 1993:1096) on Forest Maintenance	These documents state that the forest is a renewable resource that is to be managed sustainably to ensure not only a reliable yield of timber and the multiple use of forests, but also preserve biological diversity.	1980-NA
	Ordinance (SFS 2009:1393) with Instructions for the Swedish Forest Agency	Defines the role and tasks of the Swedish Forest Agency.	2010-NA
	Ordinance (SFS 2010:1879) on Support for Certain Measures in Forestry	Financial support may be granted under this Ordinance to support forestry actions resulting in the protection of natural environments and cultural heritage and for establishing/protecting broad-leaved deciduous forest.	2011-NA

4.2.3 Documents in the Water Sector

Table 6: Inventory of policy documents in the water sector

Type of Document	Title of Document	Short Description	Life Span
Fishing Policy	Act (SFS 1993:787) on Fisheries Ordinance (SFS 1994:1716) on Fishing, Aquaculture and Fisheries Ordinance (SFS 1998:1343) on the Support of Fish Conservation	These documents cover the right to fish as well as fishing activities in Sweden's territorial waters and exclusive economic zone. They regulate both fishing activities as such and subsequent activities until the landing of the fish and the fisherman's reporting of the catch.	1994-NA
Flood Risk Policy	Ordinance (SFS 2009:956) on Flood Risk	This Ordinance implements the Floods Directive 2007/60/EC and contains provisions to reduce the harmful consequences of floods.	2009-NA
Groundwater Policy	Act (SFS 1975:424) on the Duty to Report on the Exploration for Groundwater and Drilling of Wells	This Act requires whoever is engaged professionally in the drilling, digging or any other operation for the exploration of groundwater to report to the Swedish Geological Exploration Institute.	1975-NA
Water Operation Policy	Act (SFS 1998:812) Containing Special	This law contains parts of the old water law that could not be included in	1999-NA

Type of Document	Title of Document	Short Description	Life Span
	Provisions concerning Water Operations	the Environmental Code, e.g., many rules for joint water facilities (i.e., water facilities with several partners).	
Water Quality Policy	Ordinance (SFS 2004:660) on management of the quality of the aquatic environment	This Ordinance implements provisions of the Water Framework Directive 2000/60/EG and contains e.g. rules regarding the environmental quallity objectives for water bodies.	2004-NA
	Ordinance (2008:218) on Bathing Waters	This Ordinance implements Directive 2006/7/EC and provides rules for the identification, control and classification of surface bathing waters.	2008-NA
	Ordinance (SFS 2001:554) on Environmental Quality Standards for Fish and Bivalve Waters	This Ordinance implements the Freshwater Fish Directive (2006/44/EC) and contains environmental quality standards for fish and bivalve waters.	2001-NA
	Ordinance (SFS 1982:840) on Government Funding for Liming of Lakes and Rivers	Financial support may be granted under this Ordinance to support the liming of lakes and rivers with the goal to reduce acidifaction	1982-NA
Water Service Policy	Act (SFS 2006:412) on Public Water Services	The aim of this Act is to ensure household water supply and discharge in a coordinate manner so as to safeguard public health and the environment.	2007-NA

4.2.4 Documents in the Energy Sector

Table 7: Inventory of policy documents in the energy sector

Type of Document	Title of Document	Short Description	Life Span
Energy Policy	Act (SFS 1997:857) on Electricity	This Act provides regulations concerning power installations, trade and electrical safety.	1998-NA
	Act (1994:1776) on Tax on Energy Ordinance (2010:178) on Tax on Energy	These documents govern the carbon dioxide, the sulphur and the energy tax to increase environmental benefits.	1994-NA
	Act (SFS 2011:1200)	These documents aim to promote the	2012-

Type of Document	Title of Document	Short Description	Life Span
	Regarding Electricity Certificates Ordinance (SFS 2011:1480) on Electricity Certificates	production of renewable electricity. The certificate system, is intended to help Sweden to achieve a more ecologically sustainable energy system and also to meet the EU target for the country's proportion of renewable energy production.	2035
	Act (SFS 2010:601) on Guarantees of Origin for Electricity Ordinance (SFS 2010:853) on Guarantees of Origin for Electricity	These documents aim to ensure that the producer of electricity is entitled to receive guarantees of origins issued to show the origin of the produced product.	2010-NA
	Agreement by The Government, the Moderate Party, the Centre Party and the Christian Democrats on Swedish energy policy (link)	This agreement consists of a common road map for a controlled transition to an entirely renewable electricity system, with a target of 100 per cent renewable electricity production by 2040.	2016-NA
Renewable Energy Policy	Act (SFS 2010:598) on Sustainability Criteria for Biofuels and Bioliquids Ordinance (SFS 2011:1088) on Sustainability Criteria for Biofuels and Bioliquids	These documents implement certain provisions of the Renewable Energy Directive 2009/28/EC. They ensure that those biofuels and bioliquids that are used in Sweden fulfil a given set of sustainability criteria that cover the entire production chain of a biofuel or bioliquid, from feedstock production to end use.	2010-NA
	Ordinance (SFS 2003:564) on Grants for Measures Promoting Effective and Environmentally Sustainable Energy Supply	Financial project support for technology procurement may be granted under this Ordinance.	2004-NA
	Research and New Technology for the Future Energy System (Gov. Bill 2005/06:127)	This bill sets out guidelines for the continued long-term energy policy efforts in research, development, demonstration and commercialization in the energy field.	2006-NA

4.2.5 Documents of Horizontal Policies

Table 8: Inventory of horizontal policy documents that are relevant for several sectors

Type of Document	Title of Document	Short Description	Life Span
Agricultural Policy	A National Food Strategy for Sweden – more jobs and sustainable growth throughout the country (Gov. Bill 2016/17:104)	This Strategy is a platform that sets out the direction of Sweden's policy towards 2030, to create stability and ensure a long-term approach. Concrete measures are put forward in the Government's action plan stemming from areas identified in the strategy.	2017-2030
Biodiversity Policy	A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141)	This bill summarizes the overall strategy for biodiversity and ecosystem services, which includes milestone targets and initiatives that have been adopted.	2013-2020
	Ordinance (SFS 2007:845) on Species Protection	This Ordinance prohibits the trading, storage, and display of threatened species without special permission.	2007-NA
Cultural Heritage Policy	Act (SFS 1988:950) on Cultural Heritage Ordinance (SFS 1988:1188) on Cultural Heritage	These documents govern the cultural heritage protection and management with the aim to preserve and manage sites of historical, architectural or archaeological significance.	1989-NA
Environmental Policy	Environmental Code (SFS 1998:808)	This Code promotes sustainable development, which will assure a healthy and sound environment for present and future generations.	1998-NA
	Proposal for Consequential Legislation to the Environmental Code (Gov. Bill 1997/98:90)	This document proposes to adapt a number of existing environmental laws to the Environmental Code, (SFS 1998:808)	1998-NA
	Ordinance (SFS 1998:899) on Environmentally Hazardous Activities and the Protection of Public Health	This Ordinance concerns environmentally hazardous activities and provides for compulsory review of applications to conduct environmentally hazardous activities.	1999-NA
	Ordinance (SFS 1998:901) on Operator's Control	This document specifies regulations on the continuous examination, assessment and minimization of risks associated with the use of chemicals.	1999-NA

Type of Document	Title of Document	Short Description	Life Span
	Ordinance (SFS 1998:905) on Environmental Impact Statements	This Ordinance implements EU Directive 2001/42/EC and contains provisions on environmental impact statements and strategic environmental assessment reports.	1999-NA
	Ordinance (SFS 1998:915) on Environmental Considerations in Agriculture	This Ordinance contains regulations regarding the handling of plant nutrients, nitrate-sensitive areas, and the storage of livestock manure.	1999-NA
	Ordinance (SFS 1998:1252) on the Protection of Natural Areas According to the Environmental Code	This ordinance contains provisions for the protection of natural areas, for game parks and for fencing in an area that is of interest for outdoor recreation.	1999-NA
	Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150), Chapter 12-13	This bill specifies the environmental quality objectives that are necessary to realize Sweden's environmental policy aims. Chapter 5 describes the objective "Reduce Climate Impact" and specifies interim targets. Chapters 12 and 13 describe the objectives "Flourishing Lakes and Streams" and "Good-Quality Groundwater". Chapter 16 describes the objective "Sustainable Forests" and specifies interim targets.	2005-NA
	Act (1995:1667) on Natural Gravel Tax	This document governs the natural gravel tax in order to increase the substitution of the natural gravel derived from glacifluvial deposits with other materials.	1996-NA
	Act (SFS 1984:410) on Taxation of Pesticides	This document governs the pesticides tax in order to reduce the use of pesticides for health and environmental reasons.	1985-NA
	Act (SFS 1990:613) on an Environmental Charge on Emissions of Nitrogen Oxides in Energy Production	This document governs the NOx emission tax in order to reduce soil acidification and water eutrophication.	
Food Policy	Act (SFS 2006:804) on Food	This Act aims at ensuring a high level of safety regarding health of human	2007-NA

Type of Document	Title of Document	Short Description	Life Span
		beings in relation with food.	
Planning and Building Policy	Act (SFS 2010:900) on Planning and Building Ordinance (SFS 2011:338) on Planning and Building	These documents contain provisions on the planning of land and water areas, and on construction. The purpose of the provisions is to promote societal progress with equal and proper living conditions and a clean and sustainable habitat, for people in today's society and for future generations.	2011-NA
Road Policy	Act (SFS 1971:948) on Roads	This Act contains provisions governing the construction, viability, operation, safety, management and cancellation of public roads.	1972-NA
Rural Development Program	Ordinance (SFS 2015:406) on the Support for Rural Development Measures Ordinance (SFS 2015:407) of Locally Led Development	The Program is a tool for developing Sweden's rural areas. It contains support and compensation to achieve the objectives of the programme. Some of these target agricultural sectors in particular, although several types of support can be applied for by anyone living and working in rural areas.	2014-2020
Strategic Planning Policy	Ordinance (SFS 2007:825) with Instructions for the County Administrative Board	This document contains regulations about the County Administrative Board's responsibilities and tasks, the authoritys management and the consultation with other authorities.	2008-NA
Waste Policy	Ordinance (SFS 2001:512) on the Landfill of Waste Ordinance (SFS 2011:927) on Waste	These documents provide measures on waste and waste management, and apply to any business that deals in any capacity with non-hazardous and/or hazardous waste. The purpose is to prevent and reduce the negative effects of waste disposal on human health and the environment, especially in the area of surface water, groundwater, soil and air pollution, and the global environment.	2012-NA

4.3 Inventory of Objectives of Relevant Sectors

The subsections below include inventories of relevant policy objectives for each of the sectors under consideration: climate (Table 9), landuse/forests (Table 10), water (Table 11) and energy (Table 12).

4.3.1 *Objectives in the Climate Sector*

Table 9: Inventory of objectives in the climate sector

Overarching Objectives	Specific Objectives	Reference Documents
Ambitious, long-term and stable climate policy	Government's climate policy is to be based on the climate goals. The new climate act specifies how the work is to be carried out. The Government is to present a climate report every year in its Budget Bill. Every fourth year, the Government is to draw up a climate policy action plan which is to provide information on how the climate goals are to be achieved.	A Climate Policy Framework for Sweden (Gov. Bill 2016/17:146
Reduce Climate Impacts	Limit the rise in the global average temperature well below 2°C above pre-industrial levels. Pursue efforts to limit the rise to 1.5°C above pre-industrial levels.	A Climate Policy Framework for Sweden (Gov. Bill 2016/17:146
Emission reduction	By 2045, no net emissions of greenhouse gases into the atmosphere, thereafter negative emissions. By 2045, emissions from activities in Swedish territory at least 85% lower than in 1990 Increased uptake of carbon dioxide in forests and land, and investments in other countries. By 2030: emissions in Sweden outside of the EU ETS at least 63 per cent lower than emissions in 1990, and by 2040 at least 75 per cent lower. No more than 8 and 2 percentage points, respectively, of the emissions reductions may be realized through supplementary measures. By 2030: Emissions from domestic transport in the area of domestic aviation reduced by at least 70 per cent compared with 2010.	A Climate Policy Framework for Sweden (Gov. Bill 2016/17:146 Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150) , Chapter 5
Ensure climate action	Foster knowledge transfer and innovation. Promote resource efficiency and support the shift towards a low carbon and climate resilient economy in agriculture, food and forestry.	Ordinance (2015:406) on the Support for Rural Development Measures Ordinance (2015:407) of Locally Led Development

4.3.2 *Objectives in the Landuse Sector (Forests)*

Table 10: Inventory of objectives in the forest sector

Overarching Objectives	Specific Objectives	Reference Documents

Overarching Objectives	Specific Objectives	Reference Documents
Production goal: Ensure a reliable yield of timber	Reforest unproductive or idle forest land within three years. Use only reforestation methods that were found to produce satisfactory results within an acceptable time frame. Apply necessary rejuvenation measures to ensure regrowth of a forest of adequate density. Plowing may not be used as a soil/land preparation method.	Act (SFS 1979:429) on Forest Maintenance Ordinance (SFS 1993:1096) on Forest Maintenance
Environmental goal: Sustainable development and management of forest resources	The environment is protected against damage and detriment, whether caused by pollutants or other impacts. Valuable natural and cultural environments are protected and conserved. Biological biodiversity is preserved. The use of land, water and the physical environment in general is such as to secure a long-term good management in ecological, social, cultural and economic terms. Reuse and recycling, as well as other management of materials, raw materials and energy are encouraged with a view to establishing and maintaining natural cycles. Knowledge transfer and innovation in forestry and rural areas is fostered. Resource efficiency is promoted and the shift towards a low carbon and climate resilient economy in the forestry sector is supported.	Environmental Code, (SFS 1998:808), Chapter 1 Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150), Chapter 16 Ordinance (SFS 2010:1879) on Support for Certain Measures in Forestry A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141) Ordinance (SFS 2007:845) on Species Protection Act (SFS 1988:950) on Cultural Heritage Ordinance (SFS 1988:1188) on Cultural Heritage Ordinance (SFS 2015:406) on the Support for Rural Development Measures Ordinance (SFS 2015:407) of Locally Led Development
Achieve the forest policy goals decided on by the	The Swedish Forest Agency shall be responsible for: supervising regulatory compliance	Ordinance (SFS 2009:1393) with Instructions for the Swedish Forest Agency

Overarching Objectives	Specific Objectives	Reference Documents
government	creating inventories, following-up and evaluating how the forests are managed providing advice and information on how the forests should be managed working towards the achievement of the Environmental Objectives and the Generation Goal, and, if necessary, proposing measures for the development of environmental work coordinating follow-up, evaluation and reporting of the Environmental Objective "Living Forest" assisting in issues related to community planning for sustainable development and use of natural resources coordinating the implementation, development, follow-up and reporting of the goals of the Outdoor Recreation Policy	

4.3.3 Objectives in the Water Sector

Table 11: Inventory of objectives in the water sector

Overarching Objectives	Specific Objectives	Reference Documents
Protect inland surface waters, transitional waters and coastal waters.	Maintain and improve the aquatic environment (essentially water quality) Prevent further deterioration of aquatic ecosystems and protect/enhance their status Promote sustainable water use based on long-term protection of available water resources Protect and improve the aquatic environment through specific measures for the progressive reduction of discharges, emissions and losses of priority hazardous substances Ensure the progressive reduction of pollution of groundwater and prevent its further pollution contribute to mitigating the effects of floods and droughts Provision of the sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use	Environmental Code, (1998:808) Chapter 5 Section 8 Swedish Ordinance (2004:660) on Management of the Quality of the Aquatic Environment Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)

Overarching Objectives	Specific Objectives	Reference Documents
	Achieving the objectives of relevant international agreements, including those which aim to prevent and eliminate pollution of the marine environment, by Community action under Article 16 Protect territorial and marine waters Ensure greater integration of qualitative and quantitative aspects of surface waters Establish common definitions of the status of water in terms of quality and, where relevant for the purpose of the environmental protection, quantity should be established; Achieve the objective of at least good water status for each river basin by defining and implementing the necessary measures within integrated programs of measures; Protect, enhance and restore all bodies of surface water with the aim of achieving good surface water status in 2015 Protect and enhance all artificial and heavily modified bodies of water with the aim of achieving good ecological potential and good surface water chemical status by 2015 Implement the necessary measures with the aim of progressively reducing pollution from priority substances	
Ensure the sustainable management of natural resources.	Restore, preserve and enhance ecosystems related to agriculture and forestry, with a focus on: restoring, preserving and enhancing biodiversity improving water management, including fertiliser and pesticide management	Ordinance (2015:406) on the Support for Rural Development Measures Ordinance (2015:407) of Locally Led Development
Lakes and watercourses must be ecologically sustainable, of	Development of environmental quality standards for water bodies and for fish/bivalve waters. Provide rules for the identification, control and	Ordinance (SFS 2004:660) on management of the quality of the aquatic environment

Overarching Objectives	Specific Objectives	Reference Documents
good quality and their variety of habitats must be preserved.	classification of surface bathing waters. Reduce acidification. Support liming of lakes and rivers. Reduce pollution. Protect water areas with high natural value. Restoring disturbed fresh waters. Reinstate a sufficient number of ecologically sustainable and diverse habitats. Strengthen the financial and the legal frameworks for restoring rivers and streams.	Ordinance (2008:218) on Bathing Waters Ordinance (SFS 2001:554) on Environmental Quality Standards for Fish and Bivalve Waters Ordinance (SFS 1982:840) on Government Funding for Liming of Lakes and Rivers A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141) Ordinance (SFS 2007:845) on Species Protection
Groundwater must provide a safe and sustainable supply of drinking water and contribute to viable habitats for flora and fauna in lakes and watercourses.	Secure good water quality by establishing measures on water quantity Ensure greater integration of qualitative and quantitative aspects of groundwater. Reduce the extraction of gravel from Eskers (natural gravel deposits). Implement the measures necessary to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater; Protect, enhance and restore all bodies of groundwater, ensure a balance between abstraction and recharge of groundwater Implement the measures necessary to reverse any significant and sustained upward trend in the concentration of any pollutant resulting from the impact of human activity in order progressively to reduce pollution of groundwater;	Environmental Code, (1998:808) Chapter 5 Section 8 Swedish Ordinance (2004:660) on Management of the Quality of the Aquatic Environment Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy Act (SFS 1975:424) on the Duty to Report on the Exploration for Groundwater and Drilling of Wells Act (1995:1667) on Natural Gravel Tax
Natural productive capacity, biological	Support people's opportunities to spend time in nature and enjoy outdoor recreational activities, with the right of public access being a foundation of outdoor recreation.	Act (SFS 1993:787) on Fisheries Ordinance (SFS 1994:1716)

Overarching Objectives	Specific Objectives	Reference Documents
diversity, cultural heritage assets and the ecological and water-conserving function of the landscape must be preserved, at the same time as recreational assets are safeguarded.		on Fishing, Aquaculture and Fisheries Ordinance (SFS 1998:1343) on the Support of Fish Conservation Act (SFS 1998:812) Containing Special Provisions concerning Water Operations Act (SFS 2006:412) on Public Water Services
Promote sustainable development to ensure a healthy and sound aquatic environment for present and future generations	The environment is protected against damage and detriment, whether caused by pollutants or other impacts. Valuable natural and cultural environments are protected and conserved. Biological biodiversity is preserved. The use of land, water and the physical environment in general is such as to secure a long-term good management in ecological, social, cultural and economic terms. Reuse and recycling, as well as other management of materials, raw materials and energy are encouraged with a view to establishing and maintaining natural cycles.	Environmental Code, (SFS 1998:808), Chapter 1

4.3.4 Objectives in the Energy Sector

Table 12: Inventory of objectives in the energy sector

Overarching Objectives	Specific Objectives	Reference Documents
Sustainable and environmentally friendly energy supply	Promotion of the production of renewable energy and thereby increase their share The target by 2040 is 100 per cent renewable electricity production. By 2045, Sweden is to have no net emissions of greenhouse gases into the atmosphere and should thereafter achieve negative emissions. Impose modern environmental requirements on hydropower Continue to protect the protected 'national rivers' in the north of Sweden and other waterways specified by law from development Reduce property tax on hydropower plants Extend the electricity certificate system and expand by 18 TWh of new electricity certificates until 2030.	Act (SFS 2010:601) on Guarantees of Origin for Electricity Ordinance (SFS 2010:853) on Guarantees of Origin for Electricity Act (SFS 2010:598) on Sustainability Criteria for Biofuels and Bioliquids Ordinance (SFS 2011:1088) on Sustainability Criteria for Biofuels and Bioliquids Act (SFS 2011:1200) Regarding Electricity Certificates Ordinance (SFS 2011:1480) on Electricity Certificates Agreement by The Government, the Moderate Party, the Centre Party and the Christian Democrats on Swedish energy policy
Efficient energy use with minimal impact on the environment	An energy-efficiency target for the period 2020 to 2030 will be produced and adopted no later than 2017. Adapt existing regulatory frameworks to new products and services in the areas of energy efficiency, energy storage and electricity sales Introduce a special energy efficiency program Investigate broadly the potential obstacles to enable services to develop with respect to active customers and energy efficiency	Act (1994:1776) on Tax on Energy Ordinance (2010:178) on Tax on Energy Agreement by The Government, the Moderate Party, the Centre Party and the Christian Democrats on Swedish energy policy
Competitive energy provision: Offer electricity at competitive prices and build a robust electricity network with high	Strengthen Nordic cooperation on network investments, develop the cooperation on NordPool, and contribute to	Agreement by The Government, the Moderate Party, the Centre Party and the Christian Democrats on

security.	completing the move towards a harmonized Nordic electricity retail market Nuclear power needs major investment if it is to meet upcoming safety requirements. Continue high production of hydropower Increase transmission capacity within Sweden	Swedish energy policy

4.3.5 Objectives of other Horizontal Sectors

Table 13: Inventory of horizontal policy documents that are relevant for several sectors

Overarching Objectives	Specific Objectives	Reference Documents
Environmental goal: A varied agricultural landscape	Protect the value of the farmed landscape and agricultural land for biological production and food production. Preserve and strengthen biological diversity and cultural heritage assets.	A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141) Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)
A market-oriented agricultural sector and a competitive food supply chain	Increase overall food production while achieving the relevant national environmental objectives. The increase in production – of both conventional and organic food – should correspond to consumer demands. Generate growth and employment Increase the level of self-sufficiency. Reduce vulnerability in the food supply chain.	A National Food Strategy for Sweden – more jobs and sustainable growth throughout the country (Gov. Bill 2016/17:104)
Environmental goal: Rich Diversity of Plant and Animal Life	Preserve biological diversity for the benefit of present and future generations. Safeguard species habitats and ecosystems and their functions	A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141) Environmental Quality

Overarching Objectives	Specific Objectives	Reference Documents
	and processes. Provide people with access to a good natural and cultural environment rich in biological diversity, as a basis for health, quality of life and well-being.	Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)
Environmental goal: Zero Eutrophication	Nutrient levels in soil and water must not be such that they adversely affect human health, the conditions for biological diversity or the possibility of varied use of land and water.	Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)
Environmental goal: A Magnificent Mountain Landscape	Preserve the pristine character of the mountain environment in terms of biological diversity, recreational value, and natural and cultural assets. Activities in mountain areas must respect these values and assets, with a view to promoting sustainable development. Protect particularly valuable areas from encroachment and other disturbance.	Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)
Environmental goal: Natural Acidification Only	Limit the acidifying effects of deposition and land to values that can be tolerated by soil and water.	Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)

4.4 Inventory of instruments of Relevant Sectors

This section includes inventories of relevant policy instruments for each of the sectors under consideration below: climate (Table 14), landuse/forests (Table 15), water (Table 16) and energy (Table 17). Main instrument categories in this report are *administrative instruments* (e.g., regulations), *economic instruments* (including fees, flexible mechanisms, taxes and subsidies), *information* (e.g, education, consultation or guidance), *research & development*, and *voluntary actions* (such as certification or agreements).

4.4.1 Instruments in the Climate Sector

Table 14: Inventory of instruments in the climate sector

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Administrative (Regulation)	Land drainage provisions of the Environmental Code, which	Environmental Code, (SFS 1998:808), Chapter 11

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
	indirectly affect trends in carbon dioxide removal	
	Site protection and nature conservation agreements, which indirectly affect trends in carbon dioxide removal	Environmental Code, (SFS 1998:808), Chapter 7-8
	Provisions on forest management in the Forestry Act, which indirectly affect trends in carbon dioxide removal	The Swedish Forestry Act (SFS 1993:1096)
	Provisions on the use of biofuels (in transport) and bioliquids (for electricity and heating)	Act (SFS 2010:598) on sustainability criteria for biofuels and bioliquids Ordinance (SFS 2011:1088) on sustainability criteria for biofuels and bioliquids
	Provisions concerning guarantees of origins to reduce greenhouse gas emissions and improve sustainability rating.	Act (SFS 2010:601) on Guarantees of Origin for Electricity Ordinance (SFS 2010:853) on Guarantees of Origin for Electricity
Economic (Flexible Mechanisms)	EU Emission Trading System (EU ETS) Joint Implementation (JI) Clean Development Mechanism (CDM)	Ordinance (SFS 2004:1205) on Emissions Trading
Economic (Subsidy)	Financial support to local climate investments with the goal to provide greatest possible climate benefit and reduce greenhouse gas emissions.	Ordinance (SFS 2015:517) on Aid to Local Climate Investments
	Financial support to municipalities for energy and climate consulting	Ordinance (SFS 2016:385) on Financial Support for Municipal Energy and Climate Advisors
Economic (Tax)	Energy tax Carbon tax Electricity consumption tax	The Swedish Energy Tax Act (1994:1776)
Information	Information campaigns at local, regional and national levels	Sweden's Sixth National Communication on Climate Change (Swedish Ministry of the Environment, 2015)
Research & Development	Extensive research and innovation efforts.	A Climate Policy Framework for Sweden (Gov. Bill 2016/17:146
	Technology procurement: Support the development for more energy-efficient products/systems and an increased use of renewable energy.	Sweden's Sixth National Communication on Climate Change (Swedish Ministry of the Environment, 2015)
Voluntary Action (Certification)	Electricity Certification	Act (SFS 2011:1200) Regarding Electricity Certificates

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
		Ordinance (SFS 2011:1480) on Electricity Certificates

4.4.2 Instruments in the Landuse Sector (Forests)

Table 15: Inventory of instruments in the forest sector

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Administrative (Regulation)	Define minimum requirements as to how to manage the forest	Act (SFS 1979:429) on Forest Maintenance Ordinance (SFS 1993:1096) on Forest Maintenance
	Provisions concerning forestry activities that can potentially have a significant impact on the natural environment (including an obligation to make a notice of consultation)	Environmental Code, (SFS 1998:808), Chapter 12, Section 6
	Site protection and nature conservation agreements, which affect forest activities	Environmental Code (SFS 1998:808), Chapters 7-8 Ordinance (SFS 1998:1252) on the Protection of Natural Areas According to the Environmental Code
	Provisions concerning the management of the quality of the aquatic environment, which affects the management of forests	Ordinance (SFS 2004:660) on management of the quality of the aquatic environment
	Provisions on the protection and management of cultural heritage.	Act (SFS 1988:950) on Cultural Heritage Ordinance (SFS 1988:1188) on Cultural Heritage
	Provisions on the trading, storage, and display of threatened species without special permission.	Ordinance (SFS 2007:845) on Species Protection
Economic (Fee)	Environmental sanction charges can be charged directly by a supervisory authority when a violation against the Environmental Code (SFS 1998:808) is ascertained.	Environmental Code (SFS 1998:808), Chapters 29-30
Economic (Subsidy)	Financial support for environmental measures in forests	Ordinance (SFS 2015:406) on the Support for Rural Development Measures Ordinance (SFS 2015:407) of Locally Led Development
	Financial support for forestry actions resulting in the protection of natural environments and cultural heritage,	Ordinance (SFS 2010:1879) on Support for Certain Measures in Forestry

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
	and for establishing or protecting broad-leaved deciduous forest	
Information	Provide advice and information on how the forests of the country should be managed	Ordinance (SFS 2009:1393) with Instructions for the Swedish Forest Agency A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141)
Research & Development	Extensive research and innovation efforts into biodiversity and ecosystem services.	A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141)
Voluntary Action (Certification)	Forest Certification through the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC)	Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)
Voluntary Action (Agreements)	Voluntary nature conservation agreements ('Naturvårdsavtal') between the government and a landowner to formally support long-term development and protection of areas with high natural values	Proposal for Consequential Legislation to the Environmental Code (Gov. Bill 1997/98:90)

4.4.3 Instruments in the Water Sector

Table 16: Inventory of instruments in the water sector

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Administrative (Regulation)	Provisions on flood risk assessments and management plans.	Ordinance (SFS 2009:956) on Flood Risk
	Provisions concerning the management of the quality of the aquatic environment.	Ordinance (SFS 2004:660) on management of the quality of the aquatic environment
	Site protection and nature conservation agreements, which affect forest activities	Environmental Code (SFS 1998:808), Chapters 7-8 Ordinance (SFS 1998:1252) on Protection of Natural Areas According to Environ. Code
	Definition of duties for municipal authorities to provide for coordinated water services. General directives for the planning and operation of water supply and discharge installations.	Act (SFS 2006:412) on Public Water Services
	Regulations regarding fishing	Act (SFS 1993:787) on Fisheries

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
	activities	Ordinance (SFS 1994:1716) on Fishing, Aquaculture, Fisheries
	Water-related provisions governing the construction, viability, operation, safety, management and cancellation of public roads.	Act (SFS 1971:948) on Roads
	Provisions on the planning of land and water areas.	Act (SFS 2010:900) on Planning and Building Ordinance (SFS 2011:338) on Planning and Building
	Minimum requirements as to how to manage the forest, which can have substantial physical and hydrological impacts.	Act (SFS 1979:429) on Forest Maintenance Ordinance (SFS 1993:1096) on Forest Maintenance
	Provisions on the protection and management of cultural heritage.	Act (SFS 1988:950) on Cultural Heritage Ordinance (SFS 1988:1188) on Cultural Heritage
	Regulations on environmentally hazardous activities.	Environmental Code (SFS 1998:808) Ordinance (SFS 1998:899) on Environmentally Hazardous Activities and the Protection of Public Health
	Provisions on environmental impact statements and strategic environmental assessment reports.	Environmental Code (SFS 1998:808) Ordinance (SFS 1998:905) on Environmental Impact Statements
	Provisions on the continuous examination, assessment and minimization of risks associated with the use of chemicals.	Environmental Code (SFS 1998:808) Ordinance (SFS 1998:901) on Operator's Control
	Regulations concerning measures on waste and waste management.	Environmental Code (SFS 1998:808) Ordinance (SFS 2001:512) on the Landfill of Waste Ordinance (SFS 2011:927) on Waste
	Provisions on the identification, control and classification of surface bathing waters.	Ordinance (2008:218) on Bathing Waters
	Provisions regarding environmental quality standards for fish and bivalve waters.	Ordinance (SFS 2001:554) on Environmental Quality Standards for Fish and Bivalve Waters
	Provisions on the handling of plant nutrients.	Environmental Code (SFS 1998:808) Ordinance (SFS 1998:915) on

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
		Environmental Considerations in Agriculture
	Provisions on drinking water quality.	Act (SFS 2006:804) on Food
	Regulations regarding the reporting on drilling, digging or any other operation for the exploration of groundwater.	Act (SFSS 1975:424) on the Duty to Report on the Exploration for Groundwater and Drilling of Wells
	Provisions on the responsibilities and tasks of the County Administrative Boards, which are coordinating national authorities with supervisory responsibilities that work amongst others on issues concerning the environment and nature.	Ordinance (SFS 2007:825) with Instructions for the County Administrative Board
Economic (Fee)	Annual fees to be paid by water operators as determined by the Land and Environment Court.	Act (SFS 1998:812) Containing Special Provisions concerning Water Operations
	Fees to be paid by property owners for the supply of drinking water and the removal of waste water.	Act (SFS 2006:412) on Public Water Services
	Water operators have to pay compensations to property owners in case of property damage.	Environmental Code (SFS 1998:808)
	Fees to be paid in case of water pollution caused by emissions from ships.	Act (SFS 1993:787) on Fishing
	Environmental sanction charges can be charged directly by a supervisory authority when a violation against the Environmental Code (SFS 1998:808) is ascertained.	Environmental Code (SFS 1998:808), Chapters 29-30
Economic (Subsidy)	Financial compensation for water operators in connection with the establishment of nature reserves.	Environmental Code (SFS 1998:808)
	Government Funding for municipalities to support liming of lakes and rivers to reduce acidification	Ordinance (SFS 1982:840) on Government Funding for Liming of Lakes and Rivers
	Financial support for fish conservation activities.	Ordinance (SFS 1998:1343) on the Support of Fish Conservation
	Financial support for forestry actions resulting in the protection of natural environments and cultural heritage.	Ordinance (SFS 2010:1879) on Support for Certain Measures in Forestry
	Financial support for investing in the improvement of the environment (e.g. reductions in leaching from farms or establishment/restoration of wetlands)	Ordinance (2015:406) on the Support for Rural Development Measures Ordinance (2015:407) of Locally Led Development

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Economic (Tax)	Natural gravel tax, which indirectly reduces hydrological impacts.	Act (1995:1667) on Natural Gravel Tax
	Tax on pesticides to reduce the impact on water quality.	Act (SFS 1984:410) on Taxation of Pesticides
	Tax on NOx emissions, with the intent of reducing acidification and eutrophication.	Act (SFS 1990:613) on an Environmental Charge on Emissions of Nitrogen Oxides in Energy Production
Information	Project "Focus on Nutrients" ('Greppa näringen'), which is the largest single undertaking in Sweden to reduce losses of nutrients to air and water from livestock and crop production. It offers free-of-charge advice to farmers.	http://www.greppa.nu/om-greppa/om-projektet/in-english.html
	Provide consultation, education and information material, e.g. Handbook for water planning Handbook on water protection areas General advice on nitrogen fertilization of forest land provided by the Swedish Forest Agency	A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141)
Voluntary Action (Agreement)	Voluntary nature conservation agreements ("Naturvårdsavtal") between the government and a landowner to formally support long-term development and protection of areas with high natural values	Proposal for Consequential Legislation to the Environmental Code (Gov. Bill 1997/98:90)

4.4.4 *Instruments in the Energy Sector*

Table 17: Inventory of instruments in the energy sector

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Administrative (Regulation)	Provisions concerning power installations, trade in electrical power in certain cases and electrical safety.	Act (SFS 1997:857) on Electricity
	Provisions on the use of biofuels (in transport) and bioliquids (for electricity and heating)	Act (SFS 2010:598) on Sustainability Criteria for Biofuels and Bioliquids Ordinance (SFS 2011:1088) on Sustainability Criteria for Biofuels and Bioliquids
	Provisions concerning guarantees of origins to reduce greenhouse gas emissions and improve sustainability rating.	Act (SFS 2010:601) on Guarantees of Origin for Electricity Ordinance (SFS 2010:853) on

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
		Guarantees of Origin for Electricity
	Provisions of the Environmental Code, which indirectly affect the use of land and water areas for energy production.	Environmental Code, (SFS 1998:808)
	Provisions of the Planning and Building Policy, which affect the use of land and water areas for energy production.	Act (SFS 2010:900) on Planning and Building Ordinance (SFS 2011:338) on Planning and Building
Economic (Flexible Mechanisms)	EU Emission Trading System (EU ETS)	Ordinance (SFS 2004:1205) on Emissions Trading
Economic (Subsidy)	Carbon tax relief for industry Energy tax exemption for fuels used in industrial activities in the manufacturing process.	Act (1994:1776) on Tax on Energy
	Financial support to promote the development of new technology and the use of more energy-efficient products and systems (technology procurement)	Ordinance (SFS 2003:564) on Grants for Measures Promoting Effective and Environmentally Sustainable Energy Supply
Economic (Tax)	Energy tax Carbon tax Electricity consumption tax	Act (1994:1776) on Tax on Energy Ordinance (2010:178) on Tax on Energy
Information	Information initiatives, including Energy advice Energy labeling Energy declarations for buildings campaigns on energy use	'Policy Instruments for Reduced Environmental Impacts' (Swedish Energy Agency, 2007)
Research & Development	Extensive research and innovation efforts in the energy field.	Research and New Technology for the Future Energy System (Gov. Bill 2005/06:127)
Voluntary Action (Certification)	Electricity Certification	Act (SFS 2011:1200) Regarding Electricity Certificates Ordinance (SFS 2011:1480) on Electricity Certificates
	Energy Mapping (provides municipalities and utilities with a way to evaluate existing energy use in a community and plan to improve energy efficiency through the use of better building standards and alternative energy sources)	'Policy Instruments for Reduced Environmental Impacts' (Swedish Energy Agency, 2007)

5 Assessment of Policy Coherence

5.1 Assessment of Interactions between Nexus Critical Objectives

5.1.1 Description of Nexus Critical Objectives

From the inventory of objectives for each sector (section 4.3), 14 objectives (Table 18) were identified to be most critical for the nexus. These objectives are particularly interesting to investigate, because they are either highlighted in the Swedish Government's policy work and objectives (e.g. climate, energy and environmental objectives, see http://www.government.se/government-policy/), or widely mentioned in news and media (e.g. climate and energy goals), or controversial and often discussed in debates (e.g. forest production versus environmental goal), or objectives that are not only important for Sweden but can also affect a larger region including the Baltic Sea (e.g. water-related objectives)

Table 18: Overview of selected nexus-critical objectives

Sector	Goal ID	Goal
Climate	C1	Environmental goal: Reduce Climate Impacts
	C2	Emission Reduction Targets
Forest	F1	Production goal: Ensure a long-term sustained yield of timber
	F2	Environmental goal: Forests with high natural, cultural and recreational values
Water	W1	Environmental goal: Flourishing Lakes and Streams
	W2	Environmental goal: Good-Quality Groundwater
	W3	Environmental goal: Thriving Wetlands
	W4	Reduce the harmful consequences of floods
Energy	E1	Sustainable and environmentally friendly energy supply
	E2	Increase energy efficiency
Horizontal	H1	Environmental goal: A varied agricultural landscape
	H2	A market-oriented agricultural sector and a competitive food supply chain
	H3	Environmental goal: Zero Eutrophication
	H4	Environmental goal: Natural Acidification Only

5.1.2 Scoring Matrix of Interactions

The assessment of the interactions between the selected 14 objectives was based on the evaluation by three researchers, a literature review, results of a survey sent to stakeholders, and a Stakeholder Workshop 1 (see details in the section "Validation" below). The final scoring matrix is presented in Table 19.

Table 19: Scoring matrix of policy objectives on a scale from -3 (strong conflict) to +3 (strong synergy), where 0 indicates no interactions.

		Affected Sector													
		E1	E2	C1	C2	F1	F2	H1	H2	H3	H4	W1	W2	W3	W4
Affecting Sector	E1	NaN	2	1	1	2	1/-1	-1	-1	0	1/-1	-1	-1	-1	1
	E2	3	NaN	2	3	0	0	0	1	0	0	0/-1	0	0	0
	C1	2	2	NaN	3	1	1/-1	1	-1	1	0	1	1	1	1/-1
	C2	2	2	3	NaN	1	0	-1	-1	0	1	1	1	1	1/-1
	F1	2	0	1	1	NaN	-1	0	0	-1	-1	-1	-1	-1	-1
	F2	-1	0	1/-1	0	-1	NaN	1	-1	2	2	2	1	2	1
	H1	-1	0	0	-1	0	1	NaN	1/-1	1	0	1	0	0	1
	H2	-1	1	-1	-1	0	-1	1/-1	NaN	1/-1	-1	-2	-1	-1	0
	H3	0	0	0	0	-1	2	1	1/-1	NaN	0	2	2	2	0
	H4	1/-1	0	0	1	-1	2	0	-1	0	NaN	2	2	2	0
	W1	-1	0	1	1	-1	2	1	-2	2	2	NaN	2	2	2
	W2	-1	0	1	1	-1	1	0	-2	2	2	2	NaN	2	1
	W3	-1	0	1/-1	1/-1	-1	2	2	-1	2	2	2	2	NaN	1
	W4	1	0	1	1	-1	1	1	0	0	0	2	1	1	NaN

Cancelling	-3
Counteracting	-2
Constraining	-1
Neutral	0
Enabling	1
Reinforcing	2
Indivisible	3
Multiple	1/-1

5.1.3 Justification of the Scoring

The scoring in the final scoring matrix (Table 19) is further clarified in Table 20.

Table 20: Justification of the scores assigned to interactions among objectives

Interaction	Score	Justification
		ENERGY
E1 > E2	2	the goal of more renewable energy and reducing energy use will inevitably lead to new technology inventions that support a more efficient use of energy
E1 > C1	1	the goal of more renewable energy and reducing energy use reduces GHG emissions and thereby supports the efforts to reduce the temperature rising
E1 > C2	1	the goal of more renewable energy and reducing energy use reduces GHG emissions
E1 > F1	2	more renewable energy leads to a larger interest in production of forest biomass as energy source
E1 > F2	-1/+1	conflict: more renewable energy from forest biomass might lead to a more intensified forestry activities, which may reduce the biodiversity in forests synergy: if we interpret the goal directly (as it says the energy supply should be “sustainable” and “environmentally friendly”) this means that there is a synergy with sustainable management of forests (supporting biodiversity)
E1 > H1	-1	more renewable energy from fuel crops can lead to mono-cultures and less focus on protection of land and crops, which influences agricultural biodiversity negatively
E1 > H2	-1	the goal of reducing energy is in conflict with an increased agricultural production, which requires energy for harvest, processing etc.; the goal of more renewable energy requires more land (e.g. for fuel crops) and limits therefore agricultural production and export
E1 > H3	0	///
E1 > H4	1/-1	synergy: reduced energy use reduces those substances/emissions that cause acidification conflict: more renewable energy from forest biomass causes more intensified harvest, which in turn causes acidification

E1	>	W1	-1	Hydropower dams affect the entire downstream ecosystem, including all surface water resources
E1	>	W2	-1	Hydropower dams affect the entire downstream ecosystem, which also impacts on groundwater recharge, groundwater quality and the habitats for animals and plants
E1	>	W3	-1	hydropower dams prevent the creation/protection of wetlands (wetlands support high concentrations of animals - including mammals, birds, fish, and invertebrates)
E1	>	W4	1	hydropower dams are able to store larger amounts of water, which is typically beneficial for flood protection
E2	>	E1	3	the goal of efficient energy use will lead to new technology inventions that help to reduce energy use
E2	>	C1	2	more efficient energy use reduces GHG emissions and thereby supports the efforts to reduce the temperature rising
E2	>	C2	3	more efficient energy use reduces GHG emissions
E2	>	F1	0	///
E2	>	F2	0	///
E2	>	H1	0	///
E2	>	H2	1	increasing energy efficiency in agricultural production can lead to a more ecological production in a sustainable manner, which can increase Sweden's competitiveness in agricultural sector
E2	>	H3	0	///
E2	>	H4	0	///
E2	>	W1	0/-1	conflict: short-term regulation of water flow in hydropower dams (for more efficient energy production) is negative for aquatic biodiversity neutral: in relation to other sources of energy
E2	>	W2	0	///
E2	>	W3	0	///

E2	>	W4	0	///
				CLIMATE
C1	>	E1	2	the aim of reducing the temperature increase facilitates the increase of renewable energy shares and the reduction of energy use
C1	>	E2	2	the aim of reducing the temperature increase supports new technologies to use energy more efficiently
C1	>	C2	3	the aim of reducing temperature rise is inextricably linked to reducing GHG emissions
C1	>	F1	1	reducing the temperature rise supports the forest production goal as growing forests sequestrate CO2
C1	>	F2	-1	the aim of reducing the temperature supports forest production goal (CO2 sequestration) which limits the potential for protecting existing forest
C1	>	H1	1	the aim of reducing the temperature increase is good for different crop types/species
C1	>	H2	-1	the aim of reducing the temperature increase is limiting implementation of a market-oriented and competitive agricultural sector goal that requires more energy use, leads to emissions etc.
C1	>	H3	1	Increased temperatures mean more rain, which causes higher surface run-off leading to more nutrients flow and potential eutrophication; that is why working to mitigate climate change is beneficial for the goal of reducing eutrophication
C1	>	H4	0	///
C1	>	W1	1	reducing the temperature rise below 2 degrees has a positive effect on evaporation and the available water resources (quantity and quality)
C1	>	W2	1	reducing the temperature rise below 2 degrees has a positive effect on evaporation and the available water resources (quantity and quality)
C1	>	W3	1	reducing the temperature rise below 2 degrees has a positive effect on evaporation and the available water resources (quantity and quality)
C1	>	W4	1/-1	synergy: as climate change increases risk for high-intensity rainfall and for subsequent flooding (especially during autumn in urban areas), mitigation of climate change counteracts these effects (and thus protect against flooding) conflict: in a warmer climate, there is lower risk of spring flooding caused by

				snowmelt; reducing the temperature rise does consequently not support the goal of reduced flooding risk (in Sweden)
C2	>	E1	2	the aim of reducing emissions enables the increase of renewable energy shares and the reduction of energy use
C2	>	E2	2	the aim of reducing emissions fosters new technologies to use energy more efficiently
C2	>	C1	3	the aim of reducing GHG emissions is inextricably linked to reducing temperature rise
C2	>	F1	1	the aim of reducing emissions fosters the forest production as forest biomass can be used as energy source with lower emissions (compared to fossil fuels)
C2	>	F2	0	///
C2	>	H1	-1	the aim of reducing emissions can cause a conflict between landuse for food production and fuel crops
C2	>	H2	-1	the aim of reducing emissions is limiting implementation of a market-oriented and competitive agricultural sector goal that requires more energy use, leads to emissions etc.
C2	>	H3	0	///
C2	>	H4	1	the aim of reducing emissions (especially sulfur dioxide) helps to reduce acidification
C2	>	W1	1	reducing emissions has a positive effect on temperature and evaporation and the available water resources (quantity and quality)
C2	>	W2	1	reducing emissions has a positive effect on temperature and evaporation and the available water resources (quantity and quality)
C2	>	W3	1	reducing emissions has a positive effect on temperature and evaporation and the available water resources (quantity and quality)
C2	>	W4	1/-1	synergy: as climate change increases risk for high-intensity rainfall and for subsequent flooding (especially during autumn in urban areas), decreased emissions counteract these effects (and thus protect against flooding) conflict: in a warmer climate, there is lower risk of spring flooding caused by snowmelt; reducing emissions does consequently not support the goal of reduced flooding risk (in Sweden)

				FOREST
F1	>	E1	2	using more forest biomass as energy source increases the share of renewable energy
F1	>	E2	0	///
F1	>	C1	1	more growth sequestrates more CO2; wood products are positive for the climate
F1	>	C2	1	using more forest biomass as energy source leads to fewer emissions
F1	>	F2	-1	forest production and forestry operations are in conflict with the protection of biodiversity and social values; older forest is needed for biodiversity but not for production
F1	>	H1	0	///
F1	>	H2	0	///
F1	>	H3	-1	an increased production/felling is based on felling operations and fertilizer (locally) that increase acidification
F1	>	H4	-1	an increased production/felling is based on felling operations and fertilizer (locally) that increase nutrients in water and soil
F1	>	W1	-1	an increased production/felling is based on felling operations and fertilizer (locally) that reduce surface water quality and aquatic biodiversity
F1	>	W2	-1	an increased production/felling is based on felling operations and fertilizer (locally) that reduce groundwater quality
F1	>	W3	-1	an increased production/felling is based on felling operations and fertilizer (locally) s that reduce the quality of wetlands
F1	>	W4	-1	forest clearing can increase the risk of flooding locally
F2	>	E1	-1	the protection of forest ecosystems and forest wetlands limits the forest production and the use of forest biomass as a renewable energy source
F2	>	E2	0	///
F2	>	C1	1/-1	synergy: protecting forest biodiversity creates conditions for environmental functions to mitigate climate change (e.g. forests or wetland creation/restoration)

				conflict: protecting existing forest limits the potential for forest growth which would sequestrate CO2
F2	>	C2	0	///
F2	>	F1	-1	protecting forest biodiversity limits the production of forests; older forest is needed for biodiversity but not for production
F2	>	H1	1	increased forest biodiversity can improve agricultural biodiversity through increasing heterogeneity of landscapes, providing connectivity, ecotone habitats and source of species
F2	>	H2	-1	increasing the forest biodiversity through ecological landscape planning might limit the potential to create a strong market-oriented agricultural sector and a competitive food supply chain
F2	>	H3	2	protecting forest biodiversity creates conditions for reducing nutrients in soil and water through a reduction in fertilizer and buffering of watercourses
F2	>	H4	2	protecting forest biodiversity creates conditions for reducing acidification through a reduction in fertilizer
F2	>	W1	2	more forest biodiversity also includes more biodiversity in forest aquatic systems (forest rivers, lakes, wetlands)
F2	>	W2	1	protecting forest biodiversity creates conditions for improving groundwater quality through less use of fertilizer and buffering of watercourses
F2	>	W3	2	protecting forest biodiversity creates conditions for improving wetland quality through less use of fertilizer and buffering of wetlands
F2	>	W4	1	more forest biodiversity through more structure and a more complex combination of species increases the capacity to retain water
				HORIZONTAL
H1	>	E1	-1	conserving biodiversity and natural values involves the protection of land and crop types, which could limit to some degree the potential increase of renewable energy from agricultural crops
H1	>	E2	0	///
H1	>	C1	0	///

H1	>	C2	-1	conserving biodiversity and natural values involves the protection of land and crop types, which could limit the production of renewable energy from agricultural crops and thereby limit the emission reduction goals
H1	>	F1	0	///
H1	>	F2	1	a varied agricultural landscape produces substrates that can be used instead of wood raw materials, so that more forests can be managed in a more natural way.
H1	>	H2	1/-1	synergy: protecting biodiversity and cultural values supports ecological production conflict: protecting biodiversity makes it impossible to intensify regular production and increase export
H1	>	H3	1	agricultural biodiversity can have beneficial effects on soil function and can increase soil nitrogen, which in turn can reduce the need for inorganic fertilizers leading to eutrophication
H1	>	H4	0	///
H1	>	W1	1	more agricultural biodiversity can contribute to a better connectivity of the landscape and thereby also improve aquatic biodiversity
H1	>	W2	0	///
H1	>	W3	0	///
H1	>	W4	1	more agricultural biodiversity through more structure and a more complex combination of species increases the capacity to retain water
H2	>	E1	-1	an increased agricultural production requires more energy for harvesting and processing, which complicates energy reduction
H2	>	E2	1	the desire to increase the competitiveness can lead to a more efficient energy use, which would save energy (and money) in the long run
H2	>	C1	-1	market-oriented and competitive are euphemisms for putting less emphasis on consequences. Due to the way agriculture operates, it has negative impacts on emissions, fossil fuel use, etc.
H2	>	C2	-1	market-oriented and competitive are euphemisms for putting less emphasis on consequences. Due to the way intensive agriculture operates, it has negative impacts on emissions, fossil fuel, etc.

H2	>	F1	0	///
H2	>	F2	-1	market-oriented and competitive are euphemisms for putting less emphasis on consequences and having less focus on the costly protection of biodiversity that require lower intensity of agriculture
H2	>	H1	1/-1	synergy: an increased ecological production supports the protection of biodiversity and cultural values conflict: an increase in production and export makes protecting biodiversity impossible
H2	>	H3	1/-1	synergy: an increased ecological production supports the reduction of fertilizer conflict: an increased intensive production implies more use of fertilizer which leads to more nutrients in water and soil
H2	>	H4	-1	an increased production leads to more use of fertilizer and can lead to less protected land areas for nutrient retention
H2	>	W1	-2	an increased production implies more use of fertilizer and less natural buffers which lead to deterioration of surface water quality and aquatic biodiversity
H2	>	W2	-1	an increased production implies more use of fertilizer and less natural buffers, which lead to deterioration of groundwater quality
H2	>	W3	-1	an increased production implies more use of fertilizer and less natural buffers, which lead to deterioration of wetland quality
H2	>	W4	0	///
H3	>	E1	0	///
H3	>	E2	0	///
H3	>	C1	0	///
H3	>	C2	0	///
H3	>	F1	-1	reducing nutrients in soil and water requires reduced use of fertilizer and using more environmentally friendly, less intensive harvesting techniques

H3	>	F2	2	reducing nutrients in soil and water creates conditions for better biodiversity in forests
H3	>	H1	1	reducing nutrients in soil and water creates conditions for better agricultural biodiversity
H3	>	H2	1/-1	synergy: reducing nutrients in soil and water supports ecological production and leads to a safer food production conflict: limiting the nutrients in soils and water limits the use of fertilizer and thereby the potential to increase intensive production
H3	>	H4	0	///
H3	>	W1	2	reducing nutrients in soil and water is inextricably linked to surface water quality, which contributes to the landscape ecological functioning and good conditions for plants and animals
H3	>	W2	2	reducing nutrients in soil and water is inextricably linked to groundwater quality
H3	>	W3	2	reducing nutrients in soil and water is inextricably linked to water quality, which affects the ecological status of wetlands and their biodiversity
H3	>	W4	0	///
H4	>	E1	1/-1	synergy: reducing acidification could lead to more efforts to reach a reduction in energy use conflict: reducing acidification implies adapting harvesting techniques, which could limit the potential for more renewable energy from forest biomass
H4	>	E2	0	///
H4	>	C1	0	///
H4	>	C2	1	reducing acidification could lead to more efforts to reduce emissions (especially sulphur dioxide emissions)
H4	>	F1	-1	reducing acidification constrains the harvesting techniques used and the use of fertilizer
H4	>	F2	2	reducing acidification creates conditions for better biodiversity in forests

H4	>	H1	0	///
H4	>	H2	-1	reducing acidification may lead to more areas set aside for conservation purposes, which affects productivity negatively
H4	>	H3	0	///
H4	>	W1	2	reducing acidification is inextricably linked to surface water quality, which contributes to the landscape ecological functioning and good conditions for plants and animals
H4	>	W2	2	reducing acidification is inextricably linked to groundwater quality
H4	>	W3	2	reducing acidification is inextricably linked to water quality, which affects the ecological status of wetlands and their biodiversity
H4	>	W4	0	///
				WATER
W1	>	E1	-1	protecting/maintaining aquatic biodiversity and the landscapes natural productive capacity constrains the intensification of forestry (biomass extraction and biofuel production) and the production of hydropower
W1	>	E2	0	///
W1	>	C1	1	protecting/maintaining aquatic biodiversity (e.g. through construction of wetlands or nature reserves) can serve as environmental functions to mitigate climate change
W1	>	C2	1	protecting/maintaining aquatic biodiversity (e.g. through construction of wetlands or nature reserves) can serve as environmental functions to mitigate climate change
W1	>	F1	-1	protecting/maintaining aquatic biodiversity and the landscapes natural productive capacity constrains the intensification of forestry
W1	>	F2	2	protecting/maintaining aquatic biodiversity (e.g. through construction of wetlands or nature reserves) reinforces forest biodiversity
W1	>	H1	1	protecting/maintaining aquatic biodiversity (e.g. through construction of wetlands or nature reserves) enables agricultural biodiversity through an increased connectivity
W1	>	H2	-2	protecting/maintaining aquatic biodiversity implies a reduction of pesticides, fertilizer etc. which counteracts with increased production and export

W1	>	H3	2	protecting/maintaining aquatic biodiversity implies a reduction of pesticides, fertilizer etc. which reduces nutrients in soil and water
W1	>	H4	2	protecting/maintaining aquatic biodiversity implies a reduction of pesticides, fertilizer etc. which reduces acidification
W1	>	W2	2	protecting/maintaining aquatic biodiversity and the landscapes natural productive capacity creates conditions for good groundwater quality
W1	>	W3	2	protecting/maintaining aquatic biodiversity helps to protect wetland functioning
W1	>	W4	2	protecting/maintaining aquatic biodiversity and the landscapes natural productive capacity creates conditions for natural flood protection
W2	>	E1	-1	protecting/maintaining groundwater quality constrains the intensification of forestry (biomass extraction and biofuel production) and the production of hydropower
W2	>	E2	0	///
W2	>	C1	1	protecting/maintaining groundwater quality (e.g. through construction of wetlands or nature reserves) can serve as environmental functions to mitigate climate change
W2	>	C2	1	protecting/maintaining groundwater quality (e.g. through construction of wetlands or nature reserves) can serve as environmental functions to mitigate climate change
W2	>	F1	-1	protecting/maintaining groundwater quality constrains the intensification of forestry
W2	>	F2	1	protecting/maintaining groundwater enables opportunities to increase forest biodiversity
W2	>	H1	0	///
W2	>	H2	-2	protecting/maintaining groundwater quality implies a reduction of pesticides, fertilizer etc. which counteracts with increased production and export
W2	>	H3	2	protecting/maintaining groundwater quality implies a reduction of pesticides, fertilizer etc. which reduces nutrients in soil and water
W2	>	H4	2	protecting/maintaining groundwater quality implies a reduction of pesticides, fertilizer etc. which reduces acidification
W2	>	W1	2	protecting/maintaining groundwater quality creates conditions for aquatic biodiversity and the landscapes natural productive capacity

W2	>	W3	2	protecting/maintaining groundwater quality helps to protect wetland functioning
W2	>	W4	1	protecting/maintaining groundwater quality creates conditions for natural flood protection
W3	>	E1	-1	protecting/maintaining wetlands constrains the intensification of forestry (biomass extraction and biofuel production) and the production of hydropower
W3	>	E2	0	///
W3	>	C1	1/-1	synergy: protecting/maintaining wetlands can serve as environmental functions to mitigate climate change conflict: wetlands (particularly not forested ones) can release methane gas and amplify climate impacts
W3	>	C2	1/-1	synergy: protecting/maintaining wetlands can serve as environmental functions to mitigate climate change conflict: wetlands (particularly not forested ones) can release methane gas
W3	>	F1	-1	protecting/maintaining wetlands constrains the intensification of forestry
W3	>	F2	2	protecting/maintaining wetlands reinforces opportunities to increase forest biodiversity
W3	>	H1	2	protecting/maintaining wetlands can help to capture nutrients from agriculture run-off before they enter water bodies enabling better conditions for agricultural biodiversity
W3	>	H2	-1	protecting/maintaining wetlands implies a reduction of pesticides, fertilizer etc. which counteracts with increased production and export
W3	>	H3	2	protecting/maintaining wetlands can help to capture nutrients from agriculture run-off before they enter water bodies
W3	>	H4	2	protecting/maintaining wetlands can help to capture nutrients from agriculture run-off before they enter water bodies, which reduced acidification
W3	>	W1	2	protecting/maintaining wetlands creates conditions for aquatic biodiversity and the landscapes natural productive capacity
W3	>	W2	2	protecting/maintaining wetlands creates conditions for good groundwater quality

W3	>	W4	1	protecting/maintaining wetlands creates conditions for natural flood protection, increasing landscape's buffering capacity
W4	>	E1	1	flood protection can foster hydropower dams as they are able to store larger amounts of water, which is typically beneficial for flood protection
W4	>	E2	0	///
W4	>	C1	1	reducing flood risk can be done by creating wetlands, hydropower dams and afforestation, which can both help to mitigate climate change and reduce emissions
W4	>	C2	1	reducing flood risk can be done by creating wetlands, hydropower dams and afforestation, which can both help to mitigate climate change and reduce emissions
W4	>	F1	-1	reducing flood risk can be done by creating wetlands and afforestation, which can limit forest production
W4	>	F2	1	reducing flood risk can be done by creating wetlands and afforestation, which both foster landscape connectivity and improve conditions for forest biodiversity
W4	>	H1	1	reducing flood risk can be done by creating wetlands and afforestation, which both foster landscape connectivity and improve conditions for agricultural biodiversity
W4	>	H2	0	///
W4	>	H3	0	///
W4	>	H4	0	///
W4	>	W1	2	reducing flood risk can be done by creating wetlands and afforestation, which both reinforce the protection of aquatic biodiversity and the landscapes natural productive capacity
W4	>	W2	1	reducing flood risk can be done by creating wetlands and afforestation, which both enable the protection of groundwater quality
W4	>	W3	1	reducing flood risk can be done by creating wetlands and afforestation, which both enable the protection of wetland quality

5.1.4 Overall Assessment

The results indicate that the energy policy objectives are well aligned with the climate objectives. This might be because Sweden is a leading actor in the design of a new regulatory framework for tougher requirements in the area of climate and energy. The climate and energy goals set by Sweden are more ambitious than those of the EU. Recently, several legislative acts have been negotiated such as the Climate Policy Framework for Sweden (Gov. Bill 2016/17:146, passed in parliament 15 June, 2017) and the new Climate Act, which entered into force in January 2018.

On the other hand, our scoring highlights that the agricultural sector is the "black sheep" amongst all sectors, which is least aligned with the policy objectives of other sectors. It remains a great challenge to create synergies between a market-oriented agricultural sector and a competitive food supply chain on one side, and more environmentally and climate friendly objectives on the other side. Particularly, there is a conflict between the idea of a competitive market-oriented agriculture and the type of agriculture that would support high biodiversity. However, it has been suggested at the stakeholder workshop that if Sweden better utilized its image of "environmentally friendly" food producer and built its market competitiveness on it, it would lead to better alignment of the agricultural goal with other goals.

Another striking result is the difficulty to implement the Environmental Quality Objectives. Objectives such as biodiversity in forest and agriculture as well as good surface water, groundwater and wetland quality seem to be difficult to accomplish, while both agricultural and forestry production dominate. This is reflected in the failure to implement most of the Swedish Environmental Objectives in the recent years. One of the main problems is the higher priority given to most of the production-oriented and economic development-oriented goals as compared to environmentally oriented goals, leading to e.g. more intensive production systems that do not support high biodiversity or lead to decreasing water quality. In addition, highest priority is given to climate change goals, which are not always in line with other environmental objectives. For example producing more biomass to support climate mitigation may hinder effective biodiversity conservation, as it requires more intensive forest management.

In general, our scoring exercise shows that there seem to be more synergies than conflict between policies of different sectors. This is in line with the report published by the Swedish Environmental Protection Agency about synergies and conflicts between Swedish Environmental Quality Objectives and objectives of other sectors (Swedish Environmental Protection Agency, 2011). The report revealed that although there are some conflicts, particularly with regard to conservation-oriented versus production-oriented objectives, many synergies can be found, specifically between the Environmental Quality Objectives and forestry and energy sector.

5.1.5 Validation

Based on the inventory of objectives for each sector (see section 4.3), a pre-selection of nexus-relevant objectives was done collaboratively by three researchers with experience in forestry, biodiversity, energy, water and climate. We assured the quality of the assessment of the coherence between critical objectives by triangulation. First, three researchers independently scored the interactions between these selected 14 objectives, based on their expert knowledge and literature review. The resulting scoring matrixes were compared and all differences in the scoring were discussed and adjusted to a common scoring matrix. Second, an online survey was sent in February 2018 to 354 stakeholders with the goal to confirm the selected nexus-relevant objectives and to receive a scoring independently from the expert judgement. We received 101 responses to the survey from stakeholders representing different sectors, in most cases, authorities at different levels. Both the expert judgement and the survey results were then evaluated and merged. Finally, results of the scoring exercise from the first Stakeholder Workshop (18th of April 2018) were used to refine the scoring, resulting in the final scoring matrix (Table 19) together with justification of the scores (Table 20).

5.2 Assessment of interactions between nexus critical instruments and nexus critical objectives

5.2.1 *Description of Nexus Critical Instruments*

The Nexus critical instruments have been selected based on the review of literature and policy documents, expertise of the authors of this report and indication by the stakeholders from different sectors provided on the first Stakeholder Workshop.

Table 21: Overview of selected nexus-critical instruments

Sector	Instr. ID	Instr. Type	Goal
Climate	Ca	Economic	Tax on fossil fuels
Forest	Fa	Administrative	Act (SFS 1979:429) on Forest Maintenance
	Fb	Voluntary	Forest Certification (FSC)
Water	Wa	Administrative	Water Framework Directive (2000/60/EC)
	Wb	Administrative	Ordinance (SFS 2009:956) on Flood Risk
	Wc	Voluntary	Agreement on Water Maintenance
Energy	Ea	Voluntary	Energy mapping
	Eb	Economic	Subsidies for solar panels and environmental cars
Horizontal	Ha	Economic	Ordinance (SFS 2015:406) on the Support for Rural Development Measures(i.e., financial support for environmental measures in forests and agriculture)
	Hb	Administrative	Environmental Code (SFS 1998:808)
	Hc	Voluntary	Food Certificatio n (KRAV, EU ecolabel, SIGILL)

5.2.2 *Scoring Matrix of Interactions*

Table 22: Scoring matrix of policy instruments and objectives.

	E1	E2	C1	C2	F1	F2	H1	H2	H3	H4	W1	W2	W3	W4	Σ+	Σ-	Σ+/-
Ea	1	1	1	1	0	0	0	0	0	0	0	0	0	0	4	0	0
Eb	1	0	1	1	1	-1	-1	1	0	0	0	0	0	0	5	2	0
Ca	1	0	1	1	1	-1	-1	1	0	0	0	0	0	0	5	2	0

Fa	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2	0	0
Fb	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Ha	0	0	0	0	-1	1	1	-1	0	0	1	1	1	0	5	2	0
Hb	1	0	1	1	-1	1	1	-1	1	1	1	1	1	0	10	2	0
Hc	0	0	0	0	0	0	1	1/-1	0	0	0	0	0	0	1	0	1
Wa	0	0	0	0	0	0	0	0	0	0	1	1	1	1	4	0	0
Wb	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Wc	0	0	0	0	0	1	1	0	0	0	1	1	1	0	5	0	0
Σ+	4	1	4	4	3	5	3	3	1	1	4	4	4	2			
Σ-	0	0	0	0	2	2	2	2	0	0	0	0	0	0			
Σ+/-	0	0	0	0	0	0	1	0	0	0	0	0	0	0			

Conflict	-1
Neutral	0
Synergy	1
Multiple	1/-1

5.2.3 Justification of the Scoring

Table 23: Justification of the scores assigned to interactions among instruments and objectives

Interaction	Score	Justification

				ENERGY
Ea	>	E1	1	energy mapping provides municipalities and utilities with a way to evaluate existing energy use in a community and plan to improve energy efficiency through the use of alternative energy sources
Ea	>	E2	1	energy mapping provides municipalities and utilities with a way to evaluate existing energy use in a community and plan to improve energy efficiency through the use of better building standards and alternative energy sources
Ea	>	C1	1	energy mapping helps to reduce energy use and increase renewable energies, which leads to reduced climate impacts
Ea	>	C2	1	energy mapping helps to reduce energy use and increase renewable energies, which leads to reduced emissions
Ea	>	F1	0	///
Ea	>	F2	0	///
Ea	>	H1	0	///
Ea	>	H2	0	///
Ea	>	H3	0	///
Ea	>	H4	0	///
Ea	>	W1	0	///
Ea	>	W2	0	///
Ea	>	W3	0	///
Ea	>	W4	0	///
Eb	>	E1	1	subsidies on renewable energies increase the share of renewable energy sources
Eb	>	E2	0	///
Eb	>	C1	1	subsidies on renewable energies increase the share of renewable energy sources which leads to reduced climate impacts

Eb	>	C2	1	subsidies on renewable energies increase the share of renewable energies which leads to reduced emissions
Eb	>	F1	1	subsidies on environmental cars increase the demand for fuel produced from forest biomass
Eb	>	F2	-1	subsidies on environmental cars increase the demand for fuel produced from forest biomass, which leads to less protection of forest biodiversity
Eb	>	H1	-1	subsidies on environmental cars increase the demand for fuel produced from fuel crops, which leads to less protection of agricultural biodiversity
Eb	>	H2	1	subsidies on environmental cars increase the demand for fuel produced from fuel crops
Eb	>	H3	0	///
Eb	>	H4	0	///
Eb	>	W1	0	///
Eb	>	W2	0	///
Eb	>	W3	0	///
Eb	>	W4	0	///
				CLIMATE
Ca	>	E1	1	taxes on fossil fuels increase the share of renewable energy
Ca	>	E2	0	///
Ca	>	C1	1	taxes on fossil fuels increase the share of renewable energy, which leads to reduced climate impacts
Ca	>	C2	1	taxes on fossil fuels increase the share of renewable energy, which leads to reduced emissions
Ca	>	F1	1	taxes on fossil fuels increase the share of renewable energy including forest biomass, which leads to reduced climate impacts

Ca	>	F2	-1	taxes on fossil fuels increase the share of renewable energy including forest biomass, which leads to less protection of forest biodiversity
Ca	>	H1	-1	taxes on fossil fuels increase the share of renewable energy including fuel crops, which leads to less protection of agricultural biodiversity
Ca	>	H2	1	taxes on fossil fuels increase the demand for fuel produced from fuel crops
Ca	>	H3	0	///
Ca	>	H4	0	///
Ca	>	W1	0	///
Ca	>	W2	0	///
Ca	>	W3	0	///
Ca	>	W4	0	///
				FOREST
Fa	>	E1	0	///
Fa	>	E2	0	///
Fa	>	C1	0	///
Fa	>	C2	0	///
Fa	>	F1	1	the Swedish forestry act specifies requirements as to how to manage forests in a sustainable way
Fa	>	F2	1	the Swedish forestry act specifies requirements as to how to protect natural and cultural forest values
Fa	>	H1	0	///
Fa	>	H2	0	///
Fa	>	H3	0	///

Fa	>	H4	0	///
Fa	>	W1	0	///
Fa	>	W2	0	///
Fa	>	W3	0	///
Fa	>	W4	0	///
Fb	>	E1	0	///
Fb	>	E2	0	///
Fb	>	C1	0	///
Fb	>	C2	0	///
Fb	>	F1	0	///
Fb	>	F2	1	forest certification standards contribute to maintaining forest biodiversity
Fb	>	H1	0	///
Fb	>	H2	0	///
Fb	>	H3	0	///
Fb	>	H4	0	///
Fb	>	W1	0	///
Fb	>	W2	0	///
Fb	>	W3	0	///
Fb	>	W4	0	///
				HORIZONTAL

Ha	>	E1	0	///
Ha	>	E2	0	///
Ha	>	C1	0	///
Ha	>	C2	0	///
Ha	>	F1	-1	Financial support for environmental measures in forests limits the potential for forest production
Ha	>	F2	1	Financial support for environmental measures in forests contributes to maintaining forest biodiversity
Ha	>	H1	1	Financial support for environmental measures in agriculture contributes to maintaining biodiversity
Ha	>	H2	-1	Financial support for environmental measures in agriculture limits the potential for agricultural production
Ha	>	H3	0	///
Ha	>	H4	0	///
Ha	>	W1	1	Financial support for environmental measures in forests and agriculture contributes to maintaining surface water quality
Ha	>	W2	1	Financial support for environmental measures in forests and agriculture contributes to maintaining groundwater quality
Ha	>	W3	1	Financial support for environmental measures in forests and agriculture contributes to maintaining wetland quality
Ha	>	W4	0	///
Hb	>	E1	1	The Environmental Code states that renewable energy sources should be used and it supports the reuse of energy
Hb	>	E2	0	///
Hb	>	C1	1	The Environmental Code states that renewable energy sources should be used, which leads to reduced climate impacts

Hb	>	C2	1	The Environmental Code states that renewable energy sources should be used, which leads to reduced emissions
Hb	>	F1	-1	The Environmental Code supports measures for maintaining forest biodiversity, which limits forest production potential
Hb	>	F2	1	The Environmental Code supports forest biodiversity
Hb	>	H1	1	The Environmental Code supports agricultural biodiversity
Hb	>	H2	-1	The Environmental Code supports biodiversity, which limits the potential for agricultural production
Hb	>	H3	1	The Environmental Code supports the protection of land and nature, which limits nutrients in soil and water
Hb	>	H4	1	The Environmental Code supports the protection of land and nature, which limits acidification
Hb	>	W1	1	The Environmental Code supports the protection of surface water quality and biodiversity
Hb	>	W2	1	The Environmental Code supports the protection of groundwater quality
Hb	>	W3	1	The Environmental Code supports the protection of wetlands
Hb	>	W4	0	///
Hc	>	E1	0	///
Hc	>	E2	0	///
Hc	>	C1	0	///
Hc	>	C2	0	///
Hc	>	F1	0	///
Hc	>	F2	0	///
Hc	>	H1	1	Certification of food and other products supports a more ecological production, which also takes care of biodiversity

Hc	>	H2	1/-1	Certification of food and other products supports a more ecological production. At the same time it may hinder regular intensive agricultural production
Hc	>	H3	0	///
Hc	>	H4	0	///
Hc	>	W1	0	///
Hc	>	W2	0	///
Hc	>	W3	0	///
Hc	>	W4	0	///
				WATER
Wa	>	E1	0	///
Wa	>	E2	0	///
Wa	>	C1	0	///
Wa	>	C2	0	///
Wa	>	F1	0	///
Wa	>	F2	0	///
Wa	>	H1	0	///
Wa	>	H2	0	///
Wa	>	H3	0	///
Wa	>	H4	0	///
Wa	>	W1	1	The Water Framework Directive supports ecological and chemical protection of water, thereby maintaining surface water quality
Wa	>	W2	1	The Water Framework Directive supports ecological and chemical protection of

				water, thereby maintaining groundwater quality
Wa	>	W3	1	The Water Framework Directive supports ecological and chemical protection of water, thereby maintaining wetland quality
Wa	>	W4	1	The Water Framework Directive supports cooperation and joint objective-setting, which helps to tackle flooding risk across basins
Wb	>	E1	0	///
Wb	>	E2	0	///
Wb	>	C1	0	///
Wb	>	C2	0	///
Wb	>	F1	0	///
Wb	>	F2	0	///
Wb	>	H1	0	///
Wb	>	H2	0	///
Wb	>	H3	0	///
Wb	>	H4	0	///
Wb	>	W1	0	///
Wb	>	W2	0	///
Wb	>	W3	0	///
Wb	>	W4	1	The Ordinance (SFS 2009:956) on Flood Risk regulates how to handle flooding
Wc	>	E1	0	///
Wc	>	E2	0	///
Wc	>	C1	0	///

Wc	>	C2	0	///
Wc	>	F1	0	///
Wc	>	F2	1	The voluntary agreement on water maintenance by forest owners ensures the protection of forest biodiversity
Wc	>	H1	1	The voluntary agreement on water maintenance by forest owners ensures the protection of agricultural biodiversity
Wc	>	H2	0	///
Wc	>	H3	0	///
Wc	>	H4	0	///
Wc	>	W1	1	The voluntary agreement on water maintenance by forest owners ensures the protection of surface water quality
Wc	>	W2	1	The voluntary agreement on water maintenance by forest owners ensures the protection of groundwater quality
Wc	>	W3	1	The voluntary agreement on water mainetnence by forest owners ensures the protection of wetland quality
Wc	>	W4	0	///

5.2.4 Overall Assessment

The results show that in most cases particular instruments used to achieve individual sectoral objectives were neither in conflict nor in synergy with objectives of other sectors.

However, in individual cases, the use of particular instruments had a potential to negatively influence on other sectors. For example, economic instruments supporting climate and energy goals had potential to negatively influence both forest and agricultural biodiversity (by supporting increased production of biomass and biofuels), or administrative regulations of the horizontal policies (i.e. Environmental Code) were constraining implementation of the production goals in both forestry and agriculture. These conflicts reflected the “traditional” conflict between production-oriented and conservation-oriented policies.

In other cases, there were positive interactions. For example, instruments from energy sector positively contributed to climate related policy objectives, and, similarly, instruments supporting climate policy supported implementation of the energy objectives. Another example is subsidies in the climate policies that support a market-oriented and competitive agricultural sector by providing development possibilities for the countryside.

In case of one instrument, namely food certification, both potential conflict and synergy could be observed concerning the objective of market-oriented and competitive agricultural sector. Food certification requires a limited amount of fertilizers and pesticides and higher environmental standards, thus limiting possibilities for intensive agricultural production. On the other hand, it had potential to contribute positively to the fulfillment of the objective in case of organic production, as certification standards supports its image on the market.

It is important to mention that the exercise regarding instruments at the first Stakeholder Workshop led to several comments, reflecting on the use of the instruments. First, stakeholders highlighted a multitude of local instruments that did not have high potential to influence sectors at larger scales. For example, there was a range of local conservation instruments in relation to both forest and water sector, as well as local support to small environmental projects, but the effects of such instruments were only local. Secondly, it was highlighted that which instruments are being used is changing with time, depending on the changing of the context (including political "climate"). Presently, climate change policies were perceived as the key priority. However, it was suggested that in the future the question of food security will gain much higher importance. Finally, the stakeholders claimed that there is a considerable difference between (1) existing instruments, (2) potentially useful instruments, and (3) instruments that are actually applied. This depends largely on current political prioritization. In addition, it was underlined that in Sweden, there are few very strong instruments and in most cases, politicians do not take hard decisions but instead aim at information and democratic debates in the society. According to the stakeholders' discussions on the workshop, this is not a sufficient way to go forward. The stakeholders believed that if one was to utilize mostly information-related instruments in implementing important policies it was very important to introduce environmental aspects early on in education systems to create a society that is aware of and can deal with environmental problems.

5.2.5 Validation

The initial selection of instruments existing in individual sectors was done based on the review of all relevant sectoral policies. Then, based on authors'' expertise and literature review most critical instruments were selected, which were thereafter refined based on input from the stakeholders at the first Stakeholder Workshop. As the stakeholders mentioned a multitude of rather local instruments that in many cases could not have large influence at larger scales, we considered instruments as "critical" if they had some potential to interact with nexus critical objectives. Scoring of the interactions between critical instruments and critical objectives was conducted by two researchers independently and then compared and refined. The scoring was also informed by the information on the interactions between different sectoral objectives (see section 5.1).

5.3 Assessment of vertical interactions between policies

5.3.1 Description of Vertical Interactions

The vertical interactions were assessed by two researchers, based on their expert knowledge, the literature review and the inputs from the stakeholders met at the first Stakeholder Workshop.

Table 24: Assessment of vertical interactions between vertical policies.

HIGHER>LOWER	
Higher level policies **successfully** implemented at lower scale	
Directive on promotion and use of renewable energy (2009/28/EC)	The goal is fulfilled; Sweden has set higher goals than EU (50% versus 20% renewable energy).
Higher level policies **only partly** implemented at lower scale	
Water Framework Directive (2000/60/EC)	Lack of coordination of activities in water sector. E.g., water authorities have no influence on forestry management.
Directive on conservation of natural habitats wild fauna and flora (92/43/EEC)	There is a need for restoration of large areas of habitat to be able to fully implement this directive.
Directive on flood protection (2007/60/EC)	Lack of coordination of water management in general and lack of coordination with water and groundwater directive.
Higher level policies **poorly** implemented at lower scale	
Directive on the conservation of wild birds (2009/147/EC)	Species protection is relevant for forestry, but there has not been much focus on working with this issue within this sector.
LOWER>HIGHER	
Lower level policies **fully** supported by higher level policies	
Ordinance (SFS 2009:956) on Flood Risk	Fully supported by EU Directive on flood protection (2007/60/EC), essentially the same regulations.
Environmental Code (SFS 1998:808), chapter 6, about environmental impact assessment	Fully supported by EU Directive on Environmental Impact Assessment (2011/92/EU), essentially the same regulations.

Lower level policies **<u>only partly</u>** supported by higher level policies	
Climate Policy Framework for Sweden (Gov. Bill 2016/17:146, passed in parliament 15 June, 2017)	Sweden has set higher goals than EU (50% vs. 20% renewable energy sources). Consequently, the EU Directive on promotion and use of renewable energy (2009/28/EC) is supporting the Swedish goals, but only up to the level of EU goals.
Lower level policies only partly supported by higher level policies	
The Swedish Forestry Act (SFS 1993:1096)	Habitat and Birds Directives hamper forest production.

5.3.2 Link between Vertical Interactions and critical objectives

While Sweden has implemented most of the EU policies "on paper", the actual implementation on the ground is still facing some challenges. One of the key policies that is facing problems in actual implementation is Water Framework Directive. This is because lack of coordination between different sectors that influence water management. Water authorities have been created to manage water issues at catchment level. However, these authorities have not much power over forestry authorities (which are rather independent) and forestry activities, or over municipalities that are relatively autonomous in their decisions, particularly when it comes to local spatial planning. Although there is some effort to coordinate water-related activities of different sectors, voluntary collaboration is not sufficient in the situation where stronger legal instruments to support that coordination are missing. Similarly, there is lack of coordination between the activities linked to implementation of the Water Framework Directive and the Groundwater Directive, leading to implementation that is not optimal.

In land-related sectors, a long-standing conflict between conservation and production policies can be observed. While conservation policies "on paper" are supposed to have equal power as production and development oriented policies, they are relatively less implemented. For example, Habitat Directive is not fully implemented yet in Sweden, as this would require large restoration efforts. In addition, the Birds Directive is not treated as priority in the forestry sector and protection of species is seen as hindering production.

As highlighted at the stakeholder workshop, not all EU policies are being implemented "as EU would like", because the local level of administration (i.e. municipalities) are self-governing and have considerable level of autonomy in taking decisions. Thus, there is not always a direct national level legislation that would directly steer municipalities' work. For example, some aspects of the EU climate policies are not directly transposed to national level binding legislation, but are rather being presented as recommendations. In this situation, some municipalities choose to work a lot with climate change related issues, while others do not priorities this policy area. Similarly, there are no strict forestry-related regulations that would encompass all forest owners, but Sweden promotes a model called "Freedom with responsibility" which assumes that the forest owner should have own responsibility to pursue more environmental goals (as added to production goals), with a help of advice from forestry authorities. This leads to situation that the potential activities of forest that support environmental and conservation objectives can only be done on voluntary bases.

Our analysis have also revealed some success stories. Particularly, the EU goals for renewable energy sources of 20 % have already been achieved in Sweden, and Sweden has set a higher goal (50 %). However, this also means that EU climate policy is too limited in relation to Swedish situation and thus does not support the ambitious Swedish policy goals (higher than EU goals). In addition, some Swedish legislation mean basically the same regulations as EU legislation, e.g. Sweden's policy on flood risks, or its regulations on environmental impact assessments included in the Environmental Code.

5.3.3 Validation

The researchers used the list of EU policies identified in the SIM4NEXUS WP 2 and selected the ones that were legally binding (mostly different Directives) for the evaluation in relation to the Swedish policies. The assessment of the vertical interactions was conducted based on researchers' expert knowledge and relevant literature. It was then validated on the first Stakeholder Workshop where the stakeholders provided their input on the level of implementation of particular policies and challenges linked to that.

5.4 Formal and informal arrangements adopted to address conflicts, negotiate trade-offs and exploit synergies in practice

Formal and informal arrangements (Table 25) were gathered from a literature review, expertise of the researchers, information from the first stakeholder workshop, and interviews conducted in previous research projects.

Table 25: Overview of formal and informal arrangements

TYPE OF ARRANGE-MENT	DESCRIPTION	FUNCTION	ENABLING & LIMITING FACTORS	EFFECT ON THE ACHIEVEMENT OF NEXUS-CRITICAL OBJECTIVES
formal	Appropriation directions from the government (public service agreements, so-called 'regleringsbrev')	Annual directions from the government provided to all authorities, outlining key activities, targets, budget and how the budget will be allocated to different activities. Specifies what goals should be achieved and the reporting required	Very strong regulatory instrument that authorities follow every year	Supports all critical objectives, however may change depending on priorities (e.g. Recent priorities in Sweden are linked to climate and energy objectives)
formal	Supervisory role of county boards in following up national level interests in local decisions	County boards are supervising local level decision making, checking if they are in line with national level policies and particularly the key national interests	There are established routines for this work that has been in operation for many years, so it is working effectively. The authorities usually have a long experience in combining different objectives in their decision making	Contributes to fulfilment of all critical nexus objectives, with particular importance for the different environmental quality objectives (on agriculture, forests, water quality, wetlands). Facilitates synergies between objectives
formal	Spatial planning system	Spatial planning is conducted at the level of municipalities to support land use	There are established routines for this work that has been in operation for many years, so it is working	Contributes to fulfilment of the nexus objectives linked to land (particularly

		decisions	effectively. The authorities usually have a long experience in combining different objectives in their decision making	agriculture) and environment (horizontal objectives). Facilitates synergies between objectives, as it coordinates different goals simultaneously
formal	Formal process of public participation (consultations, exhibitions, land owner meetings, etc.)	Process of participation allowing actors outside the formal planning system to participate in	Sweden is seen as pioneer in public participation arrangement and have long history of stakeholder involvement. However, in practice the quality of participation depends on particular representatives of authorities, thus some participation processes are of low quality (superficial participation)	Supports collaboration of different actors contributing to finding synergies between different critical objectives. Particularly important in land use (agricultural & environmental objectives) and infrastructural (energy objectives) decisions
formal	Ecological compensation required by Environmental Code	The legislation requires that compensation is conducted in situation of potential damages that an investment can impose.	There are no standards and routines yet on how to conduct a process of compensation, so it is still rarely conducted in practice. It only takes place if very strict legal requirement is in place, mostly in case of investments that can influence NATURA 2000 areas	Potentially would support environmental objectives, but still not well implemented in practice
formal	Regional development and cooperation in the environmental target system (RUS)	Network of county boards collaborating in the implementation of different environmental quality objectives. Main goal is knowledge	Driven by engaged individuals from county boards works quite well. Some funding from the environmental protection agency helped development of the important	Relevant particularly for environmental objectives and to land sector objectives

		exchange.	knowledge base. Still resources are lacking for full development of this initiative.	
informal	Collaboration organized by water authorities	Organized with an aim of coordinating activities across sector to facilitate implementation of water framework directive	The water authorities do not have formal power to influence forestry sector or municipalities, so they only can suggest collaboration. Forestry sector and municipalities participate but do not have strong incentives for common activities	Supports implementation of water related objectives, and, to some extent environmental objectives linked to forests, agriculture and water quality
Informal	EU project funding in the forestry sector	Forestry authorities apply for external funding to increase knowledge base, with focus on linking knowledge from different sectors (e.g. recent large life project "Grip On Life IP" about wetlands, forests and water management that will improve collaboration of local forestry authorities, county boards and fisheries management organizations) in water-related questions	With sufficient funding there is potential. However, the application process is usually very long and time consuming, which may hinder the application	Particularly forestry, water, energy and environmental objectives
Informal	Informal arrangements for knowledge sharing	Different authorities at local and regional level organize informal arrangements, working groups	The arrangements are not obligatory/binding and depend on "good will" of participants; thus in some situations they work very well, but not in others. Depend to large extent on local leaders	Depending on the sector may facilitate fulfilment of any objectives
informal	Informal collaboration with NGOs in promoting some	County boards and local municipalities collaboration with NGOs in pursuing	Works well through voluntary engagement of NGOs and support fork authorities side	Depending on NGO, can be about any objective,

	goals	some objectives (e.g. Wetland restoration by the Swedish Anglers Association supporting Thriving wetlands objective and different biodiversity objectives)	(win-win for both parts)	however in most cases links to environmental or land sector objectives

Most of the formal arrangements that are used in handling potential conflicts and facilitate synergies in Nexus objectives are well-established arrangements that have been operating in Sweden for many years and thus they work well. However, with changing political situation, the priorities given to different objectives may change. For example, formal appropriation directions from the government are presently more focused on climate, energy and production-oriented objectives, with slightly lower priority given to some environmental objectives linked to biodiversity (e.g. the implementation of ecosystem services concept is not suggested for implementation by the regional authorities, which prevent them from active work with it).

Informal arrangements are usually about collaboration, exchange of knowledge and common creation of important knowledge base. They rely on engagement of individuals and thus do not have strong formal support. However, can also be strongly supported, if both parties gain something from collaboration, like in the case of authorities collaborating with NGOs in fulfilling some objectives (NGOs do the actual work, which contributes to fulfilment of authorities' objectives, while authorities provide formal support).

5.5 Success stories and failures

Success stories (

Table 26) and failures (

Table 27) were gathered through a literature review, including both scientific papers and reports from national level authorities, expertise of the researchers, information gained form the representatives of different sectors at the first stakeholder workshop, and interviews conducted in previous research projects. Some of the stories are strongly linked to the analysis of the formal and informal arrangements described in previous section, but also some other have been added.

5.5.1 Description of Success Stories

Table 26: Overview of identified success stories

Type of successful policy arrangement	Description	Factors of success, Do's

Implementation of EU climate goals	While national level climate policies in Sweden are set very high, the EU levels for e.g. % of renewable energy have already been achieved	- High political will leading to prioritizing climate question - Publicity linked to climate objectives, image of Sweden as future fossil-free country
Progress in the implementation of Environmental Quality Objectives (EQOs)	The system of EQOs was introduced in Sweden in 1999. Although the country is presently not reaching many of the objectives set, there has been a clear progress in their implementation. Currently a well-established system of implementation and monitoring is in place and authorities from local, through regional to national level work with implementation of the EQOs.	- Presence of high level vision for the whole country - Presence of relatively structured system of implementing EQOs - Anchoring environmental work as one of the governmental priorities - Good communication of the EQOs at different levels - Annual reporting system - Good coordination system at County level
Implementation of agri-environmental measures in agriculture	Funding is provided within the EU Rural Development Programme to land owners that conduct different measures on their land that support environment	- Commitment of land owners - Financial support from European Union
Implementation of voluntary conservation measures in forestry	Established routines exists for creation of voluntary agreements between forestry authorities and forest owners to conduct more environmentally friendly management in some forest stands (conservation agreements, in Swedish: Naturvårdsavtal). There is financial support to forest owner, but it is not large, so this is still more voluntary agreement.	- Commitment of land owners - Trust towards forestry authorities (recognized authority) - Well-known system present for a long time - Financial support to land owners
Progress in the implementation of Water Framework Directive (WFD)	Although implementation of the WFD faces some challenges (see next Table), there is a clear progress. Sweden has created five key Water Authorities based on main catchments, which coordinate water management issues, with some success.	- Common interests and goals - Sharing knowledge and expertise
Regional development and cooperation in the environmental target system (RUS)	Network of county boards collaborating in the implementation of different environmental quality objectives. The main objective of the network is to collaborate and exchange knowledge. It has involved many different country boards and has led to increasing awareness with regard to different environmental issues	- Engaged individuals - Good collaboration - Good development of network of formal and informal contacts for a few year
Collaboration between an NGO, authorities and land-	A large-scale project organized by Swedish Anglers Association to restore wetlands for the sake of predatory fish	- Common interests and goals - Committed individuals within the NGO

owners in the context of a large scale wetland restoration project ("Predatory Fish" Project)	species. In last 5 years over 25 wetlands restored in different locations. Contributing to wetland and biodiversity related objectives of the authorities.	- Good contact between the NGO and the landowners - Commitment of landowners - Trust towards the established NGO from the landowners - Good relationship build overtime between the NGO and local and regional authorities - Ability to raise money from different sources (authorities and other organizations) on continuous basis

5.5.2 Description of Failures

Table 27: Overview of identified failures

Type of unsuccessful policy arrangement	Description	Factors of success, Do's
Implementation of biodiversity conservation policies	Notwithstanding some progress, Sweden have not fully implemented Natura 2000 policies yet. For example, there is still not sufficient coverage of particular habitats in Natura 2000 network and relatively many species protected by Habitat and Birds Directive still do not have favorable conservation status. Key problems is conflict between conservation and forestry. Among other things, to fully implement Habitat Directive there is a need for large restoration effort which is not in line with forestry production objectives	- Conflicting objectives and interests - Relatively low political priority given to biodiversity conservation, compared to production-oriented goals, particularly in the forestry sector
Failures in the implementation of Environmental Quality Objectives (EQOs)	Notwithstanding progress, most of the EQOs in Sweden are not being fulfilled. Main reason is that compared to energy, climate, forest production and economic development goals, environmental and particularly	- Relatively low priority given by politicians to environmental work - Lack of holistic view by politicians and decision makers - Sectoral divisions - Conflicting sectoral objectives - Lack of specific resources for

	conservation-oriented goals have much lower priority in practice (even if they have the same priority on paper). Especially, political agenda regarding climate change goals dominates over other environmental problems.	the EQOs work - Unclear responsibilities of the implementing authorities - Fundamental conflict between economic development and environment - Fundamental conflict between production and conservation - Increasing social trends such as consumption short-sightedness and globalisation
Combining production and conservation objectives in forestry sector	The forestry sector in Sweden is mostly oriented on wood production, even if conservation related goals are equal "on paper". In addition, certification standards (FSC, PFC) are not very directed towards conservation objectives. Finally, Swedish forestry is characterized by the "Freedom with responsibility" approach, i.e. much of what is happening in the forest depends on free will of forest owners and advice given by forestry authorities, but few aspects are regulated by formal legislation	- Conflicting objectives - Political priority given to production goal - Political priority given to climate change policies - Limited certification standards - Few regulatory instruments in forestry sector
Failures in the implementation of Water Framework Directive (WFD)	There is insufficient coordination of activities in water sector. Water authorities have no influence on forestry management or spatial planning of municipalities. There is some collaboration between these different actors, but not sufficient for implementation of all WFD's goal.	- Conflicting interests - Lack of power/political mandate by Water Authorities to influence other actors - Lack of regulations supporting such influence
Implementation of climate adaptation measures	There is no national level policy/objective to implement climate adaptation measures. Climate change policies focus entirely on climate mitigation. Although some actor, particularly forestry authorities and some municipalities attempt to also introduce adaptation measures, it is not	- Lack of political priority - Lack of knowledge

	anchored in any policy	
Ongoing conflict between housing development and environmental objectives, mainly conservation of biodiversity	In many locations in Sweden, there is a conflict between developing new housing areas and maintaining natural values, green areas, biodiversity, etc. Very often in such conflicts, the development objectives win over the environmental ones	- Population growth - Market forces - Higher priority given to economic development compared to environmental objectives
Certification of organic food	Although the market for organic production in food sector is growing, fulfilling requirements for high quality organic production by food producers do not lead to competitiveness on the market	- Market forces - Lack of profitability of more environmentally friendly food production

The examples of success and failure stories are presented in the tables above. The analysis shows that the main factors of success are linked to political will and priorities given at highest governance levels (like in the case of climate policy), structured and organized system of implementing particular policies (such as Environmental Quality Objectives), good communication, collaboration and coordination between different actors, as well as common interests and goals that lead to win-win solutions (like in the case of implementing wetland restoration by an NGO supported by authorities with shared interests). The issue of resources availability also came up as important success factor. For example, support from EU in implementation of agri-environmental measures in agriculture or financial support of conservation agreements in the forest are important for the implementation of biodiversity-oriented forestry and agricultural objectives.

The political will and priorities given at highest governance levels can also be factors behind failure to implement some objectives. For example, in contrast to climate, production and development objectives, objectives linked to environmental aspects and particularly biodiversity conservation have been given lower political priority, thus leading to limited implementation. Prevalence of priorities linked to economic development seem also to be linked to market forces that “promote” development and does not allow for higher “profitability” of more environmentally friendly activities (like in case of food certification). Similarly, in some cases lack of political mandate can be an obstacle to implementing particular policies, like in the case of Water Framework Directive, where Water Authorities have little influence over forestry and municipalities’ activities related to water, and can only provide recommendations. Other factors behind the failures described above are linked to a lacking holistic view and to sectoral divisions, including conflicting interests leading to conflicts. This is particularly visible in the implementation of Environmental Quality Objectives that represent horizontal policy influencing and being influenced by many different sectors; and in the general conflict between environmental versus production objectives (like e.g. in forestry sector). According to the Swedish Environmental Protection Agency (2011), when the production objective in one sector (e.g. forestry) is in conflict with Environmental Quality Objectives, in most cases the production objective shows up as most important and is steering for the development.

In some cases implementation of some policies revealed both partial success and failure. For example, both implementation of Water Framework Directive and of Swedish Environmental Objectives show relatively large progress, due to some particular success factors (see

Table 26 for details), while at the same time these policies are still not fully implemented due to particular failure factors (see

Table 27 for details).

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D2.2
WATER-LAND-ENERGY-FOOD-CLIMATE NEXUS: POLICIES AND POLICY COHERENCE IN ANDALUSIA (SPAIN)

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Acronyms

TERM	MEANING
AIA	Andalusian Irrigation Agenda
APREAN	Andalusian Association of Promoters and Producers of Renewable Energy
BOE	Official State Bulletin
BOJA	Official Andalusian Bulletin
AWU	Annual Work Units
CAP	Common Agricultural Policy
CENTER	National Center for Irrigation Technology
EECCEL	Spanish Climate Change and Clean Energy Strategy
EU	European Union
ESC	Economic and Social Council
ESYRCE	Spanish Survey of Surfaces and Crop Yields
FENACORE	National Federation of Water Users Associations
FERAGUA	Andalusian Federation of Water User Associations
GDP	Gross Domestic Products
GHG	Greenhouse Gas
GVA	Gross Value Added
IECA	Andalusian Institute of Statistics and Cartography
IFAPA	Andalusian Institute of Agricultural and Fisheries Research and Training
INE	National Institute of Statistics
MAPAMA	Ministry of Agriculture, Fishing and Food
MINETUR	Ministry of Industry, Energy and Tourism
NIP	National Irrigation Plan
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
PAAC	Andalusian Climate Action Plan
PASENER	Andalusian Sustainable Energy Plan
PLEAN	Andalusian Energy Plan
RBD	River Basin District
RBMP	River Basin Management Plan
RDP	Rural Development Programme
SP	Standard Production
TP	Type of farming
UAA	Utilised Agricultural Area
WFD	Water Framework Directive

1 Introduction

Water, energy, food and land are important resources for the socio-economic development in Andalusia. Their sustainable management requires the design and implementation of integrated policies that consider trade-offs and synergies among the different sectors, especially under the context of climate change that is adding more pressures on them. Nevertheless, policy incoherence within the water-energy-food-land-climate (WEFLC) nexus in this region has led to over-allocation of water resources, increasing competition for water among sectors, growing energy dependence in the agricultural sector, raising greenhouse gas (GHG) emissions, soil erosion and environmental degradation (Lopez-Gunn et al. 2012; Sampedro and Del Moral 2014; Berbel et al. 2014; Salmoral and Garrido 2015).

Over the last years, both the central and the regional governments implemented different irrigation plans to save water in the agricultural sector (MAPA 2001; Junta de Andalucía 2011). These plans achieved short-term water savings but might drive up demand in the medium-term, due to growing interest in high value crops (e.g., citrus fruits). Higher water supply guarantee, combined with the decoupling of the Common Agricultural Policy (CAP) aids, encouraged farmers to reduce land devoted to irrigated crops supported by the CAP in favour of market-oriented crops such as citrus fruits which are highly water demanding (Lopez-Gunn et al. 2012; Garcia et al. 2014).

Besides the impact of water and food, the replacement of open channels and surface irrigation systems by pressurised systems triggered an increase in energy consumption in irrigated agriculture. This, together with the liberalisation of the energy market in 2008, drove up water costs (Corominas and Cuevas 2017). Thus, energy has become the key irrigation driver; when energy requirements are high, farmers tend to apply deficit irrigation even having water available (Rodriguez Diaz et al. 2011).

In this context, we investigate how agricultural and environmental policies can be integrated to address pressures on land and water whilst promoting their sustainable use and economic development. To that end, we performed a policy coherence analysis in the WEFLC nexus in Andalusia. The work builds on a detailed review of policies for the different nexus sectors for Spain and Andalusia, as well as stakeholder opinions and researcher knowledge.

The document is structured as follows: section 2 describes the socio-economic context; section 3 presents the main stakeholders involved in decision-making in the nexus; section 4 includes the inventory of goals and means in the nexus at national level for Spain and at regional level for Andalusia; section 5 discusses policy coherence; and section 6 resumes main conclusions.

2 Socio-economic context

2.1 Location

Andalusia is an autonomous community (NUTs 2) located in the South of Spain that is composed by eight provinces (NUTS 3): Almeria, Cadiz, Cordoba, Granada, Huelva, Jaen, Malaga and Seville. Andalusia is the most populous Spanish region with 8.4 million inhabitants (18% of the national population) and the second largest region with 87,600 km^2 (17.3% of the total national area).

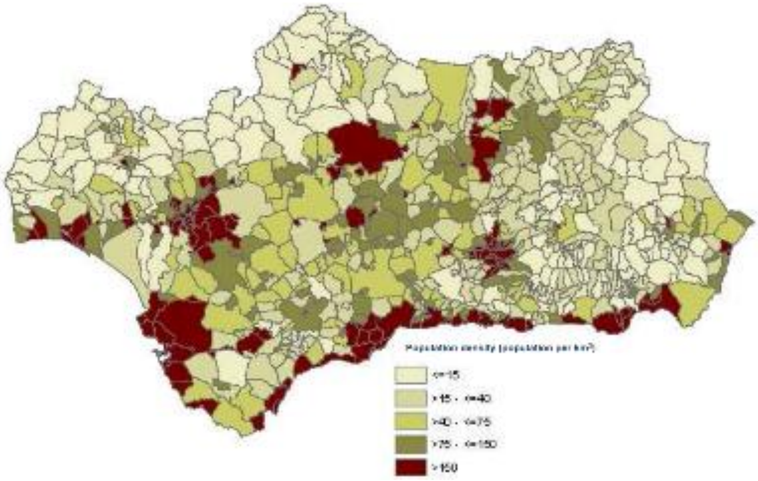
Figure 1: Location and regions of Andalusia

Source: Junta de Andalucía

The population is unevenly distributed across the territory (see Figure 2). Higher densities of population are located in capital cities and coastal areas (Seville, Malaga and Cadiz concentrate 57.3% of Andalusian population[1]), whilst lower densities are located in inland areas of Eastern Andalusia and North of the region (Almeria and Jaen). In Andalusia, 32% of the population live in rural areas, considered by the OECD as intermediate region in terms of rurality[2].

[1] INE. Población por provincias y tamaño de los municipios (2016).
[2] Junta de Andalucía. El sector agrario y pesquero en Andalucía.

Figure 2: Population density of Andalusia (2013)



Source: Junta de Andalucía

2.2 Governance

Each autonomous region in Spain has its own government and parliament. In Andalusia, the Regional Government is called "Junta de Andalucía". At provincial level, the governing body is called "Diputación provincial", which is in turn subdivided in different municipalities or City Councils (Andalusia is composed of 778).

Figure 3: Governance structure

National government
Judicial power, migration affairs, promotion of scientific and technological research, public works, etc.

Autonomous region
Junta de Andalucía
Legislative powers in agriculture, education health, urban planning, environment, tourism, etc.

Province
Diputación provincial
Assistance in waste management, water services, transport, etc.

Municipality
City council
Urban planning, water supply and waste management, public transport, maintenance of roads, tourism, etc.

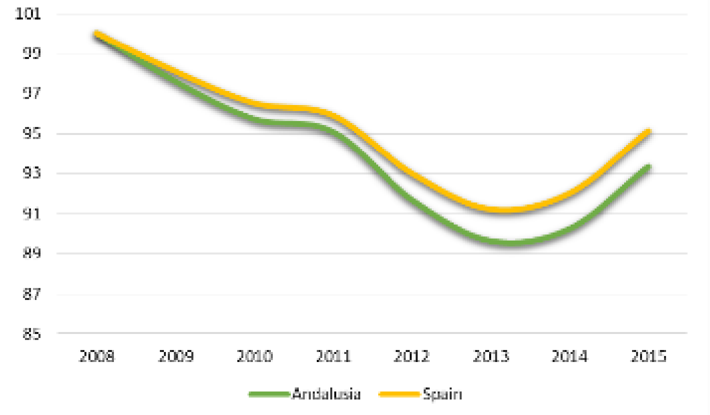
Source: Junta de Andalucía

In terms of internal organisation, the Andalusian Regional Government[3] (Junta de Andalucía) comprises thirteen regional ministries (Consejerías in Spanish): presidency and local administration; economy; financial and public administration; education; health; equity and welfare; employment, enterprise and trade; public works and housing; tourism and sports; culture; justice; agriculture, fishing and rural development; and environment and territory planning. Furthermore, some of them have satellite agencies, such as the Andalusian Water and Environment Agency appointed to the Regional Ministry of the Environment (Consejería de Medio Ambiente) or the Andalusian Energy Agency assigned to the Regional Ministry of Employment, Enterprise and Trade (Consejería de Empleo, Empresa y Comercio).

2.3 Economy and Employment overview

In 2015, Andalusia contributed with 130,500 M€ to the national Gross Value Added (GVA)[4] (13.4% of the total Spanish GVA) and accounted for 2.8 million of employees[5] (15.5% of national employment). These values placed Andalusia as the third Spanish region in terms of GVA and number of persons employed after Catalonia and Madrid.
The socioeconomic environment has been deeply marked by the international financial crisis in recent years. Thus, the Andalusian GVA decreased by 10.4 % between 2008 and 2013, whilst the Spanish GVA declined by 8.8% in the same period. These negative trends changed in 2013 when both the Andalusian and Spanish GVA started to pick up showing a positive trend, as shown in Figure 4.

Figure 4: Evolution of the total GVA in Andalusia and Spain (2008-2015, index 100 = 2008)

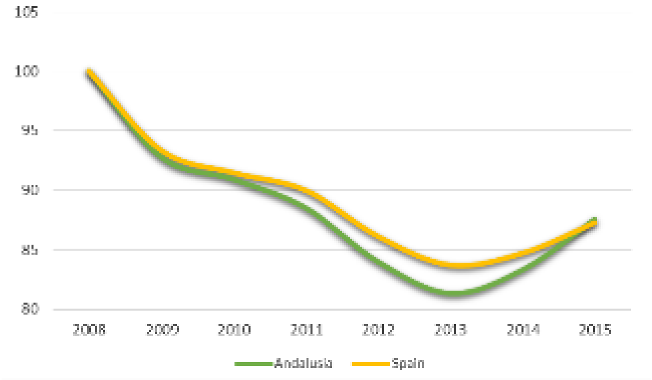


Source: INE

In terms of employment, trends have been much more critical. During the period 2008-2015, Andalusia and Spain experienced a drastic drop in the number of employees, reaching in 2013 a decrease of 18.6% and 16.3% respectively as compared with 2008. However, there has been a positive trend since 2013 in line with the GVA shown above (Figure 5).

[3] Organization chart of the Junta de Andalucía.
[4] INE. PIB a precios de mercado y valor añadido bruto a precios básicos por ramas de actividad: Precios corrientes por comunidades y ciudades autónomas y periodo.
[5] INE. Ocupados por grupo de edad, sexo y comunidad autónoma. Valores absolutos.

Figure 5: Evolution of employed persons in Andalusia and Spain (2008-2015, index 100 = 2008)

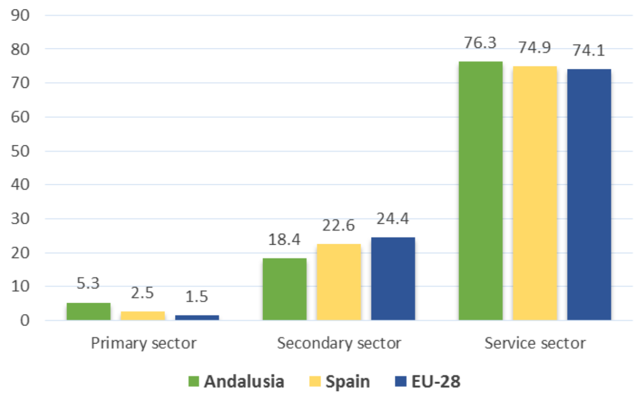


Source: INE

2.4 Economy and employment by sector

According to data from 2015, the service sector accounted for 76.3% of regional GVA while the secondary sector accounted for 18.4% and primary sector for 5.3%[6]. The primary and the service sectors in Andalusia represented a larger share in the GVA than in Spain and Europe (see Figure 6). It is remarkable that the weight of the primary sector in Andalusia (5.3%) was three times the weight of the primary sector in EU-28 (1.5%) and nearly twice the weight of the primary sector in Spain (2.5%).

Figure 6: GVA contribution by economic sector in Andalusia, Spain and Europe (2015, %)

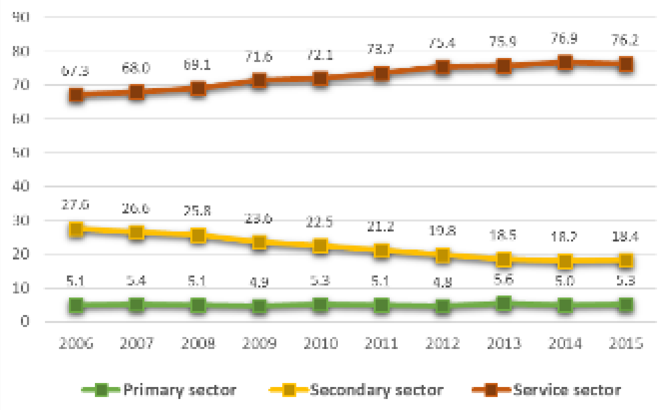


Source: INE, Eurostat and IECA

The contribution of each economic sector to the Andalusian GVA has changed over the last years. For the period 2006-2015, the dominance of the service sector increased in 8.9 points, whilst the weight of the secondary sector decreased significantly (9.2 points) and the weight of the primary sector increased slightly (0.2 points).

Figure 7: Evolution of GVA by economic sector in Andalusia (2006-2015, %).

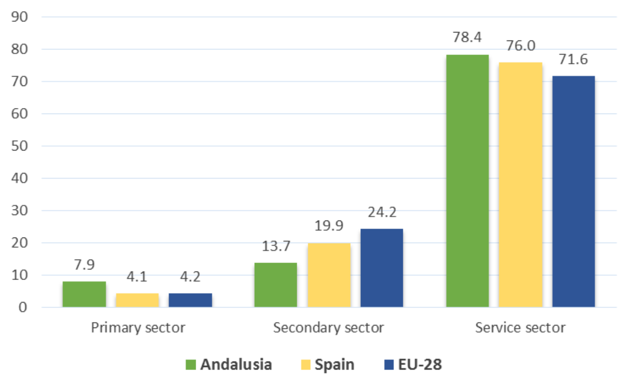
[6] INE. PIB a precios de mercado y valor añadido bruto a precios básicos por ramas de actividad: Precios corrientes por comunidades y ciudades autónomas y periodo.



Source: INE

In terms of employment, in 2015 the service sector was also the major employer (78.4%), followed by the secondary sector (13.7%) and the primary sector (7.9%). Andalusia's contribution of the primary and service sectors to regional employment stands at 7.9% and 78.4%, respectively, higher than in Spain (4.1% and 76.0%) and Europe (4.2% and 71.6%).

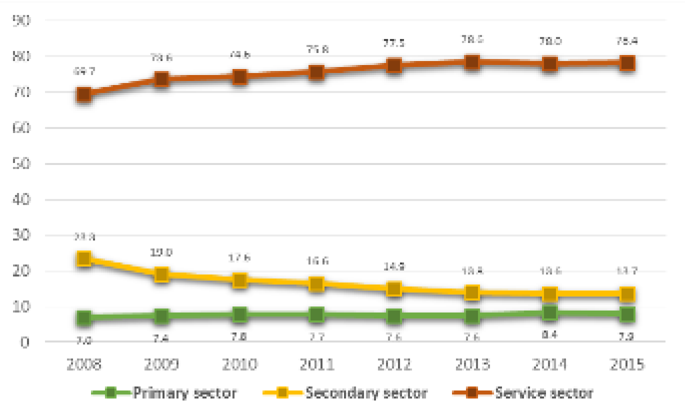
Figure 8: Employment contribution by economic sector in Andalusia, Spain and Europe (2015)



Source: INE and Eurostat

Looking at trends in employment by economic sector, for the period 2008-2015, the weight of the service sector increased 8.7 points, whilst the secondary sector decreased 9.6 points, and the primary sector increased its contribution slightly by 0.9 points.

Figure 9: Evolution of employed persons in Andalusia (2008-2015, %)

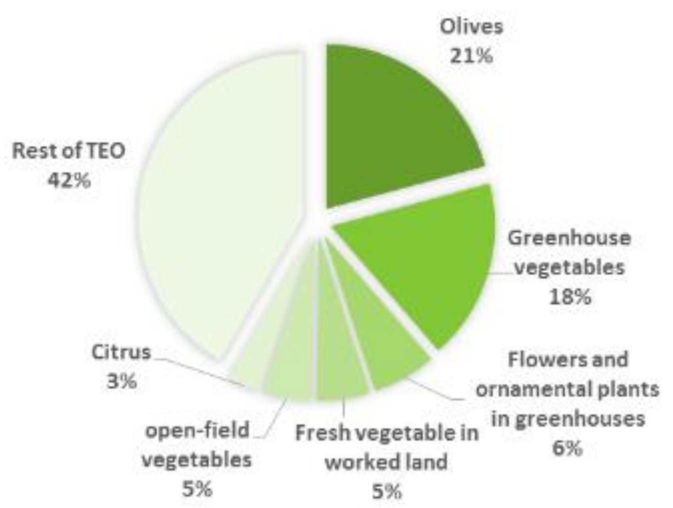

90
80
70
60
50
40
30
20
10
0
2008
2009
2010
2011
2012
2013
2014
2015
Primary sector
Secondary sector
Service sector

Source: INE

2.4.1 Andalusian Primary Sector

The Andalusian agriculture plays an important role within the Spanish agricultural production. In 2015, the Andalusian primary sector generated a total amount of 7,022 million of euros in terms of GVA [7], which placed Andalusia as the main contributor to the Spanish primary sector.
Turning to the total standard production (SP)[8], the main type of farming (TP) in Andalusia are olives (which represent 20.8% of the SP[9]) and greenhouse vegetables (17.8% of the SP) (see Figure 10).

Figure 10: Standard production in Andalusian primary sector (2013, %)



Source: Junta de Andalucía

In terms of employment, in 2015 Andalusia was the region with the largest number of agricultural workers in absolute terms (218,900 employees), representing 29.7% of the national agricultural employees.
In terms of Annual Work Units (AWUs), olives had the major share in terms of employment (39.6%) in 2013, followed by greenhouse vegetables and flower farming (21.0%). These values converted Andalusia into one of the main agricultural regions in Spain.

2.4.2 Secondary Sector

The two main subsectors[10] in terms of GVA within the Andalusian secondary sector were "manufacturing" (10,660 M€) and "construction" (7,900 M€) in 2014[11]. Both subsectors represented 78.4% of the Andalusian GVA secondary sector.

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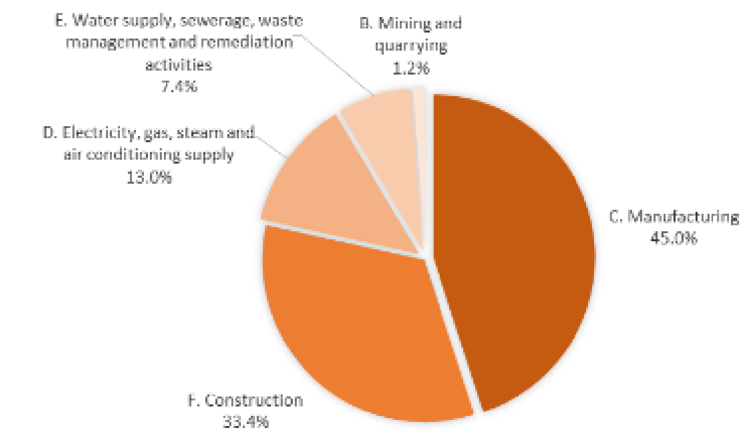
[7] INE. PIB a precios de mercado y valor añadido bruto a precios básicos por ramas de actividad: Precios corrientes por comunidades y ciudades autónomas y periodo.
[8] According to Eurostat, the standard production is the average monetary value of the agricultural output at farm-gate price, in euro per hectare or per head of livestock.
[9] Junta de Andalucía. El sector agrario y pesquero en Andalucía.

[10] Using nomenclature of NACE Rev.2.

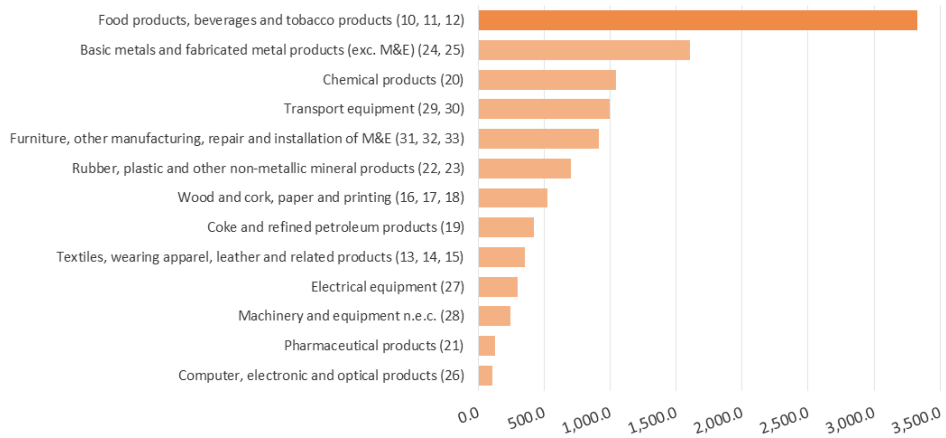
Figure 11: GVA by secondary sector sections in Andalusia (2014, %)



Source: IECA

With regards to manufacturing, the divisions food products, beverages and tobacco products represent the main part of manufacturing GVA with 31.2% (3,326 M€). The second position is occupied by manufacture of basic metals and fabricated metal products with 15.1% (1,605.6 M€) and the third position by chemical products with 9.8% (1,044 M€).

Figure 12: GVA by divisions of Manufacturing section (2014, M€)

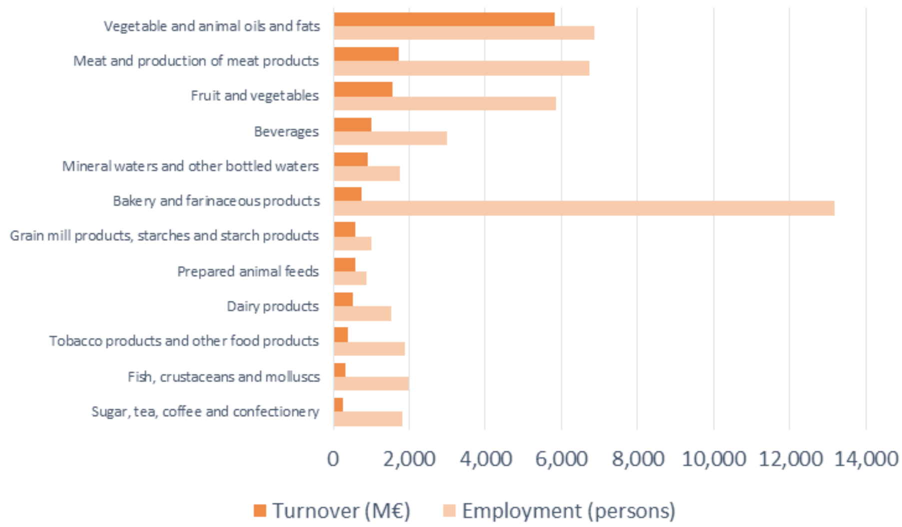


Source: IECA

[11] IECA. Contabilidad Regional Anual de Andalucía. Base 2010. Producto interior bruto a precios de mercado y sus componentes. Precios corrientes.

Focusing on the Andalusian agroindustry (food, beverages and tobacco industries), it occupies the second position in terms of GVA within the national agroindustry according to 2014 data (Andalusia represents 12.4%, behind Catalonia, which represents 22.9%)[12].
Furthermore, the Andalusian agroindustry employed 46,465 persons in 2014, representing the 13.0% of the agroindustry national employment (it is also the second region with most workers, after Catalonia).
In terms of turnover, the main group in the Andalusian agroindustry is oils and fats, which reached 5,831 M€ in 2014 (which represents 40.3% of the regional agroindustry turnover), followed by meat production (1,737 M€, which represents 12.0%) and fruit and vegetables (1,569 M€, which represents 10.8%)[13]. However, in terms of employment, the most important sector is the bakery sector, which occupies 13,164 persons (28.3% of agroindustry employment), followed by oils and fats with 6,877 persons (14.8%) and meat production with 6,744 persons (14.5%).

Figure 13: Turnover and employment by group of manufacturing section (2014)



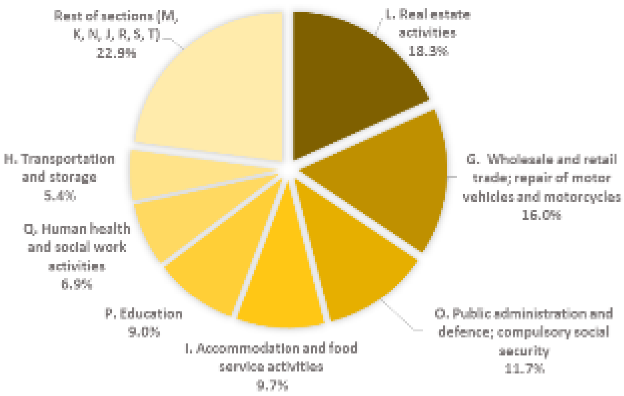
Source: EIAE and IECA

2.4.3 Service Sector

The main subsectors within the service sector in terms of GVA are "real estate activities" with 17,650 M€ (which represents 18.3% of regional service sector GVA), "wholesale and retail sale" with 15,457 M€ (which represents 16.0%) and "public administration and defence" with 11,241 M€ (11.7% of Andalusian service sector).

Figure 14: GVA by section of regional service sector (2014, %)

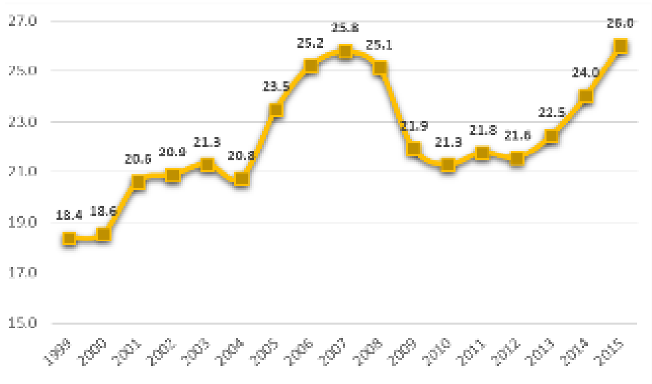
[12] MAPAMA. Informe anual de la industria alimentaria española. Periodo 2014-2015.
[13] Unicaja. Análisis económicos. Informe anual del sector agrario en Andalucía 2015.



Source: IECA

Focus on tourism, the number of tourists registered in Andalusia has steadily increased over the last years, reaching 26 million in 2015 (Consejería de Empleo y Conocimiento 2016). The average expenditure per day was 62.8 € and average stay was 8.7 days. Thus, the tourism sector generated in 2015 a total amount of 14,152.4 M€, which represents 9.4% of the Andalusian GDP. In terms of employment, the number of employees on tourism activities[14] reached 357,000 people in 2015.

Figure 15: Number of tourist in Andalusia (1999-2015, millions of persons)



Source: IECA

[14] Tourism sector employment is estimated by Junta de Andalucía as the aggregation of Divisions 49, 50, 51, 55, 56, 77, 79, 90, 91, 92, and 93 of NACE rev. 2 classification.

3 Mapping of stakeholders

3.1 Description of stakeholders

Considering the main nexus policy challenges to be addressed in the case study of Andalusia, the main stakeholders from the sectors of water, food and energy, both at public and private levels have been identified and contacted to ensure that all views are represented.

3.1.1 Public sector

Regional Ministry of the Environment and Territory Planning (RMETP)
Consejería de Medio ambiente y Ordenación del Territorio
The regional government has competences in the areas of environment, water and planning and land use management, in particular:

- Development, evaluation and monitoring of strategies, plans and programs in land, costal and urban planning.
- Promotion, coordination and development of climate change related policies.
- Water policy and promotion of sustainable water use.
- Hydrological planning in Andalusian river basins.
- Coordination of water and environmental policies.
- Biodiversity conservation and sustainable use of natural resources.

Regional Ministry of the Agriculture, Fishing and Rural Development (RGAFRD)
Consejería de Agricultura, Pesca y Desarrollo Rural
This regional governmental body has competences in the areas of agriculture, livestock, fishing, agri-food industry and rural development, in particular:

- Planning, reform and development of the agricultural and livestock producing sectors.
- Organic production policy, as well as the promotion of the use of methods of agricultural production compatible with the requirements of protection of the environment and conservation of the natural environment.
- Definition of the policy of support to the Andalusian agro-industry.
- Elaboration and implementation of rural development strategies and plans.
- Promotion and coordination of rural infrastructure plans and programs.
- Management of the European Agricultural Funds.
-

Regional Ministry Tourism and Sports (RMTS)
Consejería de Turismo y Deporte
This regional ministry has powers in the area of tourism in Andalusia. In particular, development of draft laws; planning, monitoring and evaluation of tourism strategies; and development actions and programmes to support and promote tourism activities, in particular:

- Development of strategies and guidelines regarding tourism planning.
- Development, implementation and monitoring of the General Tourism Plan.
- Promotion of innovation and the technological improvement for tourist companies and establishments.
- Elaboration of proposals and projects of tourist planning and promotion

- Enhance tourism diversification and the design of new tourism products in a context of public-private collaboration.
-

Environment and Water Agency of Andalusia (EWAA)
Agencia de Medio Ambiente y Agua
This agency is an autonomous organism that belongs to the Regional Ministry for the Environment. The general objective of this agency is the protection and improvement of the environment, the integral management of the water cycle and provision of services and the management and implementation of interventions entrusted by public or private entities in the territory in Andalusia. The functions of the Agency are:

- Evaluation and implementation of actions to cope with climate change.
- Development of water policies in Andalusia (management and maintenance of hydraulic infrastructures, management of programs to face erosion, desertification and sustainable water use).
- Development of planning measures related to the natural and rural environment.
- Promote the green economy and sustainable development of territory.
- Enhance innovation and R&D in territory, environment and water.
- Conservation of biodiversity and geodiversity of Andalusia.

Andalusian Energy Agency (AEA)
Agencia Andaluza de la Energía
The Andalusian Energy Agency is a government-owned entity assigned to the Regional Ministry of Employment, Enterprise and Trade, increasing the use of indigenous renewable resources and actions of energy saving and efficiency and demand management. The main functions of the agency are:

- Develop the policies of the Andalusian Regional Government aimed at optimising the energy supply in the region, from an economical and environmental point of view.
- Support projects of interest for the transformation of the Andalusian energy system.
- Develop programs and initiatives to promote savings, energy efficiency and the use of renewable resources.

Provincial Council (PC)
Diputación provincial
The Provincial Council is the administrative institution in charge of the provincial government. The main functions are:

- Provide assistance to municipalities in legal, economic, social services, urban planning and human resources issues.
- Waterworks and sanitation, energy, environment and urban waste management.
- Interventions in the agricultural, forest, rural development and agri-food sectors.

Guadalquivir River Basin Authority (GRBA)
Confederación Hidrográfica del Guadalquivir
The Guadalquivir River Basin Authority is a public corporation with legal personality and distinct from the state, assigned for administrative purposes to the Ministry of Environment and Rural and Marine Affairs. The main functions are:

- Development of the hydrological river basin plan, as well as its monitoring and review.

- Management and control of the hydraulic public domain.
- Administration and control of the water uses of general interest or those affecting more than one region.
- Project, construction and exploitation of the waterworks carried out by the agency's own funds, and those entrusted to them by the State.

3.1.2 Private sector

National Federation of Water Users Associations (FENACORE)
Federación Nacional de Comunidades de Regantes (FENACORE)
FENACORE is a private non-profit association that comprises of irrigation water users' associations (WUAs) throughout Spain. This organisation represents more than 700,000 irrigation users and encompasses 80% of national irrigated area. The objective of FENACORE is to defend the interests and rights of irrigators, harmonizing the effort and work of all the parties involved in the Spanish irrigation and collaborating closely with the different public administrations in the design of the country's water policy.
In this sense, FENACORE collaborated in the drafting of the Water Law and its Regulations, the preparation of the National Hydrological Plan (NHP), the preparation of the National Irrigation Plan (PNR) and the Water Law Reform Bill, the White Paper on Water Framework Directive or the Community Water Framework Directive. Recently, FENACORE has participated, among others, in hydrological planning or in drafting of new hydrological basin plans.
FENACORE works closely with the Ministry of Agriculture, Food and Environment. In addition, FENACORE is also a designated vocal of the National Water Council by Royal Decree and was at the time a founding member of the Environmental Advisory Council.
FENACORE also develops different activities such as:

- Legal and technical advice to irrigation communities.
- Collaboration with the Ministry of Agriculture in the planning of irrigation structures, improvement and diffusion of irrigation techniques, knowledge of the real problems affecting irrigation, etc.
- Seminars and conferences to defend the interests of irrigation communities and the reality of Spanish irrigation.
- Training courses for the irrigator through the National Centre for Irrigation Technology (CENTER).
- Information through the issuance of periodic circulars on topical issues (legislation, judgments, technical reports, etc.) and activities carried out by FENACORE.
- Incorporation of new technologies to irrigation management. It promotes the CORENET project, a "virtual irrigation office" that allows farmers to manage their plots through the Internet and verify their water and energy consumption according to a set optimal.

Andalusian Federation of Water User Associations (FERAGUA)
Asociación de Comunidades de Regantes de Andalucía (FERAGUA)
FERAGUA is a private association that includes WUAs across Andalusia, covering 300,000 ha representing 30% of the irrigated area in the region.

- Defence of the interests of the Andalusian irrigation.
- Technical and legal advice to the associated WUAs.
- Representation of WUAs interests before the Local, Regional and National Administration.

- Dissemination and defence of irrigation approaches amongst public opinion through participation in the public debate and the media.
- Administrative or jurisdictional claims and appeals arising in defence WUAs.
- Participation in the national irrigation representation movement, through fluid communication with FENACORE.
- Training and R&D services for the improvement of water use efficiency and productivity improvement.
- Advise to optimise the cost of electric energy (invoice control and energy auditing).

Farmer Organisation Coordinator (COAG)
Coordinadora de Organizaciones de Agricultores y Ganaderos (COAG)
COAG is a private agricultural professional organisation represented in different regions in Spain whose main objective is the defence of farmers' interests at national level. This organisation assists more than 150,000 farmers through its 220 offices throughout the national territory and a permanent delegation in Brussels. It is recognized by the Ministry of Agriculture as the most representative agrarian organization and as such is part of the Agrarian Advisory Committee and member of the Economic and Social Council (ESC), COPA-COGECA and the European Coordinator Vía Campesina.
Andalusian Association of Promoters and Producers of Renewable Energy (APREAN)
Asociación Andaluza de Promotores y Productores de Energía Renovable (APREAN)
APREAN is a business association composed of a hundred regional, national and international renewable energy companies. The organisation was born to coordinate the action of promoters and production companies of wind power, solar photovoltaic, solar thermoelectric and biomass energy. Therefore, APREAN Renewable works as a negotiator/speaker with the local, regional and central Administration and with any public or private organization. Its main objective is to represent, coordinate and defend the common professional, economic and business interests of its members and participates in the development of policies and especially energy and environmental policies.
Furthermore, it provides its members with all the information related to legislation, subventions, studies and information regarding renewable energy as well as training to employees.

3.1.3 NGOs

WWF
WWF is a global environmental conservation organisation presented in more than 80 countries. The objective of WWF is conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable and promoting the reduction of pollution and wasteful consumption.
WWF-Spain participate in advocacy and lobby actions to:
- Promote an energy transition law aimed at a 100% renewable, efficient and fair energy model by 2050.
- Encourage sustainable water use management (adequate ecological flows and complaint in relation with illegal wells).
- Boost sustainable food production (policy advocacy to change the CAP, promote high nature value agricultural systems).
- Avoid illegal agricultural activities and water overexploitation in Doñana Nature Park (Andalusia).

3.1.4 Research and education

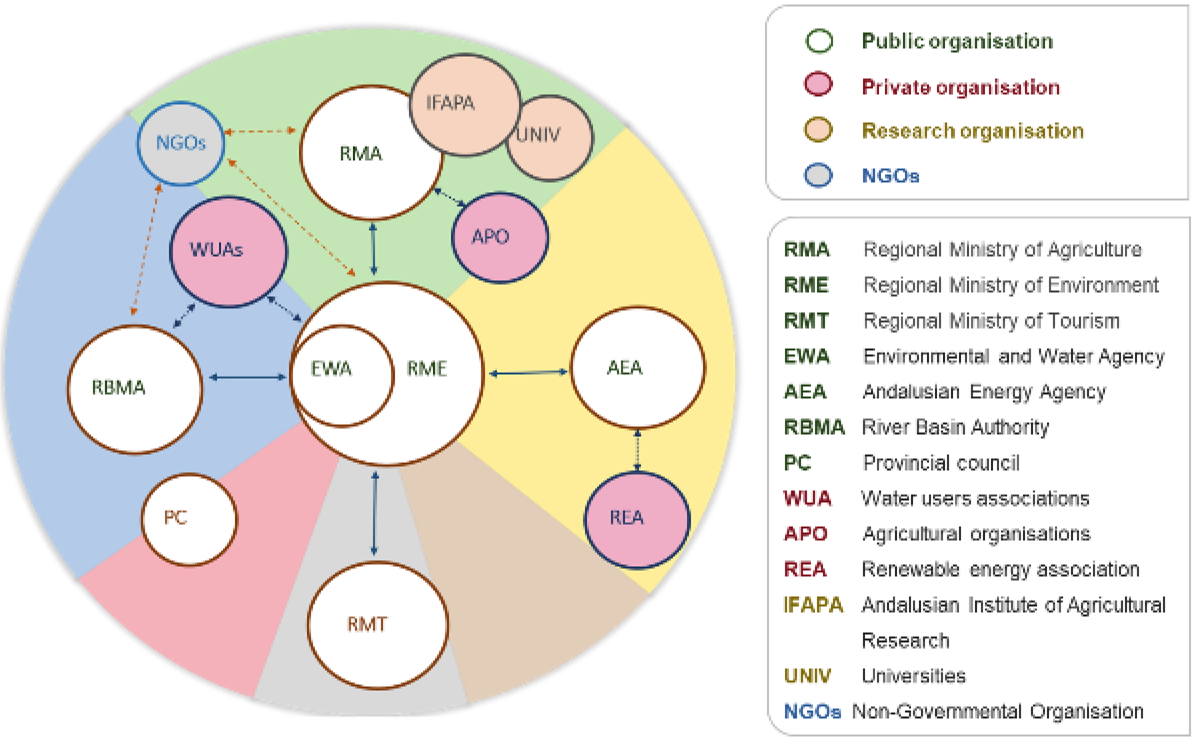
Andalusian Institute of Agricultural and Fisheries Research and Training (IFAPA)
Instituto de Formación e Investigación Agraria y Pesquera (IFAPA)
IFAPA is an autonomous body with independent legal status assigned to the Andalusian Regional Ministry for Agriculture, Fisheries and Rural Development. The objectives of the institute are to contribute to the modernization of agriculture, fisheries and agrifood sectors, as well as to improve its competitiveness through research, development, technology transfer and training.
The main functions of the institute are:

- Support the Andalusian Administration in formulating policies related to agriculture, fisheries, agri-food according to the European R&D Framework Programme.
- Design and development of sectorial research plans in collaboration with the sector
- Foster research, innovation, development and application of those production systems that benefit farms, consumers and the environment.
- Planning and carry out training programs for the agricultural and fishing sector
- Provision of services, studies and consultancy aimed at improving the productive sectors.
- Foster the collaboration with other private and public organizations in research and technology transfer.

University of Cordoba (UCO)
Unversidad de Córdoba (UCO)
Research and education institution with an extensive experience in research on sustainable water use and irrigation energy efficiency.
University of Almeria (UAL)
Universidad de Almería (UAL)
Research and education institution with an extensive experience on sustainable water use and water policy.

3.2 Map of relevant stakeholders and relationships

Figure 16: Map of relevant stakeholders and relationships



3.3 Power/interest grids

Figure 17: Power/interest of organizations on water issues

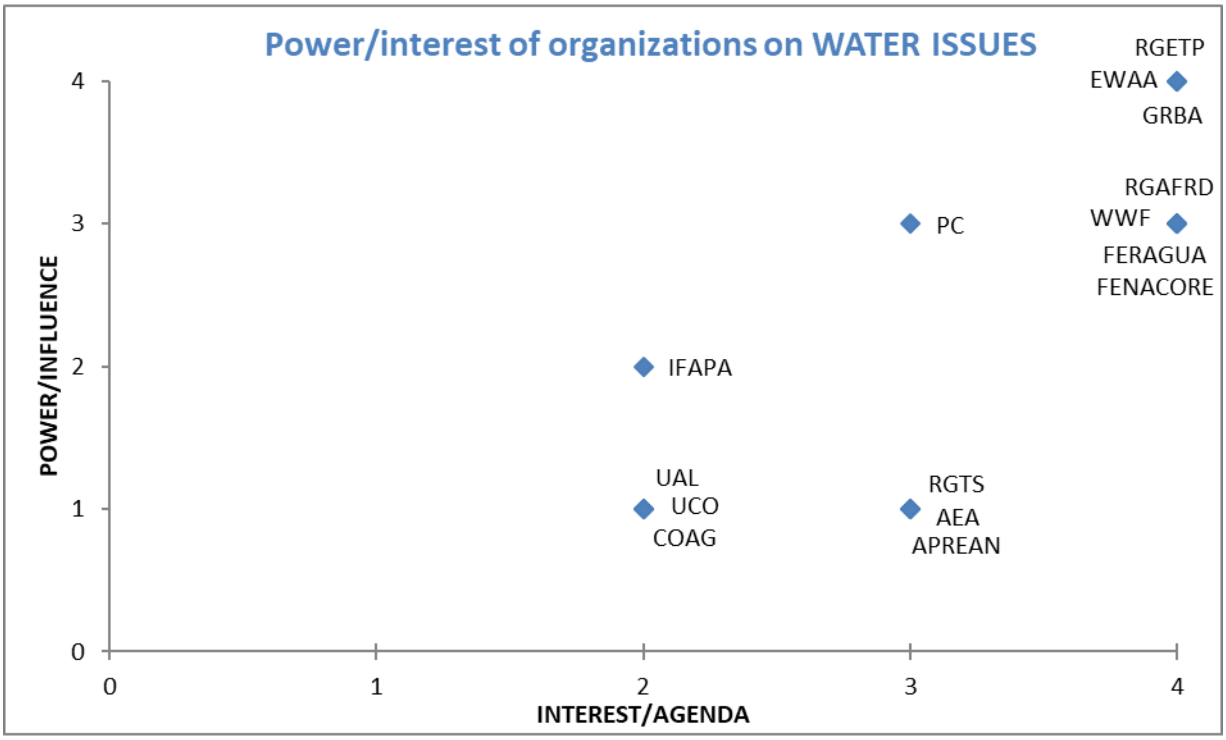


Figure 18: Power/interest of organizations on energy issues

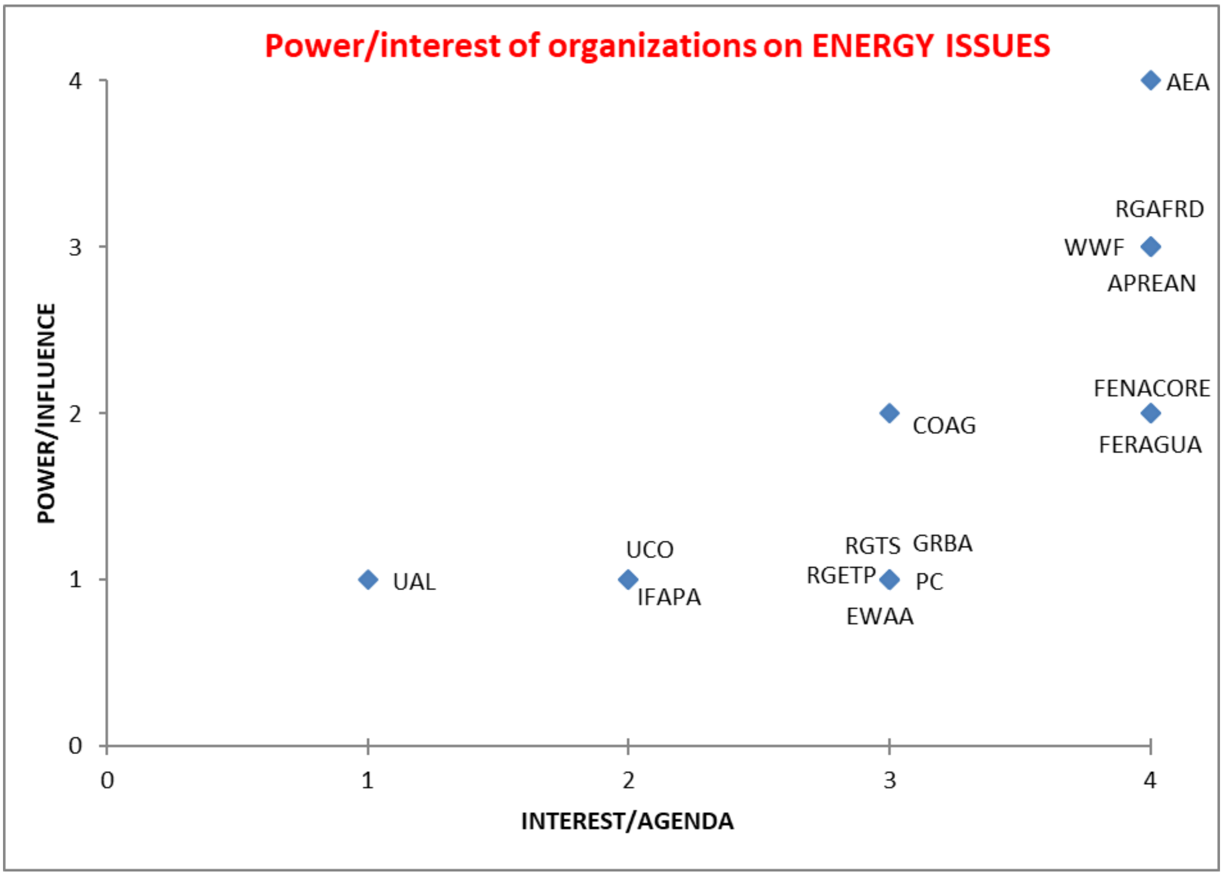


Figure 19: Power/interest of organizations on agriculture and food issues

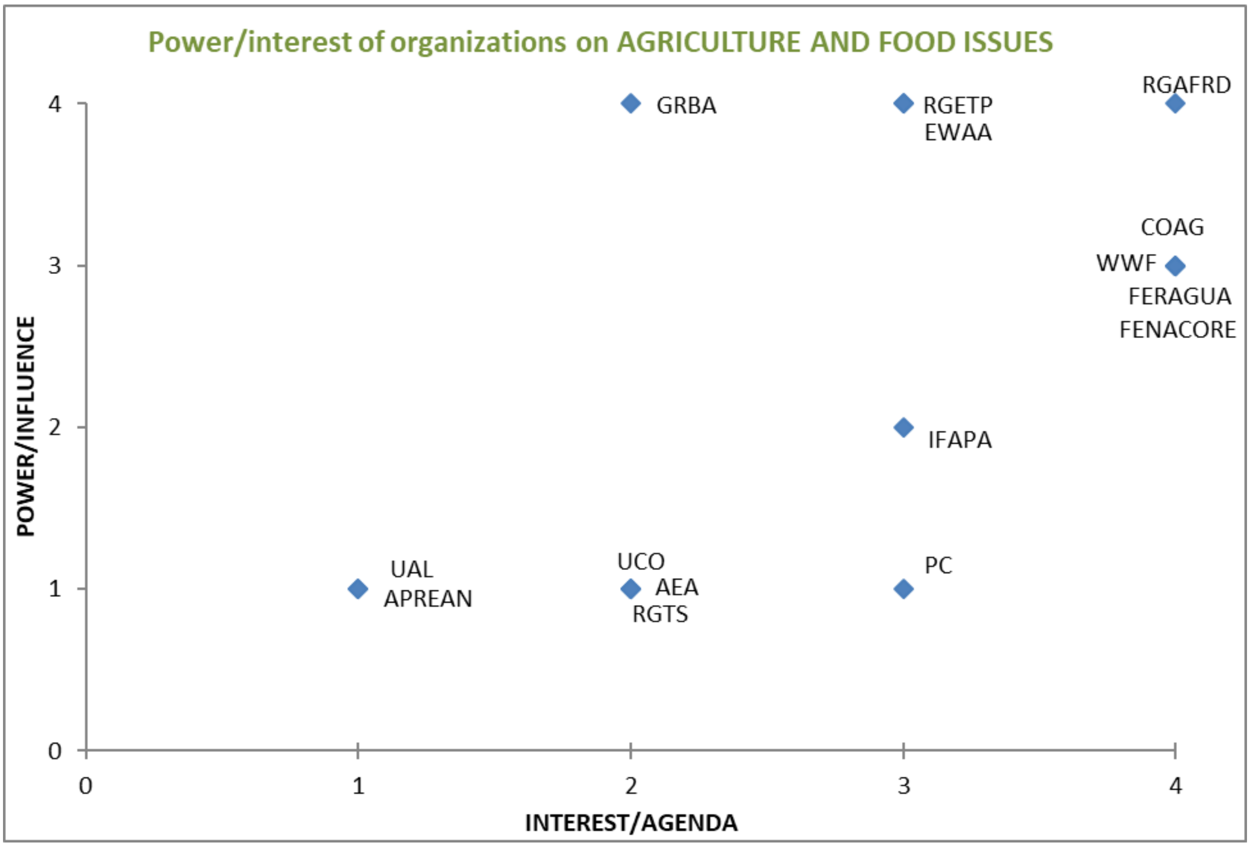


Figure 20: Power/interest of organizations on land issues

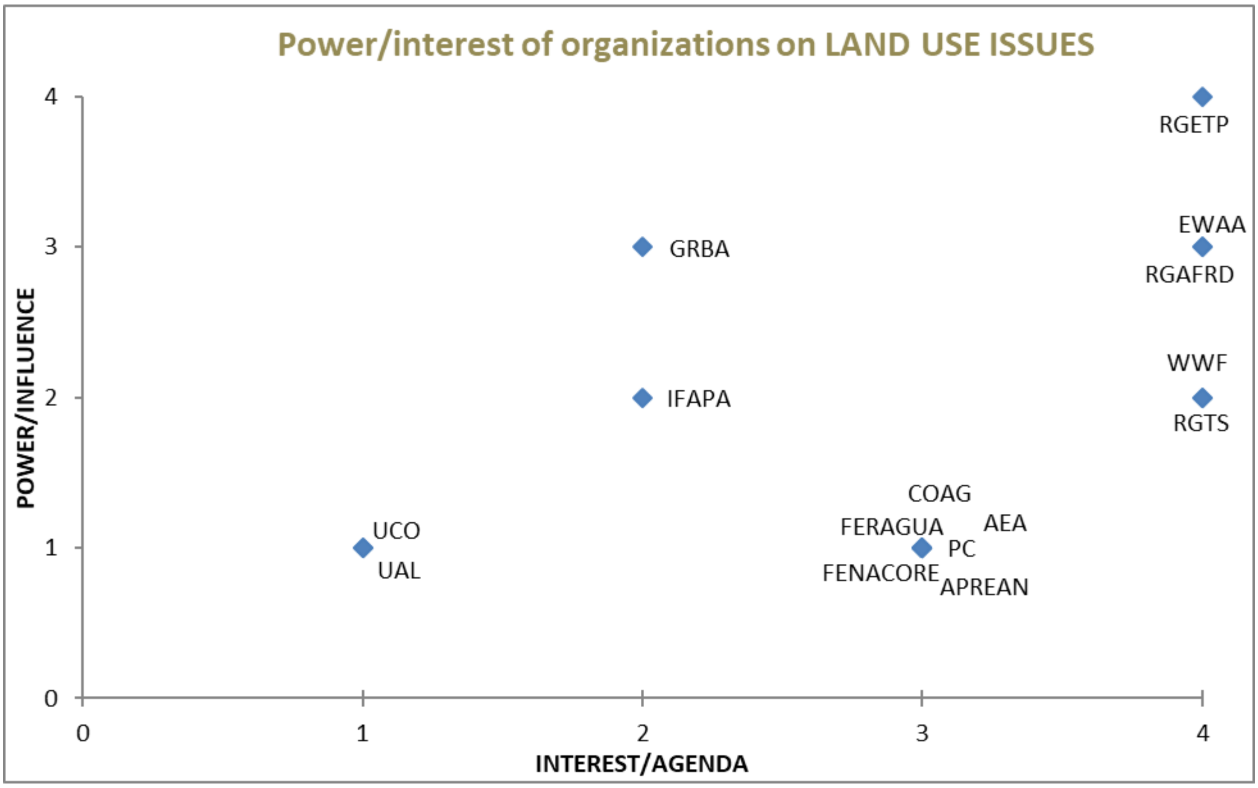


Figure 21: Power/interest of organizations on climate issues

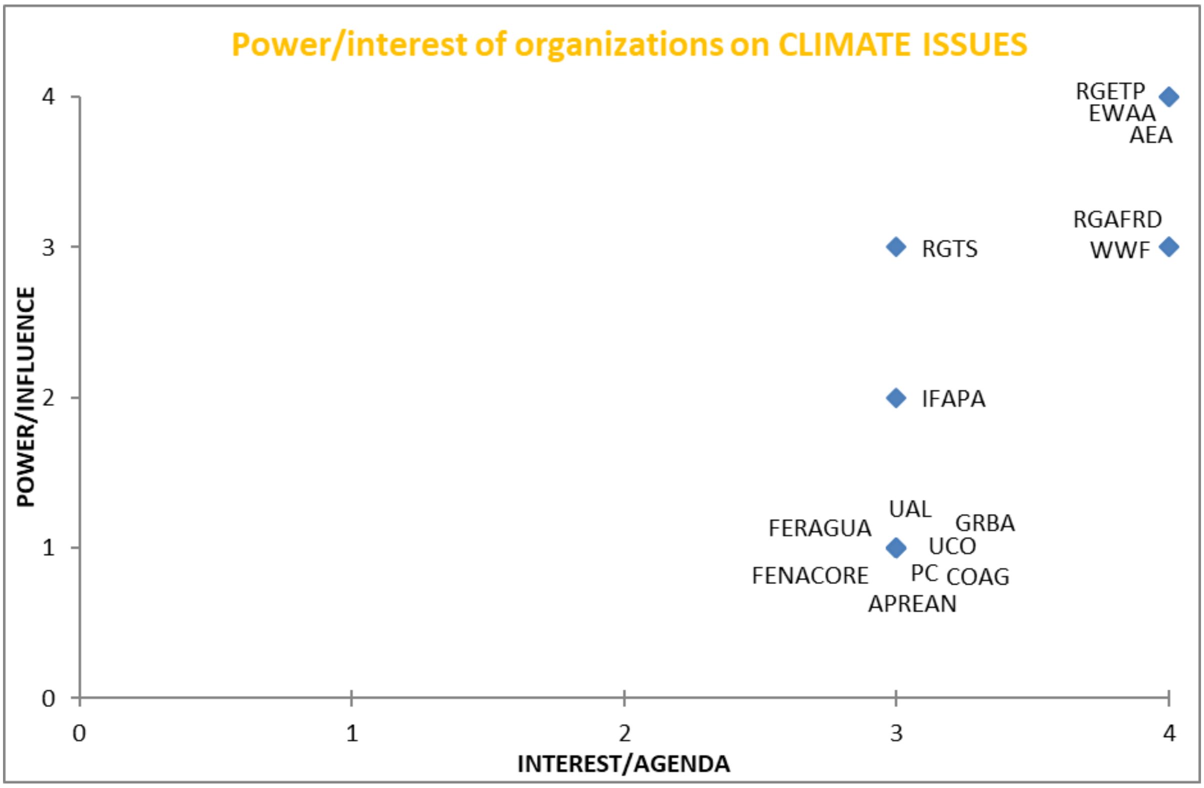
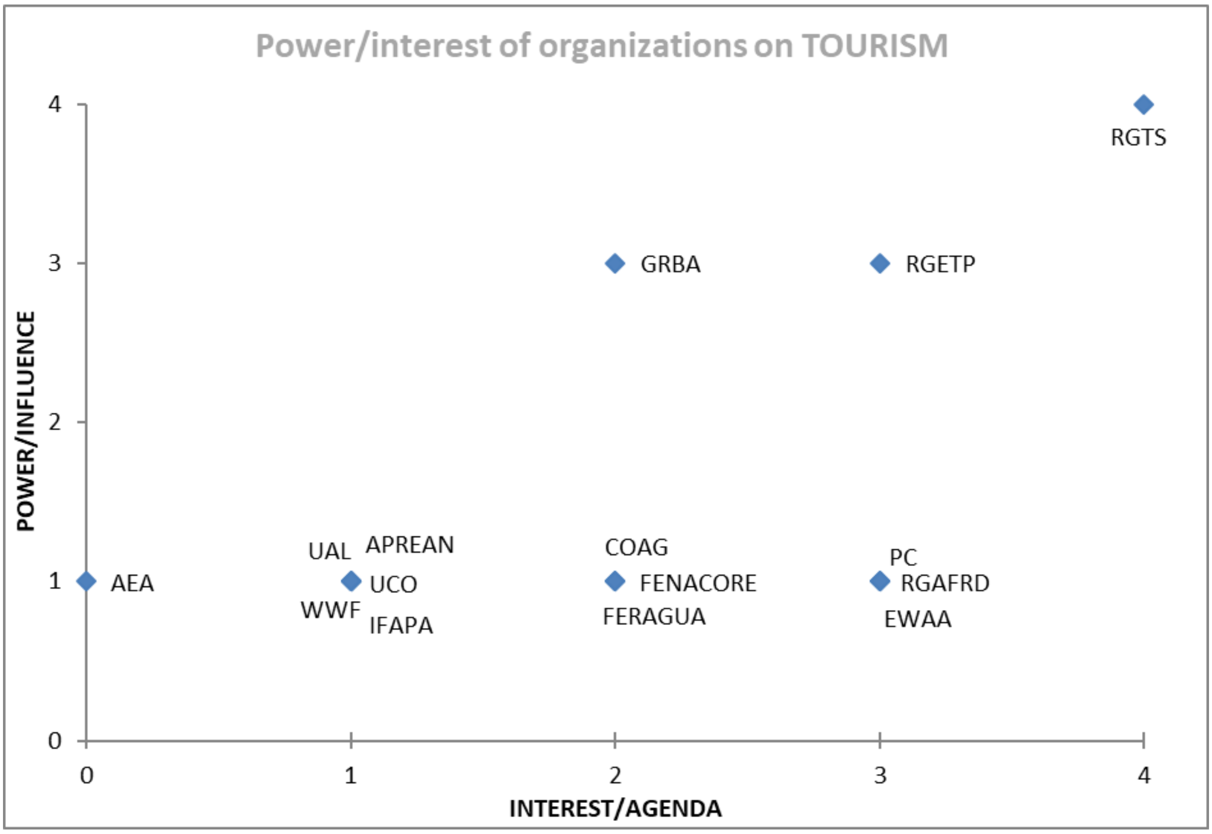


Figure 22: Power/interest of organizations on tourism issues



4 Inventory of goals and means in the WLEFC-nexus at national level for Spain and at regional level for Andalusia

4.1 National policies for Spain in the WLEFC-nexus

4.1.1 Water

A schematic representation of the Spanish water policy space is given in Figure 23 and selected objectives are shown in Table 1.

Water is tackled in the 2001 **National Water Law (Real Decreto 1/2001**[15],) enacted on 24 July 2001. According to this law, there are two main instruments for water planning: the National Water Plan (NWP) and the River Basin Management Plans (RBMP). The NWP has three functions: the coordination of the different basin plans, the planning of inter-basin transfers, and the safeguarding of existing water use systems for the supply of domestic water to towns and irrigation for agriculture. The RBMP, which are developed by each river basin authority, meet the demand for water as effectively as possible and harmonize regional and sector development.

The **Water Framework Directive (WFD)** (Directive 2000/60/EC)[16] adopted in 2000 established an EU-wide obligatory legal framework for action on water policy that for the first time set out environmental objectives for all the different bodies of water, whether continental, transitional or coastal (European Commission 2000). The implementation of the directive has led to significant changes in Spanish water required to ensure compliance with the objectives of the WFD which have yet to be put in place, including, among others, administration by river basin, the recovery of coastlines and user participation.

Key goals from these policies can be roughly grouped into water supply and demand objectives. The objectives regarding water supply include: (W1) Achieve good status of all water bodies, (W2) Provide adequate protection of all water bodies, (W3) Prevent deterioration of all water bodies, (W4) Achieve balance between extraction and recharge of groundwater. The objectives regarding water demand include: (W5) Increase of water availability, (W6) Protection of water quality, (W7) Economization of water use, (W8) Rationalization of water use in line with the environment & other natural resources.

With regards to irrigation, the **National Irrigation Plan–Horizon 2008 (NIP 2008)** (Real Decreto 329/2002[17]) was approved in 2002 to consolidate irrigation guaranteeing water resources, to modernise existing irrigation and to develop new irrigation areas. The programme was coordinated by the Ministries of Agriculture and the Environment and was implemented by State-owned companies through direct agreements with water users' associations. Notwithstanding, expected water savings were behind schedule, so the **Shock Plan for Irrigation Modernisation** (Real Decreto 287/2006[18]) was

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[15] Real Decreto Legislativo 1/2001, de 20 de julio, por el que se aprueba el texto refundido de la Ley de Aguas .

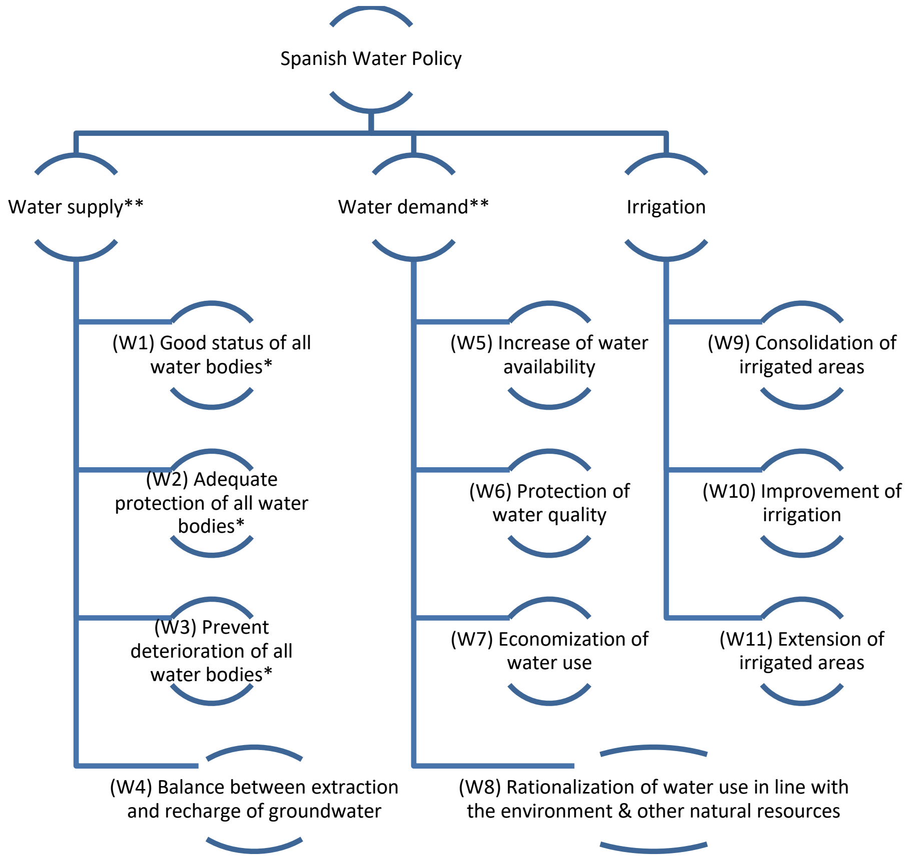
[16] Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.

[17] Real Decreto 329/2002, de 5 de abril, por el que se aprueba el Plan Nacional de Regadíos. BOE núm. 101, de 27 de abril de 2002.

[18] Real Decreto 287/2006, de 10 de marzo, por el que se regulan las obras urgentes de mejora y consolidación de regadíos, con objeto de obtener un adecuado ahorro de agua que palie los daños producidos por la sequía. BOE núm. 60, de 11 de marzo de 2006.

implemented as an urgent measure to achieve additional water savings on top of the planned water savings of the NIP 2008. Specific objectives of these plans are: (W9) the consolidation of irrigated areas (improvement of infrastructures of water transport and distribution), (W10) the improvement of irrigation (actions focussing on improving water management and saving) and (W11) the extension of irrigated areas including for public and private interests.

Figure 23: Schematic representation of the Spanish water policy space



Notes: *All water bodies include regenerated water (artificial and modified water) and the public water domain (ground water, surface water, protected areas). **Considering balanced sectorial and regional development.

Table 1: Policy objectives of the Spanish water policy space

SPANISH WATER POLICY	
W1	Achieve good status of all water bodies
W2	Provide adequate protection of all water bodies
W3	Prevent deterioration of all water bodies
W4	Achieve balance between extraction and recharge of groundwater
W5	Increase of water availability
W6	Protection of water quality
W7	Economization of water use
W8	Rationalization of water use in line with the environment & other natural resources
W9	Consolidation of irrigated areas

W10	Improvement of irrigation
W11	Extension of irrigated areas including for public and private interests

4.1.2 Energy

A schematic representation of the Spanish energy policy space is given in Figure 24 and selected objectives are shown in Table 2.

The Ministry of Industry, Energy and Tourism (MINETUR) is responsible for framing and implementing energy policy, while the autonomous communities have certain regulatory powers on electricity, such as authorising new power plants below 50 MW, which includes most renewable energy projects (IEA, 2015).

The electricity market liberalisation under the **Law 54/1997 of the Electricity Sector**[19], enacted on 27 November 1997, led to a significant imbalance between the cost of electricity generation and what consumers pay (tariff deficit), largely due to subsidies for renewable electricity (BOE 1997). In consequence, the government introduced in 2012 the **Royal decree law 1/2012**[20], enacted on 28 January 2012, leading (among others) to the elimination of economic incentives for new power generation facilities based on cogeneration, renewable energy sources and waste. As the deficit continued increasing, the government introduced a broader electricity market reform package under the **Law 15/2012**[21], enacted on 28 December 2012, focusing on fiscal measures for energy sustainability and the **Law 24/2013**[22], enacted on 26 December 2013, focusing on the electricity sector. The **Law 15/2012** that focuses on fiscal measures for energy sustainability has the major objective (E1) to harmonize the tax system with a more efficient and respectful use of the environment and sustainability. The **Law 24/2013** that focuses on the electricity sector has three key goals: (E2) secure power supply at necessary levels of quality and lowest cost, (E3) ensure the system's economic and financial sustainability, (E4) allow an effective level of competition in the electricity sector.

Energy is also regulated in three energy efficiency action plans. The 2011-2020, 2014-2020 and 2017-2020 National Energy Efficiency Action Plans set targets for primary energy consumption and reduction in 2020 that have been updated in each plan (MINETAD 2017). The most recent 2017-2020 plan sets primary energy consumption in 2020 (excluding non-energy uses) in Spain at 122.6 Mtoe, which implies (E5) a reduction of primary energy consumption of 24.7%. Moreover, the 2017-2020 plan stipulates 15,979 ktoe of total energy savings in Spain between 2014-2020.

Energy consumption is, moreover, addressed in renewable energy plans that are in line with the EU's total energy consumption targets. The 2011-2020 Renewable Energy Plan (MINETAD 2011) specifies two key goals for improving renewable energy use in Spain: (E6) 20% of energy consumption from renewable resources, (E7) 10% of energy consumption from renewable resources in the transport sector.

Table 2: Policy objectives of the Spanish energy policy space

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[19] Ley 54/1997, de 27 de noviembre, del Sector Eléctrico.

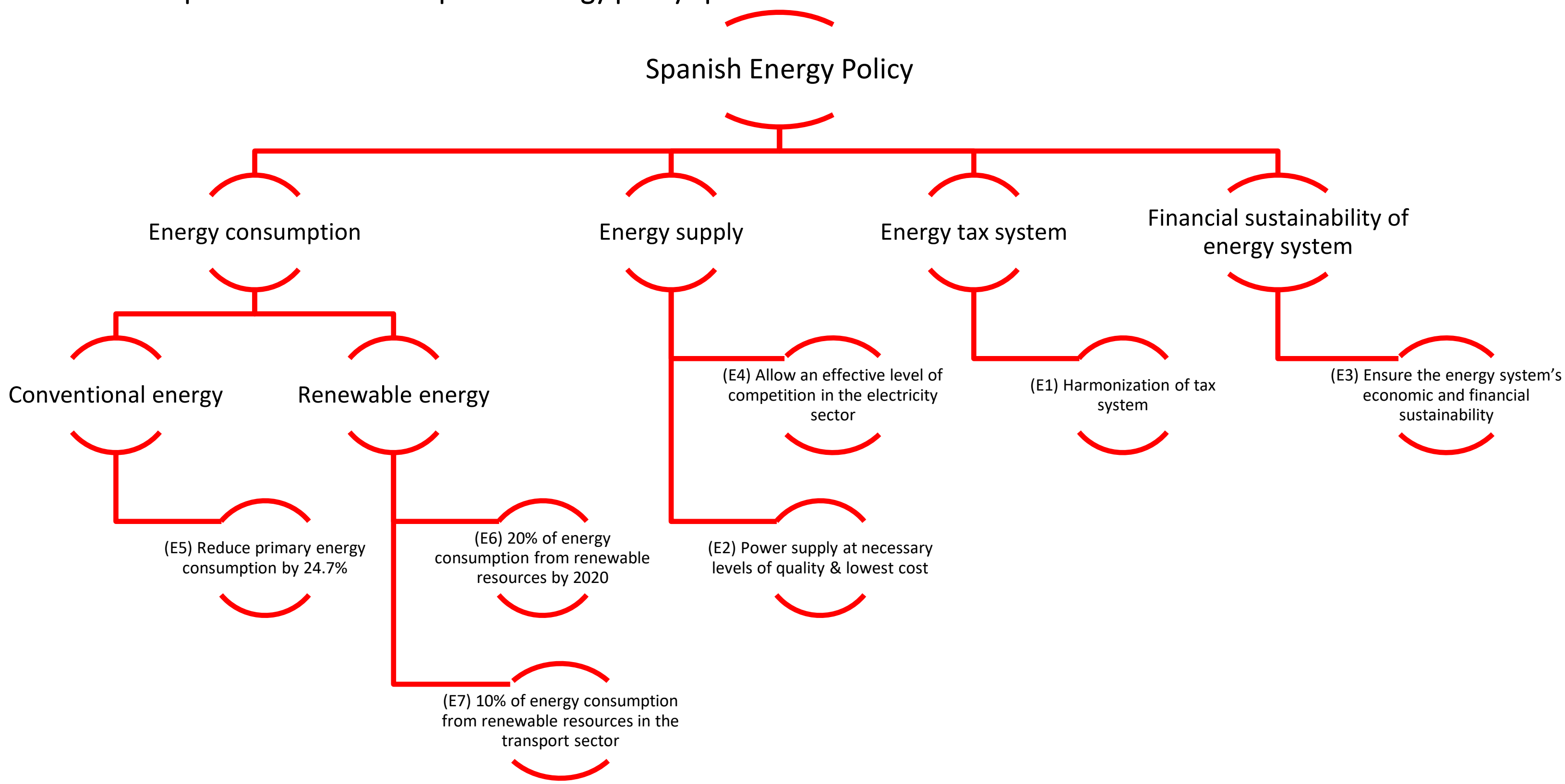
[20] Real Decreto-ley 1/2012, de 27 de enero, por el que se procede a la suspensión de los procedimientos de preasignación de retribución y a la supresión de los incentivos económicos para nuevas instalaciones de producción de energía eléctrica a partir de cogeneración, fuentes de energía renovables y residuos.

[21] Ley 15/2012, 27 diciembre, de medidas fiscales para la sostenibilidad energética.

[22] Ley 24/2013, de 26 de diciembre, del Sector Eléctrico.

Spanish Energy Policy	
E1	Harmonize the tax system with a more efficient and respectful use of the environment and sustainability
E2	Secure power supply at necessary levels of quality & lowest cost
E3	Ensure the energy system's economic and financial sustainability
E4	Allow an effective level of competition in the electricity sector
E5	Reduce primary energy consumption by 24.7%
E6	20% of energy consumption from renewable resources by 2020
E7	10% of energy consumption from renewable resources in the transport sector

Figure 24: Schematic representation of the Spanish energy policy space



4.1.3 Agriculture and Food

A schematic representation of the Spanish agriculture and food policy space is given in Figure 25 and selected objectives are shown in Table 3.

The European objectives of the **Common Agricultural Policy (CAP)** are incorporated into national law with the Royal decrees 1075/2014[23], enacted on 19 December 2014 (amended version 1172/2015[24], enacted on 27 November 2015, and 1076/2014[25], enacted on 19 December 2014, that regulate direct payments and rural development from 2015 to 2020 in Spain. Moreover, the EU's rural development policy, the "second pillar", for the 2014-2020 period was established to help the rural areas of the EU to meet the wide range of economic, environmental and social challenges of the 21st century. In Spain, there are altogether 18 rural development programmes (RDP) – one at national level and 17 regional RDPs. The Spanish National Framework for Rural Development has been formally adopted in 2015 by the European Commission (European Commission 2015).

At the European level, the CAP defines three long-term objectives: Viable food production, sustainable management of natural resources and climate action, and balanced territorial development. The operational objective is to attain higher levels of production of safe and quality food, while preserving the natural resources that agricultural productivity depends upon. Additionally, to enhance the competitiveness of EU agriculture, four more specific goals have been formulated: Enhance market orientation of EU agriculture to encourage farmers to base their production decisions on market signals, facilitate producer cooperation under both pillars of the CAP, enhance competitiveness at farm level by including restructuring and modernisation measures, offer more responsive safety net measures and strengthen the EU's capacity for crisis management.

At the European level and at the national level for Spain, six key goals are addressed within the direct payments scheme: (A1) enhance income stability of farmers by providing basic income support through the granting of a basic decoupled direct payment, (A2) enhance environmental performance of the CAP through a mandatory "greening" component of direct payments by supporting environmental measures, (A3) enhance competitiveness at farm level by providing payment for young farmers, (A4) address specific regional development and structural problems in agriculture by providing voluntary coupled support, (A5) enhance competitiveness at farm level by providing a simple and specific support scheme for small farmers, (A6) improve good agricultural and environmental practices through simplified and more targeted cross-compliance rules.

The **National RDP 2014-2020** (MAPAMA 2018) for Spain focuses on three priority areas: (A7) to enhance the economic performance and the competitiveness of agricultural cooperatives, (A8) to promote efficient use of natural resources, combating climate change and preserving rural heritage, and (A9) to foster innovation and collective approaches in the agricultural sector. Additionally, six more specific

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[23] Real Decreto Ley 1075/2014, de 19 de diciembre, sobre la aplicación a partir de 2015 de los pagos directos a la agricultura y a la ganadería y otros regímenes de ayuda, así como sobre la gestión y control de los pagos directos y de los pagos al desarrollo rural.

[24] Real Decreto 1172/2015, Real Decreto 1172/2015, de 29 de diciembre, por el que se modifica el Real Decreto 1075/2014, de 19 de diciembre, sobre la aplicación a partir de 2015 de los pagos directos a la agricultura y a la ganadería.

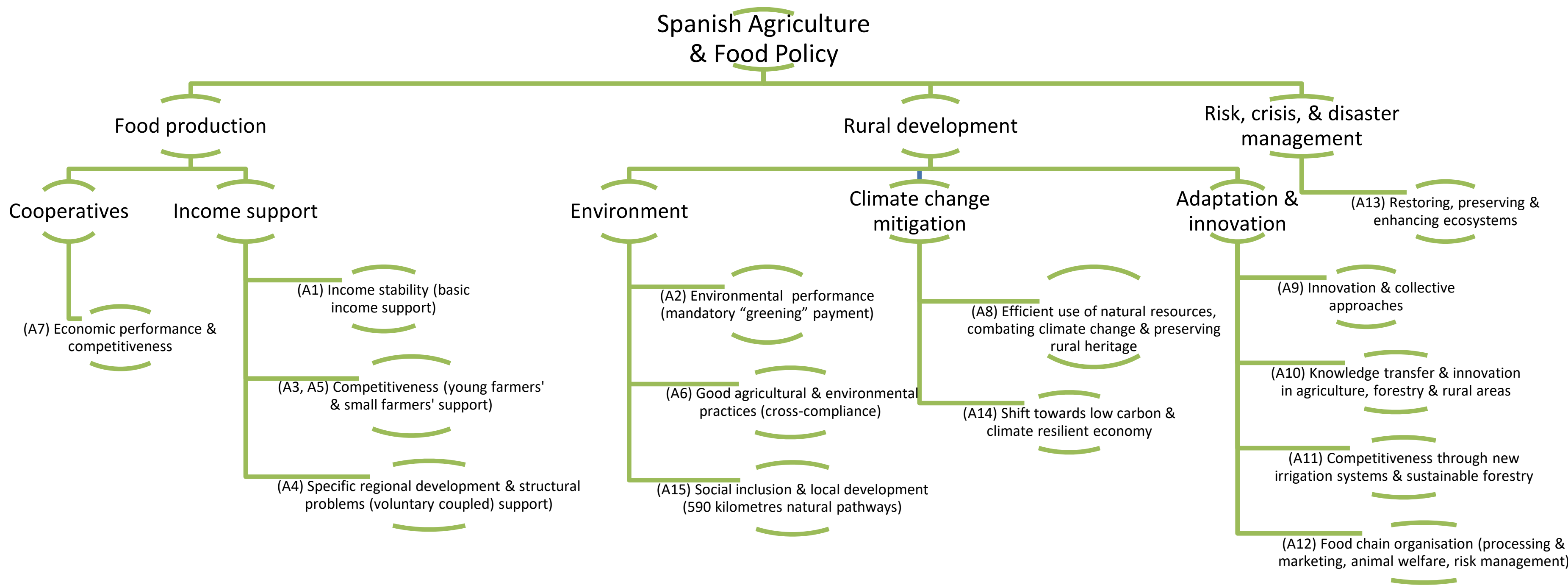
[25] Real Decreto 1076/2014, de 19 de diciembre, sobre asignación de derechos de régimen de pago básico de la Política Agrícola Común.

objectives are addressed: (A10) improve knowledge transfer and innovation in agriculture, forestry and rural areas, (A11) enhance competitiveness of the agri-food sector through new irrigation systems and sustainable forestry, (A12) improve food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture, (A13) restoring, preserving and enhancing ecosystems related to agriculture and forestry, (A14) shift towards low carbon and climate resilient economy through investments related to water efficiency that 0.07% of the total Spanish irrigated area is provided with more efficient irrigation systems, (A15) improve social inclusion and local development in rural areas by creating 590 kilometres of natural pathways.

Table 3: Policy objectives of the Spanish agriculture and food policy space

Spanish Agriculture and Food Policy	
A1	Enhance income stability of farmers by providing basic income support through the granting of a basic decoupled direct payment
A2	Enhance environmental performance of the CAP through a mandatory "greening" component of direct payments by supporting environmental measures
A3	Enhance competitiveness at farm level by providing payment for young farmers
A4	Address specific regional development and structural problems in agriculture by providing voluntary coupled support
A5	Enhance competitiveness at farm level by providing a simple and specific support scheme for small farmers
A6	Improve good agricultural and environmental practices through simplified and more targeted cross-compliance rules
A7	Enhance the economic performance and the competitiveness of agricultural cooperatives
A8	Promote efficient use of natural resources, combating climate change and preserving rural heritage
A9	Foster innovation and collective approaches in the agricultural sector
A10	Improve knowledge transfer and innovation in agriculture, forestry and rural areas
A11	Enhance competitiveness of the agri-food sector through new irrigation systems and sustainable forestry
A12	Improve food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture
A13	Restoring, preserving and enhancing ecosystems related to agriculture and forestry
A14	Shift towards low carbon and climate resilient economy through investments related to water efficiency in order that 0.07% of the total Spanish irrigated area is provided with more efficient irrigation systems
A15	Improve social inclusion and local development in rural areas by creating 590 kilometres of natural pathways

Figure 25: Schematic representation of the Spanish food and agriculture policy space



Spanish Agriculture & Food Policy
Food production
Rural development
Risk, crisis, & disaster management
Cooperatives
Income support
Environment
Climate change mitigation
Adaptation & innovation
(A13) Restoring, preserving & enhancing ecosystems
(A7) Economic performance & competitiveness
(A1) Income stability (basic income support)
(A3, A5) Competitiveness (young farmers' & small farmers' support)
(A4) Specific regional development & structural problems (voluntary coupled) support)
(A2) Environmental performance (mandatory "greening" payment)
(A6) Good agricultural & environmental practices (cross-compliance)
(A15) Social inclusion & local development (590 kilometres natural pathways)
(A8) Efficient use of natural resources, combating climate change & preserving rural heritage
(A14) Shift towards low carbon & climate resilient economy
(A9) Innovation & collective approaches
(A10) Knowledge transfer & innovation in agriculture, forestry & rural areas
(A11) Competitiveness through new irrigation systems & sustainable forestry
(A12) Food chain organisation (processing & marketing, animal welfare, risk management)

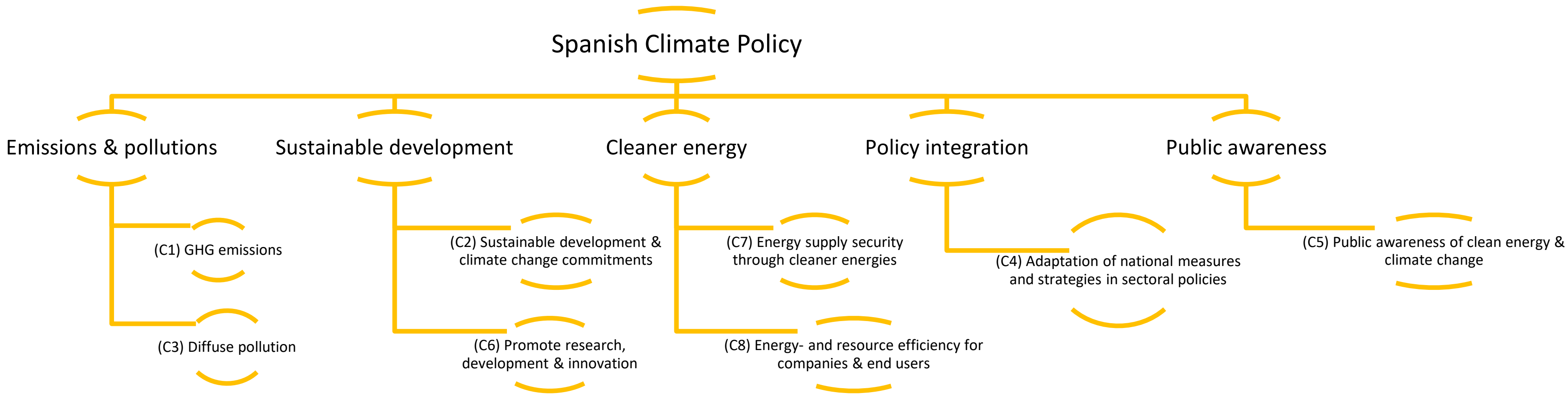
4.1.4 Climate

A schematic representation of the Spanish climate policy space is given in Figure 26 and selected objectives are shown in Table 4.
Climate change policies are developed by the Spanish Climate Change Office, which belongs to the Ministry of Agriculture and Fishing, Food and Environment (MAPAMA). Climate change and clean energy are strongly interrelated in Spain as in 2005 emissions from energy processing represented approximately 78.87% of total national emissions. The **Spanish Climate Change and Clean Energy Strategy (EECCEL) horizon 2007-2012-2020** is one strategy to accomplish sustainable development goals within the range of climate change and clean energy (MAPAMA 2007). It is part of the Spanish Sustainable Development Strategy (EEDS). Regarding GHG emissions, the government has also adopted a Plan of Urgent Measures (PMU), which together with the 2008-2012 Energy Saving and Efficiency Action Plan aims to reduce GHG emissions. Altogether Spain has currently six climate laws, 18 climate policies, and 13 climate litigation cases.
The operational objectives of the EECCEL are: (C1) to ensure the reduction of GHG emissions in Spain, giving special importance to measures related to the energy sector, (C2) to contribute to sustainable development and the fulfilment of climate change commitments by strengthening the use of flexible project-based mechanisms, (C3) to promote additional reduction measures in sectors concerned with diffuse pollution, (C4) to apply the National Climate Change Adaptation Plan (NCCAP) so as to integrate adaptation measures and strategies in sectoral policies, (C5) to increase public awareness with respect to clean energy and climate change, (C6) to promote research, development and innovation in matters of climate change and clean energy, (C7) to guarantee energy supply security by means of cleaner energies, mainly from renewable sources, achieving other environmental benefits (for example, air quality) and limiting the growth rate of external energy dependence, (C8) to boost energy- and resource efficiency for companies and for end users.

Table 4: Policy objectives of the Spanish climate policy space

Spanish Climate Policy	
C1	Ensure the reduction of GHG emissions in Spain, giving special importance to measures related to the energy sector
C2	Contribute to sustainable development and the fulfilment of climate change commitments by strengthening the use of flexible project-based mechanisms
C3	Promote additional reduction measures in sectors concerned with diffuse pollution
C4	Apply the National Climate Change Adaptation Plan (NCCAP) so as to integrate adaptation measures and strategies in sectoral policies
C5	Increase public awareness with respect to clean energy and climate change
C6	Promote research, development and innovation in matters of climate change and clean energy
C7	Guarantee energy supply security by means of cleaner energies, mainly from renewable sources, achieving other environmental benefits (for example, air quality) and limiting the growth rate of external energy dependence
C8	Boost energy- and resource efficiency for companies and for end users

Figure 26: Schematic representation of the Spanish climate policy space



4.2 Regional policies for Andalusia in the WLEFC-nexus

4.2.1 Water

A schematic representation of the Andalusian water policy space is given in Figure 27 and selected objectives are shown in Table 5.

The reform of the **Statute of Andalusia in 2007**[26], enacted on 19 March 2007, includes specific references to sustainable water management (article 10.3.7º and article 197). Subsequently, the **Andalusian Water Agreement** signed by all sectors of the society in 2008 formed the basis for drafting the **Andalusian Water Law**[27], enacted on 30 July 2010. This law entered into force in 2010 to sustainable management of the water resources by regulating water planning, infrastructures construction and public participation in water management. Key goals tackle issues in the water supply, demand and management domains. The objectives regarding water supply are: (W1) good ecological status of all water bodies, (W2) prevent/fix deterioration of all water bodies, (W3) reduce water pollution. The objectives regarding water demand are: (W4) sustainable guarantee of water demand, (W5) rational water use to ensure long term water supply. The water management objectives are (W6) guarantee water quality compatible with natural resource management, (W7) guarantee water risk management in sectoral policies & urban planning.

Water risk management in the specific river basins are, moreover, considered in different plans for the period 2016-2021 (Junta de Andalucía 2015b; Junta de Andalucía 2015c; Junta de Andalucía 2015d). The largest budget shares in these plans are allocated as follows: (W8) to reduce point & diffuse pollution, (W9) to reduce pressure by water extraction, and (W10) to increase water quantity to meet water demand. Other specific goals are (W11) to improve morphology, (W12) to prevent flooding, (W13) to improve governance, and (W14) to restore the environment.

Regarding irrigation, **the Andalusian Irrigation Agenda (AIA) Horizon 2015** (Junta de Andalucía 2011) **copes with challenges of agriculture in the region considering the effects of agricultural and water policies.** The general objective is to improve irrigators' farms competitiveness taking into account criteria of sustainability as well as economic, social, environmental and territorial criteria. Specific objectives are linked to the modernisation of irrigated agriculture, technology transfer to irrigation communities, and environmental sustainability.

Regarding the modernisation of irrigated agriculture, key goals are to: (W15) modernize existing irrigation systems, (W16) improve water availability in irrigated areas in particular through regenerated and desalinated water, (W17) optimize operation, maintenance and labour costs by incorporating control and automation elements, (W18) develop small irrigation systems in underprivileged areas with sufficient water availability, (W19) identify the comparative advantage of products and improve their competitiveness within the CAP and WFD regulations, (W20) prioritize areas that require modernisation based on water saving potential, (W21) improve effectiveness of measures by learning from experiences and their application in future actions, (W22) search for solutions to problems of irrigated crops in areas with water scarcity, low-productivity farms and environmental values of rainfed crops.

[26] Ley Orgánica 2/2007, de 19 de marzo, de reforma del Estatuto de Autonomía para Andalucía.
[27] Ley 9/2010, de 30 de julio, de Aguas para Andalucía.

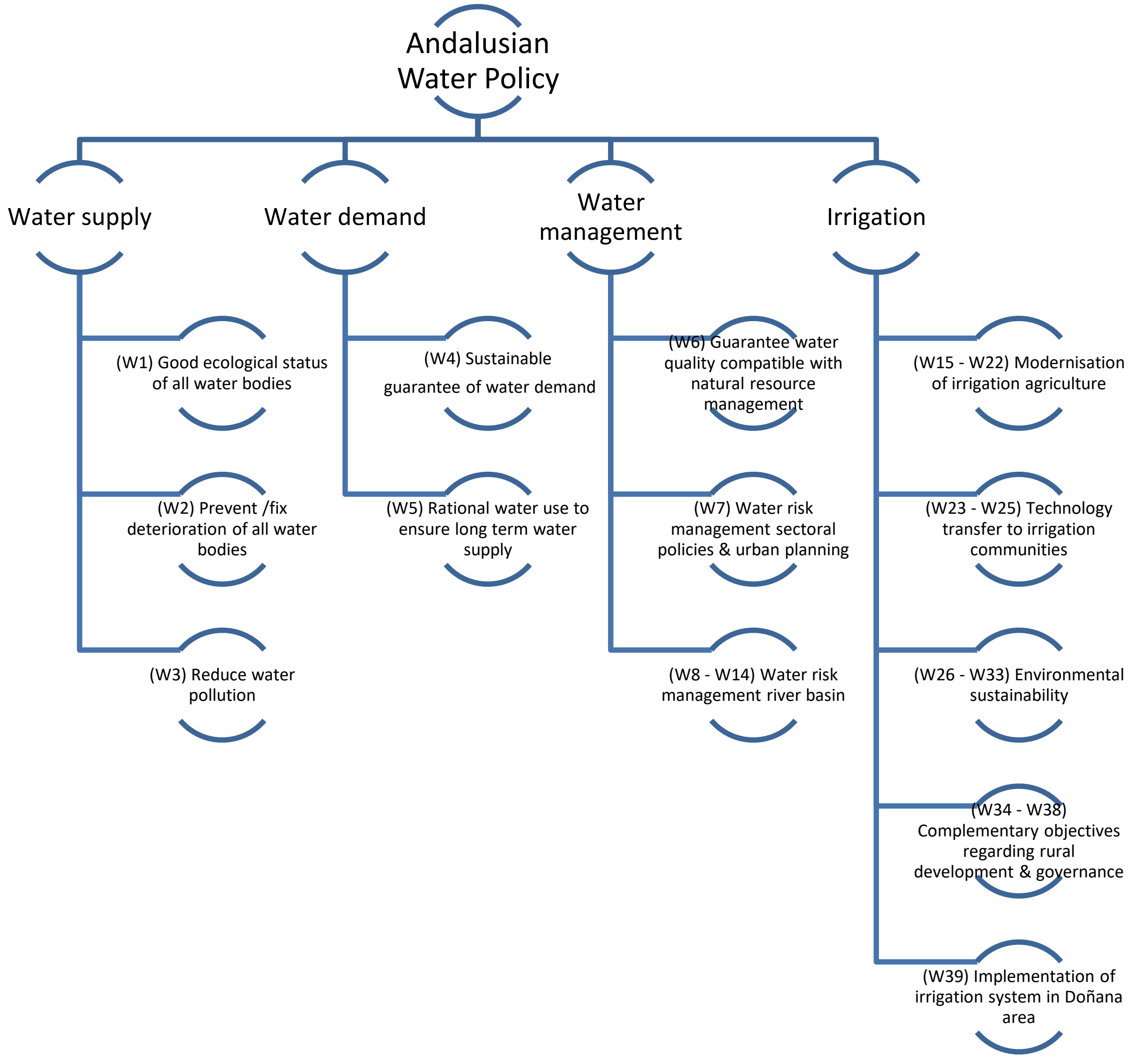
Regarding technology transfer to irrigation communities, key goals are to (W23) promote training and improve professional knowledge transfer to irrigation communities and irrigators especially in areas considered for modernization of the water distribution and irrigation systems, (W24) incorporate new irrigation technologies while reducing production costs and strengthening competitiveness as well as improving working conditions in irrigation farming, (W25) strengthen research and development in irrigation to improve farms' profitability while decreasing water consumption and diffuse pollution.
Regarding environmental sustainability, there are four major objectives with several sub-goals. The first major objective is to improve irrigation water use. To accomplish this objective, the following sub-goals have been formulated: (W26) achieve an effective and efficient use of water for irrigation through improving water saving and energy efficiency, (W27) reduce irrigation water use through improving irrigation infrastructure and monitoring systems, (W28) adapt irrigation farms to modernized irrigation systems, (W29) control illegal water abstraction, (W30) fulfil good water status as established by the WFD through maintenance of ecological flows and recovery of overexploited aquifers. The second major objective is to reduce diffuse pollution caused by agricultural activity. To accomplish this objective, the following sub-goal has been formulated: (W31) introduce measures to reduce diffuse pollution, both for ground and surface water, caused by inadequate use of fertilizers, especially nitrogen and pesticides, through integrated production and organic farming. The third major objective is to preserve the environmental conditions of irrigated areas. To accomplish this objective, the following sub-goal has been formulated: (W32) preserve the natural conditions (flora, fauna, soil, and landscape) of the irrigation zones through applying good irrigation practices, reducing environmental impacts caused by modernization, recovering hedges, naturalizing river basins and increasing biodiversity in irrigable areas. The fourth major objective is to improve energy efficiency and to introduce renewable energies. To accomplish this objective, the following sub-goal has been formulated: (W33) guarantee efficient energy use in irrigation facilities and promote renewable energy use to decrease environmental impacts.
The Agenda of Andalusian irrigation also identifies five complementary objectives: (W34) Strengthen the Andalusian agri-food system and improve the quality of life in rural areas by generating employment and increasing farm income, thus, contributing to balanced territorial development and stabilization of the rural population, all in a framework of sustainable development; (W35) consolidate and advance the Andalusian agri-food system through improved processing and marketing of irrigated production in order to improve added value of agricultural production; (W36) due to the environmental, social, economic, territorial, sanitary and public services that involve water management, it is necessary to achieve the integration and coherence of water policies with territorial and sectorial policies in order to achieve synergies and common objectives; (W37) improve productivity and generate employment through investing in modern irrigation, purification, desalination, pipelines and other infrastructures; (W38) enhance social integration of seasonal workers that are employed in intensive agricultural production and olive groves.
Furthermore, a specific plan has been set up to regulate the implementation of an irrigation system in parts of the Doñana area (2014-2029) (Junta de Andalucía 2014b). The general objective is (W39) to implement an irrigation system mainly to be used for agriculture and tourism subject to rational water use and environmental protection.

Table 5: Policy objectives for the assessment of interactions in the WLEFC-nexus

ANDALUSIAN WATER POLICY	
W1	Good ecological status of all water bodies
W2	Prevent /fix deterioration of all water bodies
W3	Reduce water pollution
W4	Sustainable guarantee of water demand
W5	Rational water use to ensure long term water supply
W6	Guarantee water quality compatible with natural resource management
W7	Guarantee water risk management in sectoral policies & urban planning
W8	Reduce point & diffuse pollution
W9	Reduce pressure by water extraction
W10	Increase water quantity to meet water demand
W11	Improve morphology
W12	Prevent flooding
W13	Improve governance
W14	Restore environment
W15	Modernize existing irrigation systems
W16	Improve water availability in irrigated areas in particular through regenerated and desalinated water
W17	Optimize operation, maintenance and labour costs by incorporating control and automation elements
W18	Develop small irrigation systems in underprivileged areas with sufficient water availability
W19	Identify the comparative advantage of products and improve their competitiveness within the CAP and WFD regulations
W20	Prioritize areas that require modernisation based on water saving potential
W21	Improve effectiveness of measures by learning from experiences and their application in future actions
W22	Search for solutions to problems of irrigated crops in areas with water scarcity, low-productivity farms and environmental values of rainfed crops
W23	Promote training and improve professional knowledge transfer to irrigation communities and irrigators especially in areas considered for modernization of the water distribution and irrigation systems
W24	Incorporate new irrigation technologies while reducing production costs and strengthening competitiveness as well as improving working conditions in irrigation farming
W25	Strengthen research and development in irrigation to improve farms' profitability while decreasing water consumption and diffuse pollution
W26	Achieve an effective and efficient use of water for irrigation through improving water saving and energy efficiency

W27	Reduce irrigation water use through improving irrigation infrastructure and monitoring systems
W28	Adapt irrigation farms to modernized irrigation systems
W29	Control illegal water abstraction
W30	Fulfil good water status as established by the WFD through maintenance of ecological flows and recovery of overexploited aquifers
W31	Introduce measures to reduce diffuse pollution, both for ground and surface water, caused by inadequate use of fertilizers, especially nitrogen and pesticides, through integrated production and organic farming
W32	Preserve the natural conditions (flora, fauna, soil, and landscape) of the irrigation zones through applying good irrigation practices, reducing environmental impacts caused by modernization, recovering hedges, naturalizing river basins and increasing biodiversity in irrigable areas
W33	Guarantee efficient energy use in irrigation facilities and promote renewable energy use to decrease environmental impacts
W34	Strengthen the Andalusian agri-food system and improve the quality of life in rural areas by generating employment and increasing farm income, thus, contributing to balanced territorial development and stabilization of the rural population, all in a framework of sustainable development
W35	Consolidate and advance the Andalusian agri-food system through improved processing and marketing of irrigated production in order to improve added value of agricultural production
W36	Due to the environmental, social, economic, territorial, sanitary and public services that involve water management, it is necessary to achieve the integration and coherence of water policies with territorial and sectorial policies in order to achieve synergies and common objectives
W37	Improve productivity and generate employment through investing in modern irrigation, purification, desalination, pipelines and other infrastructures
W38	Enhance social integration of seasonal workers that are employed in intensive agricultural production and olive groves
W39	Implement an irrigation system mainly to be used for agriculture and tourism subject to rational water use and environmental protection

Figure 27: Schematic representation of the Andalusian water policy space



4.2.2 Land

A schematic representation of the Andalusian land use policy space is given in Figure 28 and selected objectives are shown in Table 6.
Land use is regulated in the **Urban Planning Law 7/2002**[28], enacted on 17 December 2002 (BOJA 2002), and the **Land Planning Scheme 2006 for Andalusia**[29]. The Law 7/2002 regulates urban planning and land use including land underground and space in the air. The four major specific objectives are: (L1) closer coordination of urban and land use policies and instruments, (L2) develop urban planning instruments with focus on redevelopment of existing city space, (L3) regulate land prices in a rising market with limited supply flexibility, (L4) introduce mechanisms and instruments to improve urban planning. The Land Planning Scheme 2006 regulates Andalusia's territorial organization and development. Major specific objectives include: (L5) strengthen economic competitiveness, social and territorial cohesion to achieve convergence of Andalusia with the European Union, (L6) establish a territorial development strategy that moves towards sustainable development.
The coastal areas are addressed with two specific regulations: The **2007 Andalusian strategy for integrated coastal zone management** (Junta de Andalucía 2007a) and **the 2015 Protection plan for the Andalusian coastal corridor** (Junta de Andalucía 2015e). The 2007 strategy includes the following eight operational goals: (L7) stop generalized urbanization and limit certain economic activities in the Andalusian coast, (L8) improve Andalusia's coastal water quality, (L9) rationalize inland water use and decrease water demand, (L10) control the exploitation of living resources, (L11) conserve habitats and recover marine and coastal biodiversity, (L12) preserve natural resources to ensure future economic development of the Andalusian coastline, (L13) protect the Andalusian coastline's natural and cultural heritage, (L14) develop equitable cost and benefit sharing among economic activities and resource users.

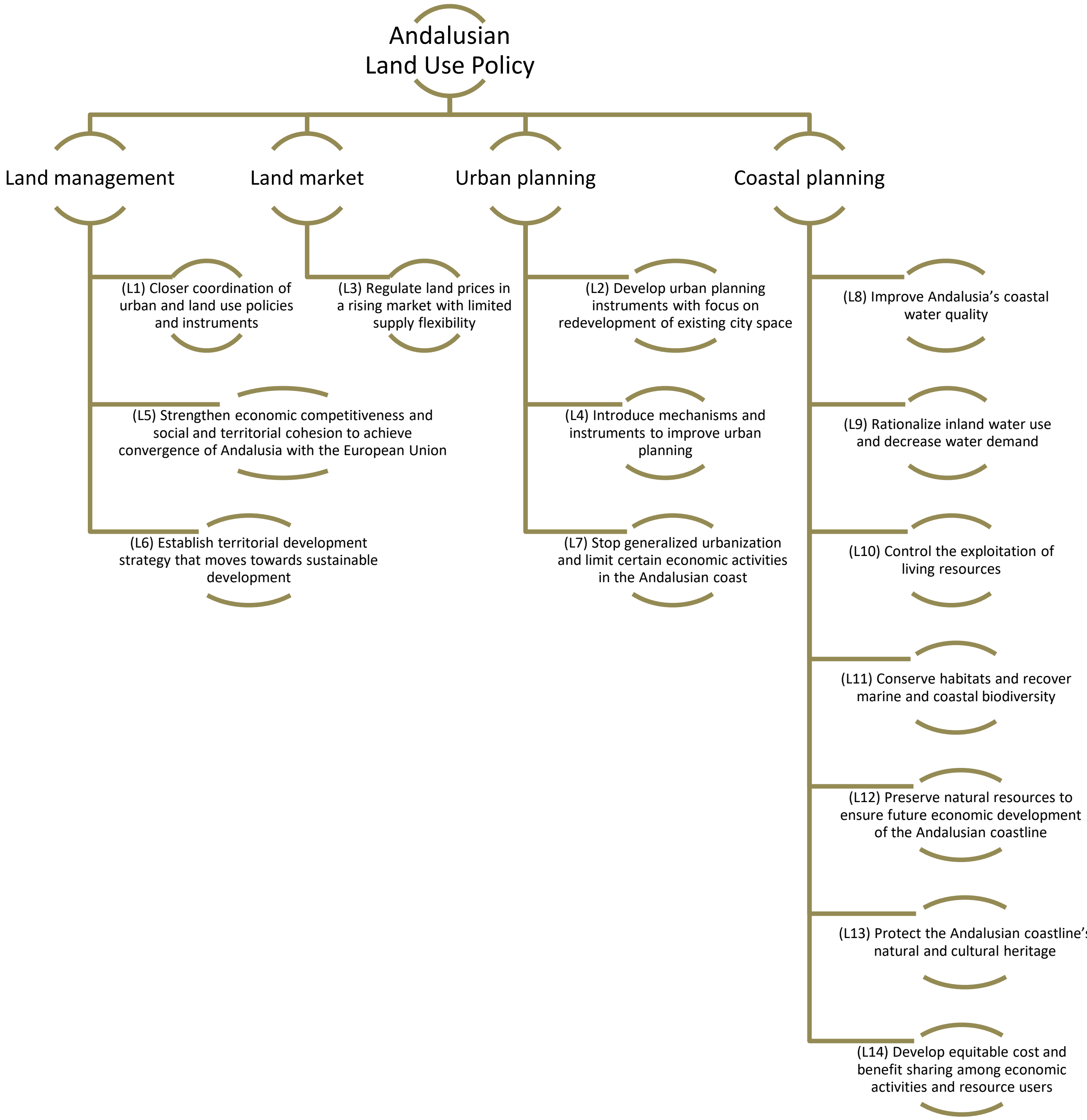
Table 6: Policy objectives of the Andalusian land use policy space

ANDALUSIAN LAND USE POLICY	
L1	Closer coordination of urban and land use policies and instruments
L2	Develop urban planning instruments with focus on redevelopment of existing city space
L3	Regulate land prices in a rising market with limited supply flexibility
L4	Introduce mechanisms and instruments to improve urban planning
L5	Strengthen economic competitiveness and social and territorial cohesion to achieve convergence of Andalusia with the European Union
L6	Establish territorial development strategy that moves towards sustainable development
L7	Stop generalized urbanization and limit certain economic activities in the Andalusian coast
L8	Improve Andalusia's coastal water quality

[28] Ley 7/2002, de 17 de diciembre, de Ordenación Urbanística de Andalucía.
[29] Decreto 206/2006, de 28 de noviembre, Plan de Ordenación del Territorio de Andalucía.

L9	Rationalize inland water use and decrease water demand
L10	Control the exploitation of living resources
L11	Conserve habitats and recover marine and coastal biodiversity
L12	Preserve natural resources to ensure future economic development of the Andalusian coastline
L13	Protect the Andalusian coastline’s natural and cultural heritage
L14	Develop equitable cost and benefit sharing among economic activities and resource users

Figure 28: Schematic representation of the Andalusian land use policy space


Andalusian Land Use Policy
Land management
Land market
Urban planning
Coastal planning
(L1) Closer coordination of urban and land use policies and instruments
(L3) Regulate land prices in a rising market with limited supply flexibility
(L2) Develop urban planning instruments with focus on redevelopment of existing city space
(L8) Improve Andalusia's coastal water quality
(L5) Strengthen economic competitiveness and social and territorial cohesion to achieve convergence of Andalusia with the European Union
(L4) Introduce mechanisms and instruments to improve urban planning
(L9) Rationalize inland water use and decrease water demand
(L6) Establish territorial development strategy that moves towards sustainable development
(L7) Stop generalized urbanization and limit certain economic activities in the Andalusian coast
(L10) Control the exploitation of living resources
(L11) Conserve habitats and recover marine and coastal biodiversity
(L12) Preserve natural resources to ensure future economic development of the Andalusian coastline
(L13) Protect the Andalusian coastline's natural and cultural heritage
(L14) Develop equitable cost and benefit sharing among economic activities and resource users

4.2.3 Energy

A schematic representation of the Andalusian energy policy space is given in Figure 29 and selected objectives are shown in Table 7.

The **Andalusian Energy Plan 2003-2006 (PLEAN 2003-2006)** was the first document that integrates energy policy with other horizontal policies in the region (Junta de Andalucía 2003). PLEAN 2003-2006 boosted the establishment of the Andalusian Energy Agency in 2005 to strengthen and centralise the actions in energy matters in Andalusia. PLEAN also promoted the enactment of the Law to Promote Renewable Energy and Energy Savings and Efficiency in Andalusia[30], which was approved in 2007. This law places Andalusia at the forefront of renewable energy regulation in Spain. This law stipulates the primacy of renewable sources over all other sources and gives public authorities legal instruments to promote energy savings and efficiency.

The **Andalusian Sustainable Energy Plan 2007-2013 (PASENER 2007-2013)** made another step forward proposing a new energy model based on greater energy diversification with higher exploitation of renewable energy resources (Junta de Andalucía 2007b).

The **Andalusian Energy Strategy 2020** (Junta de Andalucía 2013) set up different challenges to reach in 2020: low-carbon energy system, energy governance (public participation), energy for competitiveness and energy innovation. The strategy is implemented through two action plans: Andalusian Energy Action Plan 2016-2017 (Junta de Andalucía 2015a) and Andalusian Energy Action Plan 2018-2020 (Junta de Andalucía 2013).

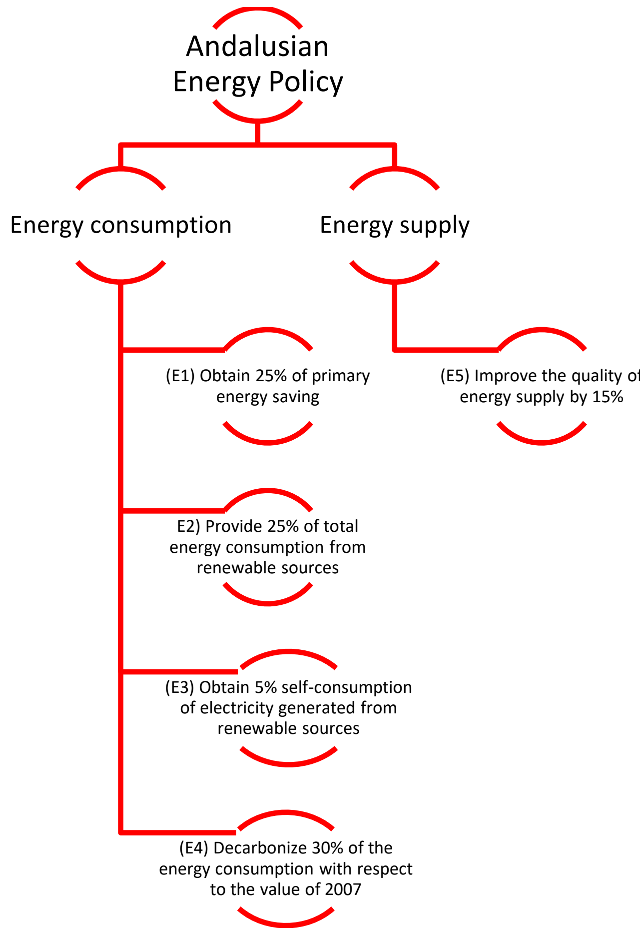
The main objectives of the energy policies in Andalusia are: (E1) obtain 25% of primary energy saving, (E2) provide 25% of total energy consumption from renewable sources, (E3) obtain 5% self-consumption of electricity generated from renewable sources, (E4) decarbonize 30% of the energy consumption with respect to the value of 2007, (E5) improve the quality of energy supply by 15%.

Table 7: Policy objectives of the Andalusian energy policy space

ANDALUSIAN ENERGY POLICY	
E1	Obtain 25% of primary energy saving
E2	Provide 25% of total energy consumption from renewable sources
E3	Obtain 5% self-consumption of electricity generated from renewable sources
E4	Decarbonize 30% of the energy consumption with respect to the value of 2007
E5	Improve the quality of energy supply by 15%

Figure 29: Schematic representation of the Andalusian energy policy space

[30] Ley 2/2007, de 27 de marzo, de fomento de las energías renovables y del ahorro y eficiencia energética de Andalucía.



4.2.4 Agriculture and Food

A schematic representation of the Andalusian agriculture and food policy space is given in Figure 30 and selected objectives are shown in Table 8.
The regional government of Andalusia approved the draft of the Andalusian Agricultural Law[31] in October 2016 (Junta de Andalucía 2016a). This law aims at improving sector competitiveness, promoting research and innovation, encouraging sustainable agricultural practices and controlling the food chain. The law also addresses the integration of agricultural activity with the environment and sustainable use of natural resources through promotion of organic and highly environmental value agriculture.
The third draft of the Law from 2017, which is about to be passed by the government, regulates agriculture, livestock and the agri-food industry, as well as rural development in Andalusia. It does not include fishery and forestry for non-food purposes. The proposed agricultural law stipulates the general objective to achieve a sustainable and inclusive economy, based on innovation, the best available scientific knowledge, environmental sustainability and social cohesion. To fulfil the general objective, twelve specific goals have been formulated: (A1) improve the sustainable competitiveness of the

[31] Anteproyecto de Ley de Agricultura y Ganadería de Andalucía.

Andalusian agricultural & agro-industrial sector, (A2) promote agricultural & agro-industrial activity as a factor of territorial cohesion, while preserving social, cultural, demographic and economic values, (A3) promote research and technological innovation in the agricultural and agri-food sectors, (A4) promote the multifunctional nature of agricultural activity and the rural environment, (A5) improve farmers' education and training and enhance employment of young people and female farmers in the agricultural and agro-industrial sector, (A6) improve social and economic conditions to generate stable agrarian employment, (A7) improve dialogue among all affected stakeholders to form agrarian and agro-industrial policies and regulations, (A8) consolidate agricultural production and rural infrastructure, (A9) advocate more sustainable agricultural practices (organic production, integrated production and conservation agriculture) and technification of farms and agro-industries to improve production efficiency, (A10) promote cooperation and improve monitoring among all the parties involved in the food chain, (A11) protect consumers rights and interests with particular attention to food safety, (A12) promote a stable, transparent and assessable regulation.

Looking at the **implementation of the CAP in Andalusia**, the region receives almost one third of the payments granted to Spain under the first pillar of the CAP. In terms of financial weight, decoupled payments amount to 71% of the total which is 32% of the total national. Other important aspects for the region are the different payment schemes for the fruit and vegetable sector (5.8%) area-based support and support for the restructuring of the cotton sector.

The **RDP 2014-2020 for Andalusia** (Junta de Andalucía 2015f) was formally adopted by the European Commission in 2015 with a total budget of € 2.4 billion (€ 1.9 billion from the EU budget and € 539.5 million of national co-funding) (European Commission 2015). The key challenges to be addressed with the RDP in Andalusia are: high unemployment rate 34.8% (2014) (over 60% young people); the lack of young farmers in the primary sector; the need to increase farm size. Regarding the environment, 29% of the regional territory (11% of the UAA) are Natura 2000 areas; 18% of the regional territory is categorized as nitrate vulnerable zone. Moreover, Andalusia has a negative water balance and faces problems of erosion (with risk of desertification). The RDP covers all aspects of rural development, including forestry and fishery.

The six specific objectives of the RDP in Andalusia are the same as the national objectives (A10-A15) mentioned in section 3.5.3, though with more specific definitions of goals and policy measures. (A13): improve knowledge transfer and innovation in agriculture, forestry and rural areas through the development of innovative solutions and training courses. (A14) enhance competitiveness of the agri-food sector and sustainable forestry. Specific objectives are: (A14.1) to modernise and restructure around 2.4% of all farms in Andalusia, (A14.2) to support around 1.1% of farms with young farmers' assistance so that young farmers can launch their businesses. (A15) improve food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture. Specific objectives are: (A15.1) to support the participation of 10,000 farmers in quality schemes, local markets and short supply chain circuits and producer groups or organisations, (A15.2) to support around 370 holdings to improve animal welfare. (A16) restoring, preserving and enhancing ecosystems related to agriculture and forestry. Specific objectives are: (A16.1) 15% of the agricultural land will be under contract for biodiversity, (A16.2) 16% of the agricultural land will be under contract for water management, (A16.3) 17% of the agricultural land will be under contract for soil management, (A16.4) 23% of the forest area will be under risk prevention actions. (A17) enhance resource efficiency and climate. Specific goals are: (A17.1) to switch almost 9% of the region's irrigated area to more efficient irrigation systems, (A17.2) to improve resilience and environmental value of forest ecosystems through supporting 1.3% of forest land. (A18) improve social inclusion and local development in rural areas.

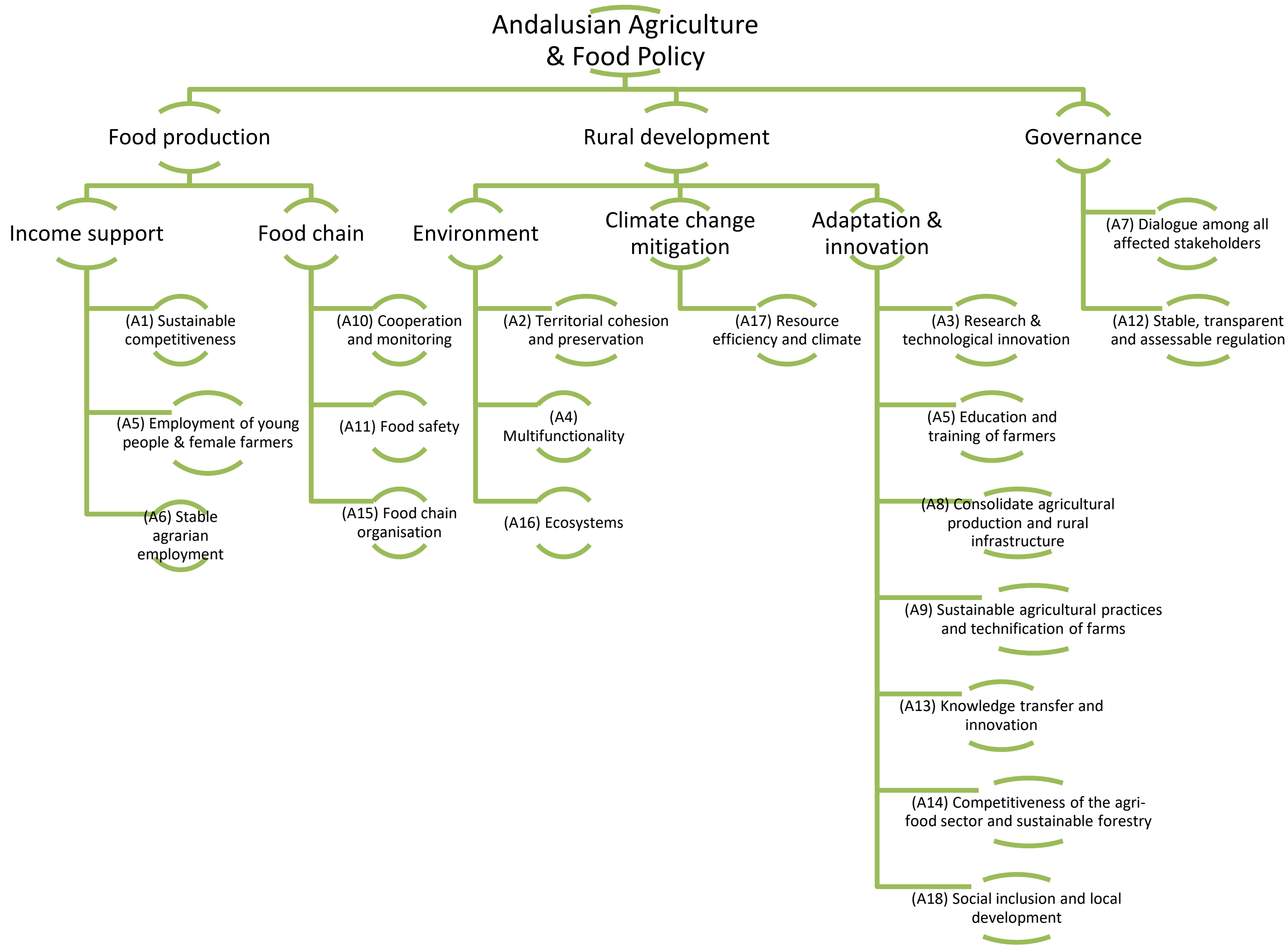
Specific goals are: (A18.1) to create around 1,600 new jobs and new business opportunities through LEADER, (A18.2) to create another 800 jobs through investments in non-agricultural activities, basic services and village renewal (including tourism and broadband infrastructure) and in forest products and technologies.

Table 8: Policy objectives of the Spanish agriculture and food policy space

Andalusian Agriculture and Food Policy	
A1	Improve the sustainable competitiveness of the Andalusian agricultural and agro-industrial sector
A2	Promote agricultural & agro-industrial activity as a factor of territorial cohesion, while preserving social, cultural, demographic and economic values
A3	Promote research and technological innovation in the agricultural and agri-food sectors
A4	Promote the multifunctional nature of agricultural activity and the rural environment
A5	Improve farmers' education and training and enhance employment of young people and female farmers in the agricultural and agro-industrial sector
A6	Improve social and economic conditions to generate stable agrarian employment
A7	Improve dialogue among all affected stakeholders to form agrarian and agro-industrial policies and regulations
A8	Consolidate agricultural production and rural infrastructure
A9	Advocate more sustainable agricultural practices (organic production, integrated production and conservation agriculture) and technification of farms and agro-industries to improve production efficiency
A10	Promote cooperation and improve monitoring among all the parties involved in the food chain
A11	Protect consumers rights and interests with particular attention to food safety
A12	Promote a stable, transparent and assessable regulation
A13	Improve knowledge transfer and innovation in agriculture, forestry and rural areas through the development of innovative solutions and training courses
A14	Enhance competitiveness of the agri-food sector and sustainable forestry
A14.1	Modernise and restructure ~2.4% of all farms in Andalusia
A14.2	Support ~1.1% of farms with young farmers' assistance so that young farmers can launch their businesses
A15	Improve food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture
A15.1	Support the participation of 10,000 farmers in quality schemes, local markets and short supply chain circuits and producer groups or organisations
A15.2	Support ~370 holdings to improve animal welfare
A16	Restoring, preserving and enhancing ecosystems related to agriculture and forestry
A16.1	15% of the agricultural land will be under contract for biodiversity
A16.2	16% of the agricultural land will be under contract for water management
A16.3	17% of the agricultural land will be under contract for soil management
A16.4	23% of the forest area will be under risk prevention actions
A17	Enhance resource efficiency and climate
A17.1	Switch almost 9% of the region's irrigated area to more efficient irrigation systems

A17.2	Improve resilience and environmental value of forest ecosystems through supporting 1.3% of forest land
A18	Improve social inclusion and local development in rural areas by creating 590 kilometres of natural pathways
A18.1	Create around 1,600 new jobs and new business opportunities through LEADER
A18.2	Create another 800 jobs through investments in non-agricultural activities, basic services and village renewal (including tourism and broadband infrastructure) and in forest products and technologies

Figure 30: Schematic representation of the Andalusian food and agriculture policy space



4.2.5 Climate

A schematic representation of the Andalusian climate policy space is given in Figure 31 and selected objectives are shown in Table 9.

In Andalusia, climate change will be mainly regulated with the updated 2017 Climate Change Law[32] that will be soon approved by parliament (Junta de Andalucía 2014a). Before the new regulation will be implemented, the **Andalusian 2007–2012 Climate Action Plan (PAAC)** (Junta de Andalucía 2010) remains the major strategy to combat climate change in Andalusia in line with the **Spanish Climate Change and Clean Energy Strategy Horizon 2007-2012-2020.** PAAC includes measures to reduce GHG emissions and to increase the ability to sink carbon. In doing so, PAAC considers current GHG emissions in the region, studies energy production and consumption, and presents potential scenarios of energy consumption and GHG emissions over the next years. Based on this information, PAAC proposes a number of measures to reduce GHG emissions in Andalusia. PAAC comprises two programs: **Andalusian Climate Change Mitigation Plan** (approved in 2007) **and Andalusian Climate Change Adaptation Plan** (approved in 2010).

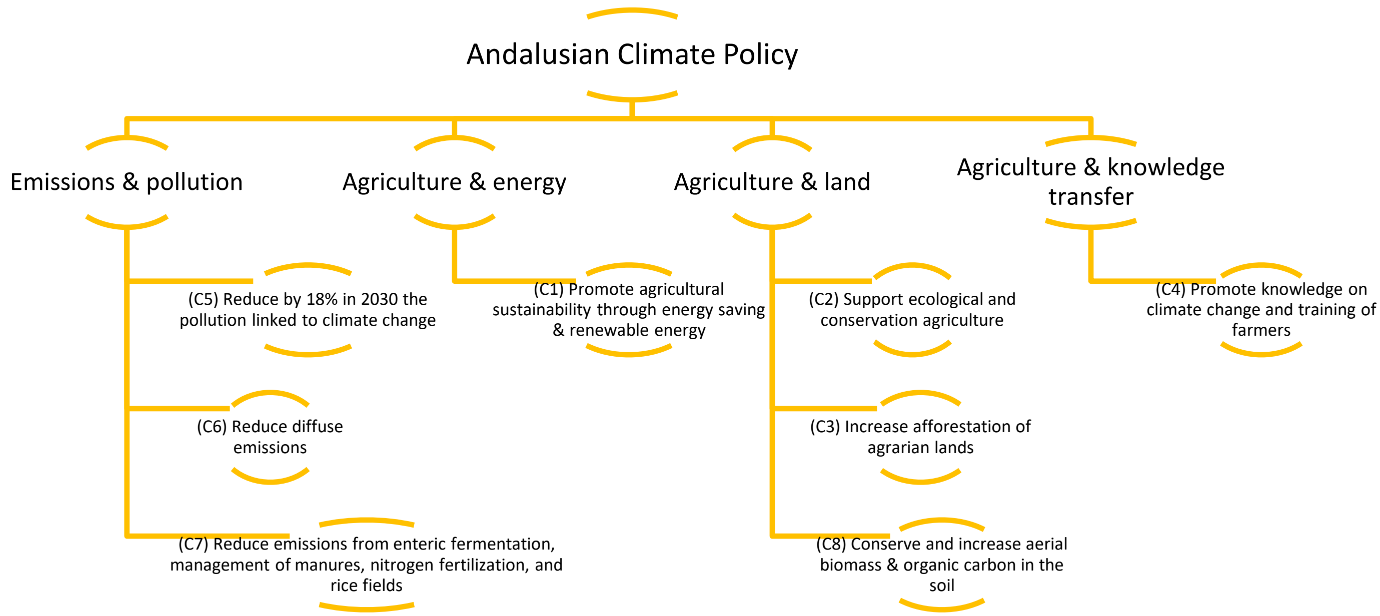
Even though the new law has not been officially approved and made available to the public, the major objectives have been discussed in the local media. Key objectives include (C1) to promote agricultural sustainability through energy saving and renewable energy in the agri-food industry, (C2) to support ecological and conservation agriculture, (C3) to increase afforestation of agrarian lands, (C4) to promote knowledge on climate change associated with agriculture and training of farmers to promote the application of good practices. In terms of mitigation, the law also includes actions: (C5) to reduce by 18% in 2030 the pollution linked to climate change compared to the 2005 level, which equals approximately 4.28 tons of carbon dioxide (CO_2) per inhabitant and year, (C6) to reduce diffuse emissions, (C7) to reduce emissions from enteric fermentation, management of manures, nitrogen fertilization, and rice fields, (C8) to conserve and increase aerial biomass and organic carbon in the soil.

Table 9: Policy objectives of the Spanish climate policy space

Andalusian Climate Policy	
C1	Promote agricultural sustainability through energy saving and renewable energy in the agri-food industry
C2	Support ecological and conservation agriculture
C3	Increase afforestation of agrarian lands
C4	Promote knowledge on climate change associated with agriculture and training of farmers to promote the application of good practices
C5	Reduce by 18% in 2030 the pollution linked to climate change compared to the 2005 level, which equals approximately 4.28 tons of carbon dioxide (CO_2) per inhabitant and year
C6	Reduce diffuse emissions
C7	Reduce emissions from enteric fermentation, management of manures, nitrogen fertilization, and rice fields
C8	Conserve and increase aerial biomass and organic carbon in the soil

[32] Anteproyecto de Ley Andaluza de Cambio Climático.

Figure 31: Schematic representation of the Andalusian climate policy space



5 Assessment of policy coherence

5.1 Assessment of interactions between nexus critical objectives (NCOs)

Within the Andalusian case-study, stakeholders have been engaged in identifying the nexus challenges, and will be engaged in validating the models and using the Serious Game. The Deliverable 5.2 (Brower and Fournier 2017) describes in detail the process of stakeholders' engagement. In this deliverable, we use the critical nexus variables and interrelationships that were identified by the stakeholders to reduce the large number of policy objectives. As Figure 32 shows, the stakeholders identify the following variables as particularly relevant for Andalusia: 1) climate change, 2) energy cost, 3) water availability, 4) irrigation water use, 5) water quality, 6) soil erosion, 7) food production, 8) irrigation agriculture, 9) socio-economic factors. To reduce the large number of policy objectives that have been identified in chapter four, these nine crucial variables were used to select the most important objectives for the policy coherence analysis of Andalusia. As a result of the selection process, we identified 32 objectives that are presented in Table 10. The policy objectives include both general and specific goals.

Figure 32: Representation of nexus critical objectives and nexus critical systems in Andalusia

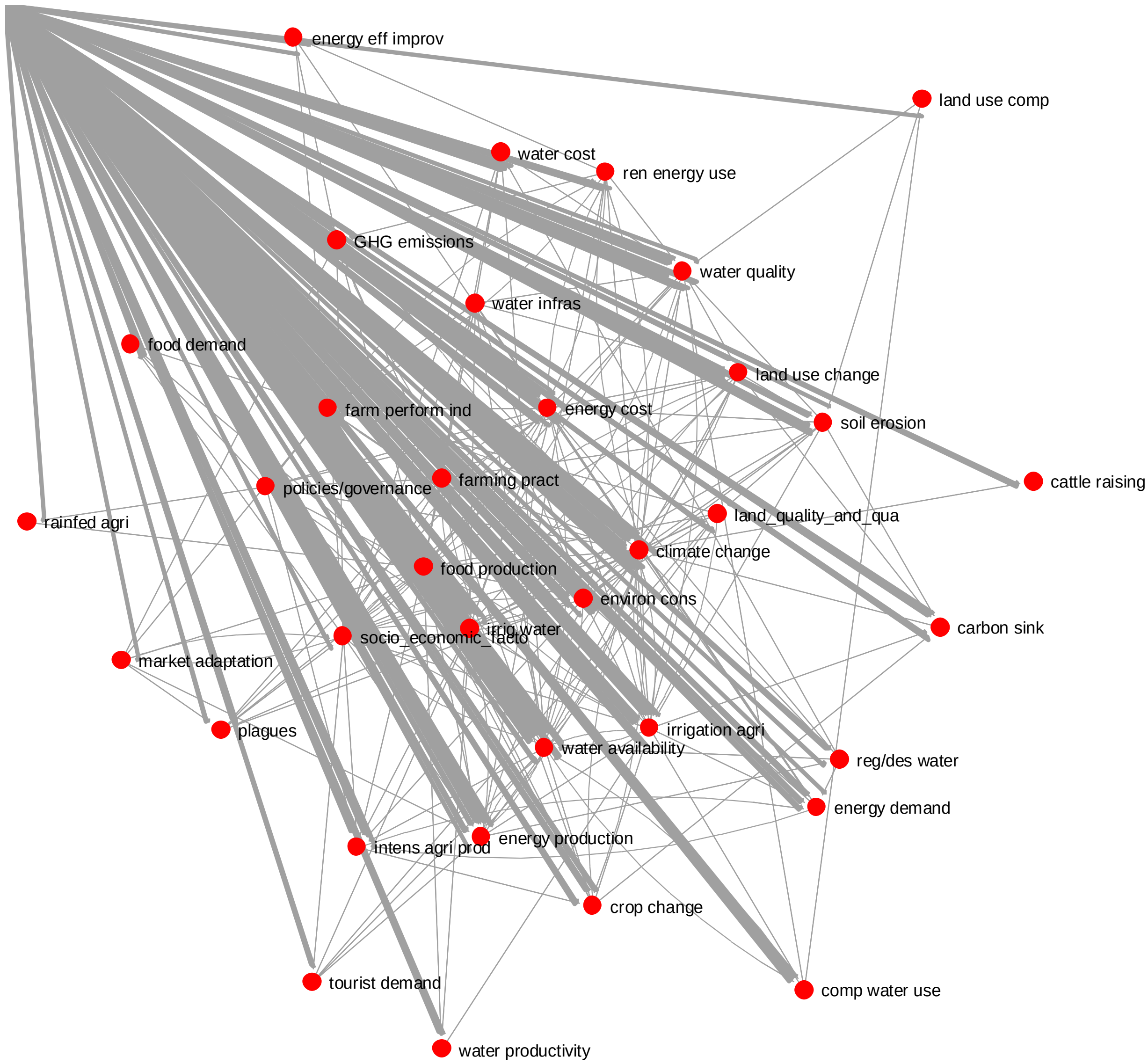

energy eff improv
land use comp
water cost
ren energy use
GHG emissions
water quality
water infras
food demand
land use change
farm perform ind
energy cost
soil erosion
cattle raising
farming pract
policies/governance
rainfed agri
land_quality_and_qua
climate change
food production
environ cons
irrig water
socio_economic_facto
carbon sink
market adaptation
plagues
irrigation agri
water availability
reg/des water
energy demand
energy production
intens agri prod
crop change
tourist demand
comp water use
water productivity

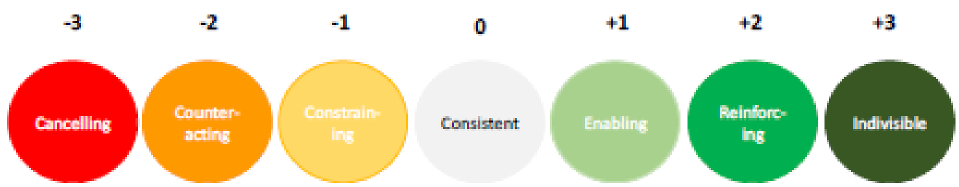
Table 10: Selected policy objectives for the assessment of interactions in the WLEFC-nexus

ANDALUSIAN WATER POLICY	
W1	Good ecological status of all water bodies
W5	Rational water use to ensure long term water supply
W15	Modernize existing irrigation systems
W16	Improve water availability in irrigated areas in particular through regenerated and desalinated water
W23	Promote training and improve professional knowledge transfer to irrigation communities and irrigators especially in areas considered for modernization of the water distribution and irrigation systems
W26	Achieve an effective and efficient use of water for irrigation through improving water saving and energy efficiency
W27	Reduce irrigation water use through improving irrigation infrastructure and monitoring systems
W29	Control illegal water abstraction
W31	Introduce measures to reduce diffuse pollution, both for ground and surface water, caused by inadequate use of fertilizers, especially nitrogen and pesticides, through integrated production and organic farming
W33	Guarantee efficient energy use in irrigation facilities and promote renewable energy use to decrease environmental impacts
ANDALUSIAN LAND USE POLICY	
L1	Closer coordination of urban and land use policies and instruments
L8	Improve Andalusia's coastal water quality
L9	Rationalize inland water use and decrease water demand
L12	Preserve natural resources to ensure future economic development of the Andalusian coastline
L13	Protect the Andalusian coastline's natural and cultural heritage
ANDALUSIAN ENERGY POLICY	
E1	Obtain 25% of primary energy saving
E2	Provide 25% of total energy consumption from renewable sources
E3	Obtain 5% self-consumption of electricity generated from renewable sources
E4	Decarbonize 30% of the energy consumption with respect to the value of 2007
ANDALUSIAN AGRICULTURE & FOOD POLICY	
A1	Improve the sustainable competitiveness of the Andalusian agricultural and agro-industrial sector
A6	Improve social and economic conditions to generate stable agrarian employment
A9	Advocate more sustainable agricultural practices (organic production, integrated production and conservation agriculture) and technification of farms and agro-industries to improve production efficiency
A13	Improve knowledge transfer and innovation in agriculture, forestry and rural areas through the development of innovative solutions and training courses
A16	Restoring, preserving and enhancing ecosystems related to agriculture and forestry
A17	Enhance resource efficiency and climate
A18	Improve social inclusion and local development in rural areas by creating 590 kilometres of natural pathways
ANDALUSIAN CLIMATE POLICY	
C1	**Promote** agricultural sustainability through energy saving and renewable energy in the agri-food

	industry
C2	Support ecological and conservation agriculture
C3	Increase afforestation of agrarian lands
C5	Reduce by 18% in 2030 the greenhouse gas emissions compared to the 2005 level, which equals approximately 4.28 tons of carbon dioxide (CO2) per inhabitant and year
C6	Reduce diffuse emissions
C8	Conserve and increase aerial biomass and organic carbon in the soil

We conducted the policy coherence analysis based on Nilsson's et al. (2012) analytical framework. The methodology is described in more detail in Deliverable 2.1 (Munaretto and Witmer 2017). To identify conflicts and synergies between pairs of objectives, a scoring matrix has been applied. Conflicts (synergies) are indicated with negative (positive) scores ranging from -3 to +3, where -3 indicates incoherence and +3 indicates coherence between two objectives (Figure 33). No significant direct interaction is indicated with the score 0. If an interaction can have both positive and negative effects, scores range from (+/-) 1 to (+/-) 3.

Figure 33: Representation of nexus critical objectives based on WP2_Deliverable 2.1



Two researchers conducted individual scorings that were then juxtaposed against each other and discussed to construct the scoring matrix (Table 11). To better understand the scoring matrix, two additional summary tables with counting of frequencies and interactions (Tables 12 and 13) are provided.
Table 12 illustrates the frequency of interactions per pairs of policy domains. The food/land and climate/land have with 83% the highest density of interactions, followed by climate/food with 79%. The interactions in these three domains are largely synergistic, though some ambiguous interactions (+/-) have been observed. Specifically, in the food/land domain 11 interactions show ambiguous relationships. While food and land use objectives have generally positive impacts on the nexus, almost 1/3 of the interactions have no clear direction, indicating possible trade-offs. Similarly, in the climate/food domain 6 interactions or almost 1/5 are ambiguous, indicating possible trade-offs between climate and food objectives.
Table 13 illustrates the counting of direct interactions per each policy objective. The density of interactions shows the highest numbers in the climate, land, and food domains when objectives influence the WLEFC-nexus and in the land and agriculture domains when objectives are influenced by the WLEFC-nexus. Specifically, when affecting the WLEFC-nexus, enhance resource efficiency and climate (A17), restoring, preserving and enhancing ecosystems related to agriculture and forestry (A16), preserve natural resources to ensure future economic development of the Andalusian coastline (L12) and support ecological and conservation agriculture (C2) show the highest density of interactions. In particular, of all possible interactions, A17 has the highest number (100%) and almost all of them are positive. A16 and L12 have the second highest numbers, 96% and 89%, respectively, and most of the interactions are also positive. As for affected objectives, enhance resource efficiency and climate (A17) shows again the

highest number of interactions (100%), followed by preserve natural resources to ensure future economic development of the Andalusian coastline (L12; 96%), improve knowledge transfer and innovation in agriculture, forestry and rural areas (A13; 96%) and improve the sustainable competitiveness of the Andalusian agricultural and agro-industrial sector (A1; 92%).

Regarding the type of interaction, we find that synergies far exceed conflicts. Nevertheless, to improve policy outcomes, attention has to be paid to potential conflicts and ambiguous relationships. For example, progress in modernizing existing irrigation systems (W15) may have positive effects on other objectives in the water domain, in particular on objectives regarding irrigation, but has largely negative effects on energy and climate domains due to an increased energy use in modernized irrigation systems. Ambiguous relationships are pronounced in the objective closer coordination of urban and land use policies and instruments (L1) and improve the sustainable competitiveness of the Andalusian agricultural and agro-industrial sector (A1). The effects on all nexus domains from L1 largely depend on how well urban and land use policies are coordinated. The economic term “competitiveness” in A1 may, for example, stand in direct contrast to water quality (W1, L8), natural resource preservation (L12, L13), renewable energy and climate goals (E2, E3, E4, C3, C5).

In general, water objectives perform in synergistic manner with most objectives in the nexus. Moreover, within the water domain, objectives are strongly synergistic; in particular objectives regarding irrigation have reinforcing objectives within the water domain. The objective W5 provides an example of positive interactions. Rational water use to ensure long term water supply (W5) performs in synergistic manner with irrigation efficiency improvements (W23, W26, W27) and also with land use objectives regarding water rationalization and quality (L8, L9); it certainly enables sustainable competitiveness of the Andalusian agricultural and agro-industrial sector and advocates more sustainable agricultural practices (A1, A9); and it is a necessary condition for restoring, preserving and enhancing ecosystems (A16) and for ecological and conservation agriculture (C2).

Regarding the energy domain, obtain 25% of primary energy saving (E1) performs in synergistic manner with energy efficiency goals in irrigation (W26, W33) and resource efficiency and climate goals (A17, C1, C5). However, energy saving (E1) stands in contrast with modern irrigation systems and regeneration and desalinization of water (W15, W16), as accomplishing these goals requires more energy.

Regarding the food and agricultural domain, the objectives, except for many land use objectives, are usually in conformity with objectives in other nexus domains. In general, synergies are observed between resource efficiency (A17) and efficiency goals in other domains, such as water (W5, W16, W26, W27, W33) and energy (E1), while conflicts may occur between socioeconomic (A6) and environmental goals (L12, L13, A16, A17).

Regarding the climate domain, the objectives, are largely in synergy with objectives in other nexus domains. In particular, objective (C5), reduce greenhouse gas emissions by 18% in 2030 is highly synergistic with primary energy saving (E1) and renewable energy objectives (E2, E3, E4), as well as energy efficiency objectives in the water (W33) and agricultural (A17) domains. Moreover, C5 is expected to positively contribute to natural resource preservation (L12, L13) and resource efficiency and climate (A17). Nevertheless, C5 may have ambiguous effects on organic carbon in the soil (C8), depending on fertilization effects of rising CO^2 levels, and on any objectives that promote economic growth (A1), as additional economic activity may increase greenhouse gas emissions.

Regarding the land domain, objectives concerning preservation and protection of natural resources (L12, L13) are highly related with objectives in other nexus domains. L12 and L13 are in coherence with objectives in the water domain that seek to improve water quality (W1) and promote rational water use (W2), with objectives in the agricultural and food domain that seek to restore ecosystems (A16) and enhance resource efficiency (A17), with objectives in the climate domain that support ecological and conservation agriculture (C2) and increase afforestation (C3). However, L12 and L13 have ambiguous relationships with improving sustainable competiveness in the agricultural sector (A1) and with improving social inclusion and economic development (A18) given that increased economic activity and development may hamper preservation and protection of natural resources. Similarly, a negative relationship may be observed with the objective to improve social and economic conditions (A6), as it may counteract natural resource protection and preservation.

Table 11: Scoring matrix of coherence among policy objectives in the WLEFC-nexus domains

	W1	W5	W15	W16	W23	W26	W27	W29	W31	W33	L1	L8	L9	L12	L13	E1	E2	E3	E4	A1	A6	A9	A13	A16	A17	A18	C1	C2	C3	C5	C6	C8
W1		3	1	1	1	2	2	2	3	0	0	3	2	2	2	0	0	0	0	1	0	2	2	2	2	0	1	2	1	1	1	1
W5	3		2	2	1	3	3	3	2	1	0	3	3	2	2	1	0	0	1	2	0	2	1	2	1	0	1	1	0	1	1	0
W15	2	2		1	3	3	3	1	1	2	0	1	2	0	0	-2	0	0	-1	3	2	1	1	0	2	1	-1	-1	-1	-1	-1	0
W16	1	2	2		1	3	2	2	1	0	0	0	2	1	1	-1	0	0	-1	2	0	1	1	0	2	0	-1	0	0	-1	0	0
W23	1	1	2	1		2	2	1	2	2	0	1	2	1	0	1	1	1	1	2	1	2	3	1	1	1	2	0	0	1	1	0
W26	2	3	2	2	1		3	2	2	3	0	1	3	1	0	3	(+/-) 1	(+/-) 1	2	2	1	1	1	1	2	0	3	0	0	2	2	0
W27	2	2	2	1	1	2		2	1	1	0	1	2	1	0	1	0	0	1	2	0	1	1	1	2	0	1	0	0	1	1	0
W29	3	3	1	2	1	2	2		1	0	0	2	3	1	1	0	0	0	0	-1	0	1	1	2	1	0	0	0	0	0	0	0
W31	3	2	2	1	1	1	1	1		0	0	3	2	2	2	0	0	0	0	1	0	1	1	2	2	0	0	0	0	2	3	1
W33	0	2	2	0	1	3	2	0	0		1	0	2	1	1	3	3	3	3	2	0	1	1	1	3	0	3	0	0	3	2	0
L1	(+/-) 1	(+/-) 1	0	0	0	0	0	0	0	0		(+/-) 1	(+/-) 1	(+/-)1	(+/-) 1	(+/-) 1	(+/-) 1	(+/-) 1	(+/-) 1	0	0	0	0	(+/-) 1	(+/-) 1	(+/-) 1	0	0	(+/-) 1	(+/-) 1	0	(+/-) 1
L8	3	2	0	2	1	0	0	0	1	0	0		1	2	2	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0
L9	2	3	2	1	1	3	3	2	2	0	0	1		1	1	0	0	0	0	1	0	1	1	2	2	0	0	1	0	0	0	0
L12	2	2	0	0	0	1	1	2	2	2	(+/-) 2	2	2		2	1	1	1	1	(+/-) 2	-2	1	1	3	3	(+/-) 2	2	3	3	2	2	2
L13	2	2	0	0	0	0	0	2	2	1	(+/-) 2	2	2	3		1	1	1	1	(+/-) 2	-2	2	2	3	3	(+/-) 2	2	3	3	2	2	2
E1	0	2	-2	-1	1	3	-1	0	0	3	0	0	0	1	1		0	0	2	1	0	2	1	1	3	0	3	2	0	3	0	0
E2	0	0	1	0	1	(+/-) 1	0	0	0	3	(+/-) 2	0	0	(+/-) 1	(+/-) 1	0		3	3	(+/-) 1	0	0	1	1	3	1	3	0	0	3	1	0
E3	0	0	1	0	1	(+/-) 1	0	0	0	3	(+/-) 2	0	0	(+/-) 1	(+/-) 1	0	3		3	(+/-) 1	0	0	1	1	3	1	3	0	0	3	1	0
E4	0	0	0	0	1	2	0	0	0	2	(+/-) 2	0	0	(+/-) 1	(+/-) 1	2	3	3		(+/-) 1	0	1	1	2	3	0	3	0	0	3	1	0
A1	(+/-) 1	(+/-) 1	3	1	1	2	2	0	1	2	(+/-) 1	(+/-) 1	(+/-) 1	(+/-) 1	(+/-) 1	2	(+/-) 1	(+/-) 1	(+/-) 1		(+/-) 2	2	2	(+/-) 3	2	(+/-) 2	3	0	0	(+/-) 2	(+/-) 2	0
A6	0	0	1	0	2	1	0	0	0	0	0	0	0	(+/-) 1	(+/-) -1	0	0	0	0	(+/-) 2		2	2	(+/-) 1	(+/-) 2	3	0	1	0	0	0	0
A9	2	2	2	0	2	2	2	0	2	2	0	2	2	(+/-) 2	(+/-) 2	2	2	2	2	3	(+/-) 1		3	2	2	(+/-)1	2	3	2	2	2	2
A13	1	2	2	0	2	2	2	0	1	1	0	1	2	1	1	2	1	1	1	2	1	2		2	2	1	2	1	1	1	1	1
A16	2	2	(+/-) 1	1	1	3	2	2	2	3	(+/-) 1	2	2	3	3	0	2	2	2	(+/-) 3	0	2	1		2	0	2	2	3	2	2	3
A17	1	3	(+/-) 1	3	1	3	3	2	2	3	(+/-) 1	1	3	1	1	3	2	2	2	3	0	3	2	2		0	3	1	2	3	2	1
A18	0	0	2	2	2	0	0	0	0	0	(+/-) 2	1	0	2	2	0	0	0	0	(+/-) 2	3	0	1	(+/-) 1	0		2	2	(+/-) 1	1	0	0
C1	1	1	-1	1	2	3	1	0	0	3	(+/-) 1	1	2	(+/-) 1	(+/-) 1	3	3	3	2	3	0	3	2	(+/-) 2	2	0		2	(+/-) 1	2	1	1
C2	2	3	3	2	2	3	3	3	3	3	0	2	3	2	2	3	0	0	3	(+/-) 3	(+/-) 3	3	2	3	3	(+/-) 2	2		(+/-) 1	2	2	2
C3	1	0	0	0	0	0	0	0	1	0	(+/-) 2	1	0	3	3	0	0	0	0	(+/-) 2	0	2	2	3	3	0	(+/-) 2	(+/-) 2		3	1	2
C5	2	1	-1	-1	1	3	1	0	1	3	0	1	1	3	3	3	3	3	3	(+/-) 2	0	2	2	3	3	0	3	3	3		3	(+/-) 3
C6	2	2	2	0	1	2	3	2	3	2	0	2	2	1	1	2	0	0	1	2	1	2	2	2	3	0	2	2	1	2		1
C8	1	0	1	0	1	0	0	1	1	1	0	1	1	2	2	0	0	0	0	2	0	2	1	3	1	0	1	2	2	3	1	

Table 12: Frequency of interactions per pairs of policy domains

	Interactions			Synergies		Conflicts		Synergies & conflicts
	Actual interactions	Possible interactions	%	(+)	(0/+)	(-)	(0/-)	(+/-)
E → W	18	40	45	13	35	3	25	1
W → E	20	40	50	14	34	4	24	1
L → W	28	50	56	26	48	0	22	2
W → L	34	50	68	34	50	0	16	0
F → W	51	70	73	47	66	0	19	4
W → F	53	70	76	52	69	1	18	0
C → W	44	60	73	41	57	3	19	0
W → C	32	60	53	25	53	7	35	0
L → E	12	20	60	8	16	0	16	4
E → L	11	20	55	2	11	0	9	7
F → E	19	28	68	16	25	0	9	3
E → F	20	28	71	17	25	0	8	3
C → E	12	24	50	12	24	0	12	0
E → C	12	24	50	12	24	0	12	0
F → L	29	35	83	17	23	0	6	11
L → F	25	35	71	16	26	2	12	7
C → L	25	30	83	21	26	0	5	3
L → C	16	30	53	13	27	0	14	3
C → F	33	42	79	27	36	0	9	6
F → C	32	42	76	29	39	0	10	3

Table 13: Counting of direct interactions per each policy objective

	INFLUENCING What happens in the nexus if we make progress on objective X?							INFLUENCED What happens to objective X if we make progress on other objectives in the nexus?						
	Interac-	%	Synergies		Conflicts		Syn & Conf	Interac-	%	Synergies		Conflicts		Syn & Conf
Obj. X	tions		(+)	(0/+)	(-)	(0/-)	(+/-)	tions		(+)	(0/+)	(-)	(0/-)	(+/-)
W1	15	68	15	22	0	7	0	16	73	14	20	0	6	2
W5	15	68	15	22	0	7	0	15	68	13	20	0	7	2
W15	15	68	8	15	7	14	0	16	73	11	17	3	9	2
W16	11	50	7	18	4	15	0	10	45	8	20	2	14	0
W23	17	77	17	22	0	5	0	18	82	18	22	0	4	0
W26	16	73	14	20	0	6	1	16	73	14	20	0	6	1
W27	13	59	13	22	0	9	0	12	55	11	21	1	11	0
W29	9	41	8	21	1	14	0	8	36	8	22	0	14	0
W31	12	55	12	22	0	10	0	14	64	14	22	0	8	0
W33	16	73	16	22	0	6	0	16	73	16	22	0	6	0
L1	12	44	0	15	0	15	12	10	37	1	18	0	17	7
L8	8	30	8	27	0	19	0	20	74	19	26	0	7	1
L9	15	56	15	27	0	12	0	20	74	19	26	0	7	1
L12	24	89	21	24	1	4	2	26	96	19	20	0	1	6
L13	22	81	19	24	1	6	2	23	85	16	20	0	4	6
E1	19	68	15	25	3	14	0	18	64	15	25	2	12	1
E2	18	64	12	23	0	13	3	13	46	10	25	0	15	2
E3	18	64	12	23	0	13	4	13	46	10	25	0	15	3
E4	18	64	13	24	0	14	4	19	68	15	24	2	11	2
A1	21	84	9	13	0	4	11	23	92	14	16	1	3	8
A6	6	24	4	23	0	19	2	7	28	4	22	2	20	1
A9	22	88	20	23	0	3	2	22	88	22	25	0	3	0
A13	22	88	22	25	0	3	0	24	96	24	25	0	1	0
A16	24	96	22	23	0	1	2	22	88	20	26	0	3	2
A17	25	100	23	23	0	0	2	25	100	12	24	0	0	1
A18	11	44	9	23	0	14	2	8	32	4	21	0	17	4
C1	22	85	17	21	1	5	3	20	77	18	24	2	8	0
C2	23	88	20	23	0	3	3	13	50	12	25	1	14	0
C3	11	42	9	24	0	15	2	10	38	7	23	1	17	2
C5	22	85	19	23	2	6	1	22	85	18	22	2	6	2
C6	21	81	21	26	0	5	0	18	69	16	24	1	9	1
C8	15	58	15	26	0	11	0	9	35	8	25	0	17	1

Notes: Counting of direct interactions per each policy objective (excluding interactions within the sector); in red, the first 2 highest number of interactions; % is calculated on the total number of possible interactions

5.2 Assessment of the nexus critical instrument "consolidation and improvement of existing irrigation systems" with the nexus critical objective (W1) good ecological status of all water bodies

In this section, we assess the nexus critical instrument "consolidation and improvement of existing irrigation systems" with the nexus critical objective "(W1) good ecological status of all water bodies". The instrument and objective were chosen based on the policy analysis and stakeholder´s assessment. The instrument is given in the Agenda of Andalusian irrigation (2011-2015), while W1 is an objective of the Andalusian Water Law. The assessment is, thus, a horizontal policy assessment, as both the instrument and the objective are from the Andalusian policy space and not from the national policy space.

The instrument "consolidating and improving existing irrigation systems" might positively affect the objective "contribute to a good ecological status of all water bodies (W1)", as improved irrigation systems are expected to improve water saving and reduction of diffuse pollution. However, in practice, water saving goals have not been achieved and have even been reversed. Paradoxically, consolidating and improving existing irrigation systems actually increase water consumption in Spain. In Andalusia, possible explanations for this adverse effect are: shifts to cropping patterns with greater water demands reinforced by subsidies for particular crops, and irrigation of larger areas. The instrument and the subsequent investment, which are several billion euros, benefit solely irrigation agriculture and irrigation systems are consuming more water than ever before having a clear negative impact on objective W1. Furthermore, the authorities provide no precise assessments of actual water savings to evaluate the policy instruments.

5.3 Assessment of the effects of the national Royal decree law 1/2012 on the nexus critical regional objective (W33) guarantee efficient energy use in irrigation facilities and promote renewable energy

In this section, we assess the effects of the national Royal decree law 1/2012 on the nexus critical regional objective (W33) guarantee efficient energy use in irrigation facilities and promote renewable energy. The national Royal decree law 1/2012 puts forth the elimination of economic incentives for renewable energy sources. The instrument and objective were chosen based on the policy analysis and stakeholder´s assessment. The assessment is a vertical policy assessment, as the instrument is from the national Royal decree law 1/2012 and the objective from the Andalusian policy space.

The Spanish renewable energy sector suffered from three major problems, which resulted in the enactment of the Royal decree law 1/2012: 1) A large installation of renewables in a period when the technology was not mature and required large public aid, which was poorly designed and very expensive; 2) a crisis that drastically reduced the demand for electricity and has slumped tax revenues; 3) an over-capacitated system - there is much more installed power than what is demanded - based on expensive fossil fuel plants and facilities.

To avoid adding new costs to the electrical system, the government introduced in 2012 the Royal decree law 1/2012, enacted on January 27, leading (among others) to the elimination of economic incentives for new power generation facilities based on cogeneration, renewable energy sources and waste. The decree was aimed at closing the widening gap between the cost of electricity generation and what consumers pay (tariff deficit). Without these economic incentives, the Spanish renewable energy sector came almost to a halt. For example, wind and photovoltaic solar energy production increased only by 0.07% and 0.3% between 2013 and 2015, respectively.

Regarding efficient energy use in irrigation facilities, the high energy costs are a huge conundrum for irrigators. As a result of modernization of the irrigation system, the Spanish water delivery system was changed from surface irrigation to pressurized systems. This required the installation of usually electric pump systems to guarantee sprinklers or drip irrigation to function properly. Energy has, thus, turned into an essential resource for irrigation agriculture with huge increases in energy consumption. Moreover, the Ministry of Industry subsidized energy for irrigation with a special rate (R rate) until July 2008. After July 2008, the energy market was liberated and brought about higher (unsubsidized) energy prices for irrigators to the benefit of power companies.

Clearly, the effects of the national Royal decree law 1/2012 on the nexus critical regional objective (W33) guarantee efficient energy use in irrigation facilities and promote renewable energy are negative and are cancelling each other out. It has not only discouraged investment in renewable energy generation but also reduced output from existing renewable facilities, therefore, also leading to barriers in reducing CO^2 emissions. Moreover, the reform triggered huge social costs in rural areas given that roughly 55,000 families have invested in small solar farms and are now indebted, leading to even more economic uncertainties in the countryside.

5.4 Assessment of vertical interactions between policies

This section presents the assessment of the interaction between policies across scales. As this is a regional case study, the analysis focuses on the interaction between Andalusian policies and national policies in Spain for the different nexus sectors.

The objective of the assessment is to investigate: 1) to what extent higher level policies are transposed and implemented at lower level and 2) to what extent lower level policies are supported or hindered by higher level policies and why.

The assessment builds upon a wide review of policy documents and the interviews with the stakeholders. Table 14 summarizes the main findings from the analysis with a description of how vertical interactions may hamper or support the achievement of the nexus critical objectives both from higher to lower level and vice versa.

Table 14: Assessment of vertical interactions between policies

HIGHER>LOWER	
Higher level policies successfully implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
Royal Decree 1/2001 Rewritten Text of the Water Act	Transposed to the regional level through the Law 9/2010 of Water of Andalusia and the River Basin Management Plans. These policies contribute to achieve the NCO of achieving good status of the water bodies and to the rational water use.
National Irrigation Plan Horizon 2008	This plan contributed to consolidate and modernise existing irrigation land and to develop new irrigation areas in Andalusia.
Law 24/2013 Electric Sector and Royal Decree 900/2015	This legislation aims at the economic sustainability of the electric sector in Spain. However, it hampers the NCOs of obtaining 5% self-consumption of electricity from renewable sources and **providing 25% of total energy consumption from renewable sources**.
Saving and energy efficiency action plan 2014-2020	Transposed to the regional level in the Andalusian Energy Strategy 2020. It contributes to promote a low-carbon energy system.
Renewable Energy Plan 2011-2020	National 2020 target of 20% of renewable energy share is transposed to the regional level through the Andalusian Energy Strategy 2020 that sets a more ambitious target of 25%.
National Rural Development Programme 2014-2020	This programme guarantees the coherence between national and regional strategies.
Spanish Climate Change and clean	The national objectives of reducing GHG emissions and boosting resource efficiency and translated to Andalusia through the Andalusian Climate Action

energy strategy Horizon 2007-2012-2020	Plans and the Andalusian Energy Strategy 2020.
Higher level policies only partly implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
N/A	
Higher level policies poorly implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
N/A	
LOWER > HIGHER	
Lower level policies fully supported by higher level policies	
Policy	Description of reason and how NCOs are influenced
Law 9/2010 of Water of Andalusia	In line with the Spanish Water Law, this regional law was ratified at the national level.
Andalusian Rural Development Programme 2014-2020	This programme is developed at the regional level and is validated at the national level. It contributes to preserve ecosystems related to agriculture, enhance resource efficiency and climate and improve social inclusion and local development in rural areas.
Andalusian Energy Strategy 2020	In line with national strategies, this strategy sets the targets on energy consumption and saving.
Law 7/2002, Urban Planning of Andalusia	This regional law was ratified at the national level.
Andalusian Climate Action Plans	These plans were considered when framing the Spanish Climate Change and clean energy strategy Horizon 2007-2012-2020.
Lower level policies only partly supported by higher level policies	
Policy	Description of reason and how NCOs are influenced
N/A	
Lower level policies hindered/disrupted by higher level policies	
Policy	Description of reason and how NCOs are influenced
N/A	

5.5 Formal and informal rules and practices to handle conflicts, negotiate trade-offs and exploit synergies

In this section, we investigate how problems and opportunities are managed in policy implementation practices. In particular, we explore the rules that are in place to handle conflicts, exploit synergies and negotiate trade-offs among stakeholders in practice.

The assessment is based on the information collected during the interviews with the stakeholders. Table 15 presents both the main formal and informal arrangements identified in Andalusia.

Table 15: Formal and informal arrangements in place in the Andalusian case study

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of nexus critical objectives
Formal	Andalusian Environmental Council. It is a body for social participation constituted by different agents interested in environmental issues in the region (regional government, agricultural organisations, NGOs, etc.)	Coordination, knowledge sharing	This council works as a platform to discuss proposed environmental actions in Andalusia	Contributing to environmental protection
	Andalusian Water Council. It is an advisory body in water issues of the regional government. The members are water users, NGOs, as well as the regional government, etc.)	Coordination, knowledge sharing	This council works as a forum to inform and advise, as well as to propose measures that improve water resources sustainability in Andalusia.	Contributing to sustainable water management
	Andalusian Land Planning Council. It is an advisory body in land planning and urbanisation of the regional government. The members are the regional government, trade unions, business associations, universities, NGOs,	Coordination, knowledge sharing	This council works as a forum to discuss actions regarding land planning in Andalusia	Contributing to resource efficiency use

	etc.			
	Regional government agreement to formulate the Andalusian bio economy strategy	Decision-making	This agreement has boosted the design and implementation of a bio economy strategy in the region	Promoting resource efficiency use and biomass and biofuel production
	Inter-ministerial Committee to identify measures to design the RDP 2014-2020.	Decision-making	This collaboration enabled the implementation of targeted and effective measures promoting energy efficiency. However, some trade-offs with water policies were not considered adequately.	Promoting energy saving and efficiency
	Inter-ministerial Committee for framing the law on measures addressing climate change	Decision-making	This committee facilitates the integration of the different sectors and the views of the different regional governments	Setting up measure to cope with climate change
	Collaboration between (IFAPA, IAS) and the regional administration	Knowledge sharing, decision-making	Research centres advice the regional government (reports about specific issues). However, this collaboration could be further developed.	Promoting resource use efficiency and environmental protection
	Cooperation between water users associations and river management authorities	Coordination, decision-making	This cooperation enables the participatory elaboration of river basin management	Ensuring good status of water bodies and rational water use to ensure long term water supply

			plans	
	Covenant of Mayors for Climate & Energy. Initiative integrated in the Andalusian Urban Sustainability Strategy to meet the objectives of reducing emissions. 546 municipalities in Andalusia have signed it	Coordination and knowledge sharing	The covenant is working as 1700 municipalities in Spain and more than 7000 in Europe have signed it. It promotes the knowledge sharing and the collaboration between different institutions	Contributing to reduceGHG emissions and increasing resilience against climate change impacts.
	Bureau of water formed by the Federation of irrigation farmers of Almeria (FERAL) and several agricultural professional organisations (COAG, ASAJA)	Coordination	This forum is working as a common platform for farmers to pursue their interests and resolve water problems	Promoting sustainable water management
Informal	Irrigation farmers in Almeria collaborate together to develop a project to desalinate a water pond, using solar energy	Management	It is working as a measure to face water scarcity and water quality problems in Almeria	Improving water quality and water availability Using renewable energy in desalination

The analysis of the formal and informal arrangements in Andalusia reveals that policy-making is increasingly based on participative, multi-sectorial and integrated approaches. Public administration is progressively opening up the political process to public participation and promoting evidence-based decision-making. To that end, different councils bring together public and private agents to discuss policies and actions. Moreover, research centers are contributing to support decision-making in the region.

5.6 Identify success stories and failures

Table 16: Success stories

Type of successful policy arrangement	Description	Factors of success, do's
Andalusian Rural Development Programme	Different regional ministries worked together in the design of the	Cooperation Knowledge sharing

2014-2020	programme measures (renewable energy promotion in agriculture, water use efficiency, etc.).	Integrated approach Public participation
Draft law on measures addressing climate change in Andalusia	An inter-ministerial Committee that includes different regional ministries in Andalusia is working on the design of this law. This cooperation enables the definition of a crosscutting policy to face climate change.	Cooperation Knowledge sharing Integrated multi-sectorial approach Public participation
Draft of the Andalusian law on Agriculture	Collaboration between the regional administration and professional organisations can contribute to design an effective policy that has a real impact on the agricultural sector in the region.	Cooperation Integrated approach Public participation
Draft of the Andalusian bio-economy strategy	This strategy is designed by an inter-ministerial Committee that includes different regional ministries in Andalusia. The collaboration among different regional ministries allows for designing an integrated strategy that considers interrelations among sectors.	Cooperation Knowledge sharing Integrated multi-sectorial approach Public participation

Table 17: Failures

Type of unsuccessful policy arrangement	Description	Factors of failure, dont's
Regional energy strategies	Although regional energy strategies try somehow to offset the negative effects of the national energy policy on renewable energies, much more action is needed to promote clean energies.	Constraining national energy policies
River Basin Management Plans	Although the water management over the last years has improved the state of water bodies in the region, there are still specific problems of overexploitation and water quality.	Increased competition for water Inefficient control of illegal water withdrawal Importance of irrigated agriculture

The policy analysis shows that Andalusia is a region specially committed to resource efficiency use and environmental protection. Climate change and bio-economy are in the center of the political agenda with the law on climate change and the strategy on bio-economy being under development. These policies are an opportunity to implement integrated actions that cope with climate change and promote sustainable economic development, based upon a low carbon economy.

Besides successful policy arrangements, there are also unsuccessful policy arrangements that constrained the renewable energy promotion and sustainable water management in the region. While renewable energy promotion depends mainly on decision-making at the national level in Spain, sustainable water management is a challenge that is addressed with regional policies.

6 Conclusions

This deliverable provides the policy coherence analysis for the WLEFC-nexus in Andalusia. We use a mixed-method approach combining interviews with stakeholders and content analysis of policy documents.

Stakeholders from the different nexus sectors were identified through an online investigation and snowball sampling. Fourteen representatives from the public administration, water user associations, farmer organisations, renewable energy associations, NGOs, research centres and universities were contacted and interviewed. Then, a stakeholder workshop held in Seville in October 2017 brought together the stakeholders to discuss nexus challenges and policy objectives.

Stakeholders assessments are used to select crucial policy objectives. To analyse pairs of policy objectives, a scoring matrix is used and additional summary tables with counting of frequencies and interactions are provided to better understand the scoring matrix (Nilsson et al. 2012). We focus on synergies and conflicts between policy objectives given in policy documents but not on actual policy implementation.

Policy coherence analysis for the WLEFC-nexus in Andalusia shows that among the 32 crucial policy objectives synergies far exceed conflicts. The agriculture/land and climate/land domains have with 83% the highest density of interactions. This is perhaps to be expected given that land use objectives include water and climate specific goals but not energy or agricultural specific goals. The objective "enhance resource efficiency and climate", an objective of the agriculture/food domain, is the most relevant policy objective in the nexus as it is affected and affects all other objectives within the nexus. If this objective is pursued correctly, it could trigger positive and synergistic effects in the whole WLEFC-nexus. Other strongly synergistic objectives are found in the water domain, specifically for irrigation water use.

Attention has to be paid to nexus critical objectives that have ambiguous and negative effects on other WLEFC-nexus objectives. Generally, conflicts may occur between socioeconomic and environmental goals, as increased economic activity and development may hamper preservation and protection of natural resources as well as reduction of greenhouse gas emissions. Specifically, energy saving objectives stand in contrast with modernization of irrigation systems and regeneration and desalinization of water, as accomplishing these goals requires more energy. In these cases, policy objectives may be formulated from a nexus perspective involving all affected stakeholders to better cope with inevitable trade-offs.

Moreover, our findings suggest that for conducting an effective policy coherence analysis, it is crucial to involve stakeholders in defining nexus challenges and policy objectives. Otherwise it would be very difficult to select major policy objectives among the immense number of laws, rules, and regulations affecting the WLEFC-nexus.

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8 Appendix 1: Inventory of policies

NATIONAL POLICIES			
Water			
Type	Title	Short description of document	Life span
Law	Royal Decree 1/2001 Rewritten Text of the Water Act	Normative framework to achieve good status and properly protection of hydraulic public domain and water bodies in Spain.	N/A
	Royal Decree 125/2007	Additions of transitional and coastal waters to the territorial framework for the river basin	N/A
	Royal Decree 126/2007	Creation of the Authorities for river basin districts in inter-regional river basins to guarantee cooperation in the application of water protection rules	N/A
	Royal Decree 907/2007	Definition of the content of the hydrologic plans and the procedures for drafting and approving them	N/A
	Law 10/2001 National Hydrological Plan	Instrument for water planning in Spain having three functions: coordination of the different basin plans, planning of inter-basin transfers, and safeguarding of existing water use systems for the supply of domestic water to towns and irrigation for agriculture	N/A
Plan	National Irrigation Plan Horizon 2008	National plan focus on implementing demand management measures, mainly modernisation of agricultural irrigation technology, to conserve water resources through the increase of water use efficiency	2008

NATIONAL POLICIES			
Energy			
Type	Title	Short description of document	Life span
Law	Law 15/2012, Fiscal Measures for Energy Sustainability	Normative framework to harmonize the fiscal system with a more efficient and respectful use with the environment and the sustainability	N/A

	Law 24/2013 Electric Sector	Reform package for the electricity market to reduce the remuneration and compensation for the activities in the electricity system by several billion euros per year. The reform introduced a new way of calculating compensation for renewable energy, waste, and co-generation	N/A
Royal Decree	Royal Decree 900/2015 that regulates the administrative, technical and economic conditions of the modalities of electric energy supply and production with self-consumption	Normative framework that taxes self-consumption photovoltaic installations for the electricity they produce (sun tax)	N/A
Plan	Saving and energy efficiency action plan 2014-2020	Plan to reduce primary energy consumption in Spain	2014-2020
	Saving and energy efficiency action plan 2017-2020	Measures in different sectors (energy efficiency, renewable energy use promotion..) to reduce primary energy consumption in Spain	2017-2020
	Renewable Energy Plan 2011-2020	Establishes the national 2020 target to 20.8% share of renewable energy in the gross final energy consumption. In order to support the plan contents, fifteen general and sectorial studies have been completed.	2011-2020

NATIONAL POLICIES			
Food and agriculture			
Royal Decree	Royal Decree 1075/2014 implementation of direct payments and rural development in Spain	Normative regarding CAP direct payments and rural development implementation in Spain	2015-2020
	Royal Decree 1072/2015 modification of RD 1075/2014 of implementation of direct payment and rural development in Spain	Modification of the normative regarding CAP direct payments and rural development implementation in Spain	2015-2020
	Royal Decree 1076/2014 allocation of payment entitlement	Normative regarding CAP direct payment entitlements allocation	2015-2020

Programme	National Rural Development Programme 2014-2020	CAP instrument to boost rural development in Spain, framework for regional rural development programmes.	2015-2020

NATIONAL POLICIES			
Climate			
Type	Title	Short description of document	Life span
Strategy	Spanish Climate Change and clean energy strategy Horizon 2007-2012-2020	Based on the objectives under the Kyoto Protocol, it takes into account the measures and Programmes adopted by the Autonomous Communities during the last few years. This strategy has two chapters: Actions to fight against climate change and actions to achieve cleaner energy	2007-2012-2020

ANDALUSIAN POLICIES			
Water			
Type	Title	Short description of document	Life span
Law	Law 9/2010 of Water of Andalusia	Normative framework to achieve good status and properly protection of hydraulic public domain and water bodies, ensuring water demand in Andalusia.	N/A
River basin management plan	Guadalquivir River Basin Management Plan	Water planning in the Guadalquivir River Basin. Meet the demand for water as effectively as possible while harmonizing regional and sector development	2015-2021
	Guadiana River Basin Management Plan	Water planning in the Guadiana River Basin. Meet the demand for water as effectively as possible while harmonizing regional and sector development	2015-2021
	Segura River Basin Management Plan	Water planning in the Segura River Basin. Meet the demand for water as effectively as possible while harmonizing regional and sector development	2015-2021
	Mediterranean Basins Management Plan	Water planning in the Mediterranean basins. Meet the demand for water as effectively as possible while harmonizing regional and sector development	2015-2021
	Guadalete and Barbate River Basin Management Plan	Water planning in the Guadalete and Barbate River Basin. Meet the demand for water as effectively as possible while harmonizing regional and sector development	2015-2021

	Tinto, Odiel and Piedras River Basin Management Plan	Water planning in the Tinto, Odiel and Piedras River Basin. Meet the demand for water as effectively as possible while harmonizing regional and sector development	2015-2021
Irrigation plan	Agenda for Andalusian Irrigation Horizon 2015	Regional plan focus on improving irrigation efficiency, developing new water sources (desalination) and technology transfer to farmers	2015
	Special Management Plan of the Irrigation Zones Located to the North of the Forest Crown of Doñana	Plan to make the development opportunities of this territory (especially in the fields of agriculture and tourism) compatible with the protection of the exceptional natural values of Doñana and the rational use of water.	2029
Agreement	Andalusian Water Agreement in the Guadalquivir RBD	Document signed by national and regional Administrations and local stakeholders, which agreed to limit new water concession for irrigation in the Guadalquivir basin.	2015

ANDALUSIAN POLICIES			
Energy			
Type	Title	Short description of document	Life span
Strategy	Andalusian Energy Strategy 2020	Sets up main challenges to reach in 2020: low-carbon energy system, energy governance (public participation), energy for competitiveness and energy innovation. To this end, the Strategy defines different objectives and programmes.	2020
Plan	Andalusian Energy Action Plan 2016-2017	Establishes action lines and specific actions in line with the Andalusian Strategy 2020.	2016-2017

ANDALUSIAN POLICIES			
Food and agriculture			
Type	Title	Short description	Life span

Draft law	Andalusian proposed law on agriculture	This law proposal aims at improving sector competitiveness, promoting research and innovation, encouraging sustainable agricultural practices and articulating the food chain. The law also addresses the integration of the agricultural activity within the environment and the sustainable use of natural resources through the promotion of organic and highly environmental value agriculture	N/A
Rural Development Programme	Andalusian Rural Development Programme 2014-2020	CAP instrument to boost rural development in Andalusia through measures aiming at improve resource use efficiency, Improvement of the coordination of research and technology transfer and modernisation of farms.	2015-2020

ANDALUSIAN POLICIES			
Land			
Type	Title	Short description of document	Life span
Law	Law 7/2002, Urban Planning of Andalusia	Regulatory framework for urban planning in Andalusia	N/A
Strategy	Andalusian Integrated Coastline Management Strategy	This strategy promotes the sustainable development of the Andalusian coastline through the protection and conservation of the most important natural processes and resources	N/A
Plan	Andalusian Land Planning Scheme	The plan defines the land spatial organization for different uses in Andalusia, according to their needs and potentialities.	N/A
	Andalusian Land Planning Scheme	The plan defines the land spatial organization for different uses in Andalusia, according to their needs and potentialities.	N/A
	Andalusian Coastline Protection Plan	This plan aims at protecting natural and agricultural areas in the coast from urbanization and promoting the maintenance of the coast as a basic tourist resource.	N/A

ANDALUSIAN POLICIES

Climate			
Type	Title	Short description of document	Life span
Draft law	Draft law on Measures addressing Climate Change	Legal framework to structure and organise fight against climate change in Andalusia	N/A
Plan	Andalusian Climate Action Plan: Mitigation programme 2007-2012	Establishes 12 areas of action and several mitigation measures for each one: land use, transport, waste, tourism, agriculture, industry, energy efficiency, renewable energy, carbon sinks, research, communication and dissemination and governance	2007-2012
	Andalusian Climate Action Plan: Adaptation programme 2007-2012	Includes fours sub-programs: 1) Immediate action measures; 2) Sectorial assessment of climate change effects; 3) Sectorial measure of adaptation; and 4) Improvement of knowledge and governance. Sectors considered in this plan are water, soil, energy, forest, biodiversity, health, floods, agriculture, tourism, transport, and land use.	2007-2012
Covenant	Covenant of Mayors for Climate & Energy	The Regional Environmental Government of Andalusia (Climate Change and Urban Environment) will support the Covenant by giving technical assistance to municipalities of Andalusia through the Ciudad 21 Program and will promote the Covenant of Mayors in all of these municipalities.	N/A

ANDALUSIAN POLICIES			
Tourism			
Type	Title	Short description of document	Life span
Law	Law 13/2011 of Tourism of Andalusia	Regulatory framework sustainable tourism promotion	N/A
Strategy	Sustainable Integral Strategy for the Development of Interior Tourism in Andalusia	Measures to promote interior tourism (tourist attraction sector, forums for public-private cooperation, internationalization of the largest number of Andalusian tourist companies…)	

Plan	Andalusia Quality Tourism Plan 2014-2020	Proposes different actions aiming at creating sustainable tourist destinations that promote economic development while preserving natural resources. These actions include the study of the tourism sector in terms of sustainability; the promotion of good tourist practices in protected natural areas; the review of tourism regulations to include sustainability criteria; and economic support subject to tourist sustainability criteria	2014-2020
	General Plan for Sustainable Tourism in Andalusia – Horizon 2020	Measures to promote sustainable tourism: reinforce the mark Andalusia, innovation, management of tourist seasonality...)	2020

ANDALUSIAN POLICIES			
Horizontal policies			
Type	Title	Short description of document	Life span
Law	Law 2/2007 on Reform of the Statute of Autonomy of Andalusia.	Law establishing powers of Andalusia	N/A
	Law 45/2007 Sustainable Rural Development	National political framework on rural development complementing European regulation	N/A
	Law 7/2007 de Environmental Quality Integrated Management of Andalusia	The law completes and updates the surveillance and inspection regime and constitutes a set of sanctions aimed at ensuring the restoration of environmental damages.	N/A
Plan	Environmental Plan Andalusia - Horizon 2017	Integration of the environmental policy with other policies through promotion of the environmental R&D, environmental integrated management, water resources sustainable management, urban sustainability and environmental integration in economic activities.	2017
Strategy	Spanish Strategy for Sustainable Development	Action lines aimed towards the protection of the atmosphere, air quality, water, land, nature and health in Spain.	
	Andalusian Strategy for Sustainable Development 2020	Aims at leading policies and public and private initiatives towards a sustainable development model based on the transition to a green economy	2020

	Urban Sustainability Strategy for Andalusia	Political framework to promote sustainable urban development (mobility, building, natural spaces…)	
	Formulation agreement for the Bioeconomy Strategy of Andalusia	Agreement to formulate a bioeconomy strategy in Andalusia	2030
	Andalusian Strategy for Biodiversity Integrated Management	Strategy to conserve and improve the management of biodiversity of Andalusia	
	Spanish Strategy for Science, Technology and Innovation 2013-2020	Strategy that includes the general objectives to be achieved related to the promotion and development of research and innovation activities in Spain.	2013-2020
	Innovation Strategy 2020 - RIS3 Andalusia	Instrument to promote a new productive model based on innovation that will generate employments and increase productivity in the region	2020
Draft strategy	Andalusian Bio-economy Strategy	Promotion of production based on renewable sources to increase competitiveness of agricultural sector	

9 Appendix 2: Inventory of goals of each relevant policy sector

Water		
Overarching objectives	Specific objectives	Reference documents
Integrated water management	Prevents further deterioration, protects and enhances the status of water resources	Spanish water law Andalusian water law National hydrological plan Andalusian Water Agreement in the Guadalquivir RBD
	Promotes sustainable water use based on long-term protection of water resources	
	Ensures the progressive reduction of water pollution	
	Meet the demand for water as effectively as possible while harmonizing regional and sector development	Spanish water law Andalusian water law National hydrological plan Andalusian Water Agreement in the Guadalquivir RBD
Policy integration in water management	Integrate public water domain protection within sectoral policies and land planning	Andalusian water law
Water management planning	River basin management plans	Spanish water law River basin management plans

Conserve water resources through the increase of water use efficiency in agriculture	Transformation and improvement of irrigation systems	National irrigation plan Horizon 2008
Enhance competitiveness of the Andalusian irrigation sector	Improvement of irrigation systems Ensure water supply (regulation mechanisms, reclaimed water, desalinisation) Improve knowledge transfer Promote research and innovation in the sector Sustainable water use (reduce water use, adequate water allocation to crops..) Contribute to achieve objectives under the WFD Improve energy use efficiency in irrigation Promote the introduction of renewable energies	Agenda for Andalusian Irrigation Horizon 2015
Irrigation planning in Doñana Natural Park	Make agriculture and tourism activities compatible with the protection of the environment of Doñana and the rational use of water.	Special Management Plan of the Irrigation Zones Located to the North of the Forest Crown of Doñana

Energy		
Overarching objectives	Specific objectives	Reference documents
Ensure the economic sustainability of the energy system		Law 15/2012, Fiscal Measures for Energy Sustainability Law 24/2013 Electric Sector Royal Decree 900/2015 that regulates the administrative, technical and economic conditions of the modalities of electric energy supply and production with self-consumption
Reduce energy consumption	Establishes specific reduction to achieve in 2020	Saving and energy efficiency action plan 2014-2020 Saving and energy efficiency action plan 2017-2020
Moving towards a low carbon economy in Spain	20% final energy consumption from renewable sources	Renewable Energy Plan 2014-2020

Moving towards a low carbon economy in Andalusia	Reduce primary energy consumption in 25% 25% final energy consumption from renewable sources	Andalusian Energy Strategy 2020 Andalusian Energy Action Plan 2016-2017

Food and agriculture		
Overarching objectives	Specific objectives	Reference documents
Support EU agriculture	Viable food production Agricultural nature management and climate adaptation Territorial balance	Royal Decree 1075/2014 implementation of direct payments and rural development in Spain Royal Decree 1072/2015 modification of RD 1075/2014 of implementation of direct payment and rural development in Spain Royal Decree 1076/2014 allocation of payment entitlement
Enhance rural development	Improve resource use efficiency Improve the coordination of research and technology transfer Modernisation of farms	National Rural Development Programme 2014-2020 Andalusian Rural Development Programme 2014-2020
Improve competitiveness and promote sustainability of agricultural sector in Andalusia	Improve sector competitiveness Promote research and innovation Encourage sustainable agricultural practices Articulate the food chain Integration of the agricultural activity within the environment Sustainable use of natural resources through the promotion of organic and highly environmental value agriculture	Andalusian agricultural law proposal

Land		
Overarching objectives	Specific objectives	Reference documents
Urban development planning	Develop instruments to coordinate land and urban development	Law 7/2002, Urban Planning of Andalusia

	planning Regulation of soil prices	
Land planning	Reinforce economic competitiveness and social and territorial cohesion Strategy for sustainable spatial development	Andalusian Land Planning Scheme
Sustainable development of coastal areas	Control urbanization process in coastal areas Limit certain economic activities in the Andalusian coast Rationalize the use of inland waters and reduce the rate of growth of water demand Protection and conservation of natural processes and resources Formulate an institutional policy for integrated coastline management Improve coordination and institutional cooperation in matters related to the coast of Andalusia. Encourage public participation in policy decision making	Andalusian Integrated Coastline Management Strategy
Protection of coastal areas	Control urbanization process in coastal areas Protection and conservation of natural processes and resources Promote the maintenance of the coast as a basic tourist resource	Andalusian Coastline Protection Plan

Climate change		
Overarching objectives	Specific objectives	Reference documents
Achieve objectives under the Kyoto Protocol	Actions to fight against climate change and to achieve cleaner energy	Spanish Climate Change and clean energy strategy Horizon 2007-2012-2020
Mitigation of climate change in Andalusia	Establishment of mitigation measures for the sector land use, transport, waste, tourism, agriculture, industry, energy efficiency, renewable energy, carbon sinks, research, communication and dissemination	Andalusian Climate Action Plan: Mitigation programme 2007-2012

	and governance	
Adaptation to climate change in Andalusia	Establishment of adaptation measures for the sectors water, soil, energy, forest, biodiversity, health, floods, agriculture, tourism, transport, and land use.	Andalusian Climate Action Plan: Adaptation programme 2007-2012

Tourism		
Overarching objectives	Specific objectives	Reference documents
Sustainable tourism promotion	Distribution of powers in the area of tourism the different public regional Administrations Promotion of sustainable tourism as a strategic sector of the Andalusian economy Protection of tourism resources in accordance with the principle of sustainability	Law 13/2011 of Tourism of Andalusia
Promote sustainable tourism	Define strategies and policies to implement a sustainable tourism development model Strengthen the tourism sector and generate employment Dissemination of products promoting and valorising natural, cultural, territorial and landscape resources Establish effective participation mechanisms among the actors involved in the tourism development model	General Plan for Sustainable Tourism in Andalusia – Horizon 2020
Enhance quality tourism	Promote economic development while preserving natural resources Promotion of good tourist practices in protected natural areas Support emerging and innovative tourism initiatives to deal with seasonality	Andalusia Quality Tourism Plan 2014-2020
Promote interior tourism	Tourist attraction poles under the premise of integral sustainability Foster the creation of forums for	Sustainable Integral Strategy for the Development of Interior Tourism in Andalusia

	public-private cooperation Contribute to the integration of the local population through the creation of income and employment	

Horizontal policies		
Overarching objectives	Specific objectives	Reference documents
Powers allocation to Andalusia		Ley 2/2007 on Reform of the Statute of Autonomy of Andalusia.
Environmental protection	Surveillance and inspection regime and constitutes a set of sanctions aimed at ensuring the restoration of environmental damages	Law 7/2007 de Environmental Quality Integrated Management of Andalusia
Integration of the environmental policy with other policies	Improvement of environmental information Promotion environemental R&D Environmental integrated management Water sustainable management Urban sustainability Environmental integration in economic activities.	Environmental Plan Andalusia - Horizon 2017
Sustainable development in Spain	Protection of the atmosphere, air quality, water, land, nature and health in Spain.	Spanish Strategy for Sustainable Development
Sustainable development in Andalusia	Policies and public and private initiatives towards a sustainable development model based on the transition to a green economy	Andalusian Strategy for Sustainable Development 2020
Sustainable urban development	Political framework to promote sustainable urban development (mobility, building, natural spaces…)	Urban Sustainability Strategy for Andalusia
Promote bioeconomy	Agreement to formulate a bioeconomy strategy in Andalusia	Formulation agreement for the Bioeconomy Strategy of Andalusia
Sustainable Rural Development	National political framework on rural development complementing European regulation	Law 45/2007 Sustainable Rural Development
Biodiversity conservation		Andalusian Strategy for Biodiversity Integrated

		Management
Promotion and development of research and innovation activities in Spain		Spanish Strategy for Science, Technology and Innovation 2013-2020
Promotion and development of research and innovation activities in Andalusia	Promote a new productive model based on innovation that will generate employments and increase productivity in the region	Innovation Strategy 2020 - RIS3 Andalusia

10 Appendix 3: Inventory of instruments of each relevant policy sector

Water		
General instrument or instrument category	Specific policy instruments	Reference documents
Taxes	Fee for using the public water resources Fee for using water to produce electric energy Fee for using hydraulic works and water rate	Spanish water law Andalusian water law
Penalties	Sanctions for infringing the law (overexploitation, illegal wells...)	Spanish water law Andalusian water law
Permits	Water volume transfer between basins	National hydrological plan
Taxes	Fee for water transfer (water use rate + environmental fee)	
Regulations	Definition of common technical and methodological criteria for RBMP Implement measure for efficiency water supply Research and innovation in the field of water Monitoring of the implementation of RBMP	
Programs	Program of public investment in water works	
Measures	Reduce point-source and diffuse pollution Reduce pressures on water extraction Conservation and improvement of aquatic ecosystems Face water governance problems Increase resource availability	River basin management plans

	Prevent floods	

Energy		
General instrument or instrument category	Specific policy instruments	Reference documents
Taxes	Tax on the nuclear fuel used Tax on hydroelectric generation Tax on fossil fuels Tax on electric generation over all type of sources	Law 15/2012, Fiscal Measures for Energy Sustainability
Regulations	Limitation or suspension on the rights of producers of electric energy from renewable sources Electric markets limitations or modifications Limitation or modification on the rights of third-party access to energy networks Regulation of electric energy prices	Law 24/2013 Electric Sector
Taxes	Rate to access to transport and distribution networks	Law 24/2013 Electric Sector
Subsidies	Building renovation (residential and hotel) Renewal of agricultural Renewal of transport vehicles	Saving and energy efficiency action plan 2014-2020 Saving and energy efficiency action plan 2017-2020
Loans	Industrial investment to increase energy efficiency	
Subsidies to projects and initiatives	Research and innovation in new prototypes Technological demonstration with electric generation Investment thermic renewable energies biogas production Investment in agro-industrial biogas production	Renewable Energy Plan 2011-2020
Funding programmes	Demonstration projects of innovative technological development in renewable energies Electric energy generation installations (P<10Kw) for self-consumption Thermic renewable energies projects	

Actions on energy infrastructures	Introduction of biogas in natural gas transmission networks Increase presence of biofuels in hydrocarbons logistic	
Dissemination and formation	Promotion, information and formation	
Action lines	Sustainable building Efficient transport Innovation in the energy sector Improvement of energy infrastructures Dissemination and formation Energy management in the regional public administration	Andalusian Energy Strategy 2020 Andalusian Energy Action Plan 2016-2017

Food and agriculture		
General instrument or instrument category	Specific policy instruments	Reference documents
Direct payments	Basic payment Green payment Payment for young farmer Coupled support Payment for small farmers Total: 1275 million euros (28% of Spanish direct payments)	Royal Decree 1075/2014 implementation of direct payments and rural development in Spain Royal Decree 1072/2015 modification of RD 1075/2014 of implementation of direct payment and rural development in Spain Royal Decree 1076/2014 allocation of payment entitlement
Rural development aids	Agrienvironmental measures: 328 M€ - 13%* Soil erosion: 201 M€ – 8% Water management: 166 M€ – 7% Improving holdings competitiveness: 524 M€ Promoting the efficiency of resources and support for the transition to a low-carbon economy: 344.9 M€ - 14% Promoting social inclusion, reducing poverty and developing rural economies: 331 M€-14% Promoting the organisation of the	Andalusian Rural Development Programme 2014-2020

	food supply chain: 254.8 M€ - 10.4% Investment in improving competitiveness: 203 M€.	

*Values in millions euros and % of the RDP total

Land		
General instrument or instrument category	Specific policy instruments	Reference documents
Plans	General plans (urban planning…) Development plans (partial planning, especial plans)	Law 7/2002, Urban Planning of Andalusia
Regulations	Land planning normative Municipal regulations	
Penalties	Land use change actions without licence Infringement of this law Urbanization in undeveloped land	
Plan	Land planning at sub regional level plans Coastal area planning programmes Industrial development plans Tourism planning Energy sustainability plans Water-land programmes	Andalusian Land Planning Scheme
Action lines	Formulate integrated policies for coastlines management Obtain economic resources to support the integrated management of coastline Education and raise awareness	Andalusian Integrated Coastline Management Strategy
Protected areas	Coastlines areas of environmental protection (already under protection – Red Natura 2000, natural protected areas) Coastlines areas of territorial protection (natural or agricultural values)	Andalusian Coastline Protection Plan

Climate change		
General instrument or instrument category	Specific policy instruments	Reference documents
Action lines	Participate in new multilateral	Spanish Climate Change and

	Funds, promote the creation of private Funds Increase forest surface, restore the soil cover Increase carbon absorbed in agricultural systems Encourage the small photovoltaic facilities of less than 5 Kw., by improving the premiums related to grid-access conditions and the administrative proceedings to obtain subventions and request connection permission Define biomass national Strategies and the use of organic matter Rationalization of manure management and reduce nitrogen fertilizers Improve energy efficiency in irrigation Improve the use of renewable energies in desalination processes Discourage excessive consumption by means of modifications to the fare structure Support research and innovation projects	clean energy strategy Horizon 2007-2012-2020
Measures	Include climate change issues in land and urban planning Promotion the production and use of biofuels Improve waste management Enhance sustainable tourism Increase carbon absorbed in agricultural systems Reduce GEI in agriculture Promote renewable energies Define action plan to use of organic matter as biomass Increase carbon absorbed in natural systems Research in energy and agriculture Raise awareness	Andalusian Climate Action Plan: Mitigation programme 2007-2012
Measures	Introduction of crop varieties adapted to drought Control of soil erosion Control of diseases and pests	Andalusian Climate Action Plan: Adaptation programme 2007-2012

	Adapt tourist infrastructures to new climate conditions Land planning adapted to climate change Research and innovation in the field of adaptation to climate change	

Tourism		
General instrument or instrument category	Specific policy instruments	Reference documents
Action lines	Develop infrastructures that facilitate sector development Diversification of tourist products Sustainable land use Preservation of natural areas	Law 13/2011 of Tourism of Andalusia
Regulations	Regulation regarding tourist accommodation establishments	
Penalties	Infringement of this law	
Action lines	Tourist products and resources inventory Promotion of tourist product out of high season Support to sustainable tourist entrepreneurship	General Plan for Sustainable Tourism in Andalusia – Horizon 2020
Programmes	Excellence tourism Innovation and formation Coordination	Andalusia Quality Tourism Plan 2014-2020
Programmes	Support and formation to tourist sector Sustainability of tourist areas Promotion and communication	Sustainable Integral Strategy for the Development of Interior Tourism in Andalusia

SARDINIA
Policy analysis

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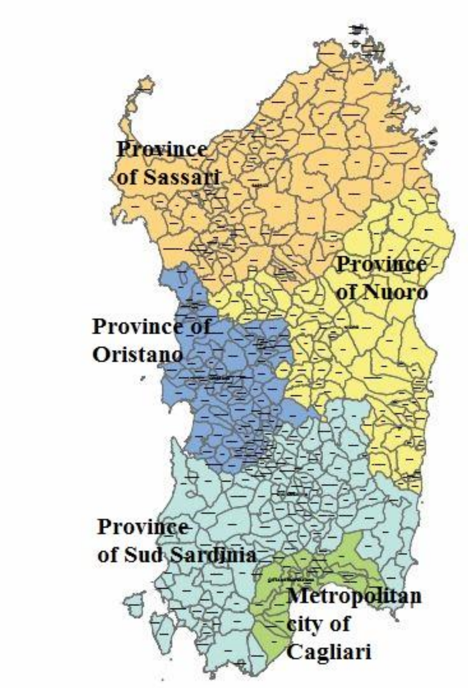
1 Socio-economic context

1.1 Governance

The Italian Republic is organized on a multilevel governance system based on various levels of sub-national government administrations, namely Regions, Provinces, Metropolitan Cities, and Municipalities.
The Region of Sardinia is one among five Italian autonomous regions with special statute, granted by the Italian Constitution (Art. 116). This special statute grants the Region of Sardinia with a higher degree of legislative and financial autonomy.
Since February 2016, the Autonomous Region of Sardinia is divided in 4 provinces, namely Nuoro, Oristano, Sassari, Sud Sardinia and one Metropolitan city, which coincides with the regional capital (Cagliari) hinterland (see map).

Figure 1 Sardinia administrative organization



While the Italian State has exclusive power to legislate on some issues (Security, Foreign Affairs etc.), all Regions retain legislative power over a large number of issues, some of them traspassinig the legislative competence of the national State, especially for some sectors (for example national energy distribution, enhancement of cultural and environmental assets). Furthermore, the Charter of the Autonomous Region of Sardinia established that the Regional administration has legislative authority over public water rights, agriculture and forests, and tourism.
The political and legislative role of the Autonomous Region is strengthened by a governance system which established a direct relationship between the Regional Government and the European institutions,

particularly for what concerns the Structural Funds (ERDF, ESF, CF, EAFRD, EMFF). Specifically, it is noteworthy that the last Structural Fund Regional Programming (2014-2020) has identified among its areas of intervention: Tourism, Culture and the Environment, Intelligent Energy Efficient Networks and Agro-industry.

1.2 Economy in Sardinia

According to the latest "Report on the Economy of Sardinia" (CRENoS, 2017), Sardinia's per capita GDP has suffered a decrease of 0.5% between 2014 and 2015, thus bringing its economy to a level experienced twenty years earlier.

Between 2011 and 2015 the per capita GDP of Sardinia ranged from 77 to 70% of the average European regions, reaching the 212th position among the 276 regions of the European Union.

The high number of small firms, the low productivity and the low level of internationalization are the main hindrances for the Sardinian economic system. Positive signals, however, are in the growth of expenditure on durable goods and services, which could indicate an improvement in the expectations of consumers and families. From a sector point of view, Sardinia confirms its agricultural production specialisation. The industrial sector generates just 12.8% of the total added value, while about one third of the added value is created by the public sector and not-for-sale service sector. The little relevance of the activities producing market goods and services, indicates a weak productive capacity of the regional economic system. On the other hand, employment and employment rates are growing, albeit to a very small degree, reflecting a modest reduction in the regional unemployment rate. Nevertheless, the unemployment rate stands at 17.3%, a value considerably higher than the national one (11.7%). Regarding participation in the labour market, the latest data confirm a strong gender gap: the female rate of activity (51.6%) is almost 20 points lower than the male one (70.3%). Although the number of new jobs contracts exceeds the number of concluded contracts, new contracts have shown a decrease of 12.5% in 2016.

Regarding trends in the number of firms, data from MOVIMPRESE – the database of active firms managed by the National Chamber of Commerce network – show important differences among sectors. During the period 2006-2016 the industrial sector presented a regional reduction of 24%, with a negative trend in all province areas[1]. On the other hand, the agri-food sub-sector registered a 6% regional growth; Sassari and Ogliastra show a low decrease, whereas all other areas have an increase in the number of firms, particularly Carbonia-Iglesias (+ 24%): apparent failures in other manufacturing production, due to the closure of large and small firms, was compensated by an increase in the agri-food sector.

Table 1 Manufacturing and agri-food sectors in years 2006 - 2016

	Manufacturing Sector			Agri-food Sector		
	2006	2016	% Change rate 2016-2006	2009	2016	% Change rate 2016-2009

[1] Despite the reorganisation in Sardinian administration, 2016 official data on economy (National network of Chambers of Commerce) and population (National Institute for Statistics) are recorded on the previous 8 provinces: Cagliari (now split into the Metropolitan Area of Cagliari and the Province of South Sardinia), Medio Campidano and Carbonia-Iglesias (both included in the Province of South Sardinia), Oristano (the current Province, plus the municipality of Genoni which joined the Province of South Sardinia), Sassari and Olbia-Tempio (now merged into the Province of Sassari), Nuoro and Ogliastra (merged in the Province of Nuoro, less the municipality of Seui which joined the Province of South Sardinia).

Sassari	3933	2931	-25%	574	561	-2%
Nuoro	2131	1679	-21%	467	511	9%
Cagliari	5749	4343	-24%	610	659	8%
Oristano	1720	1292	-25%	336	340	1%
Olbia-Tempio	2746	2121	-23%	264	289	9%
Ogliastra	641	528	-18%	128	126	-2%
Medio Campidano	967	755	-22%	181	188	4%
Carbonia - Iglesias	1178	895	-24%	148	183	24%
Sardegna	19065	14544	-24%	2708	2857	6%

The census on firms, conducted in 2011 by the National Statistics Institute, indicates that the manufacturing sector employs 51,154 workers, mainly in the agri-food industry, which has 9,585 employees, followed by the wood sector with 3,765 employees. While these two sectors are spread all over the island, other manufacturing sectors (e.g. chemical and petrochemical industries) are characterized by high concentrations in few production sites. In 2011, the mining sector – once the main economic sector in the Island – recorded only 1819 workers, in a small number of municipalities, located in the former mining district of Sulcis Iglesiente (in the former province of Carbonia-Iglesias) and in quarrying areas in the former Provinces of Nuoro, Olbia-Tempio, Sassari.

In the tertiary sector, there is a spread growth in the accommodation and catering sectors. Nevertheless, the tertiary sector is experiencing a generalized decline, albeit small, in almost all the provinces, with the exception of the areas of Sassari and Olbia-Tempio. The services sector in Sardinia employs 239,821 workers, mainly in the building sector and in the trade sector (ISTAT, Census on firms, 2011).

Table 2 Real estate, catering and tertiary sector in years 2006 - 2016

	Accommodation			Catering			Tertiary Sector		
	2009	2016	% Change Rate 2016-2009	2009	2016	Var. % 2016-2009	2006	2016	% Change Rate 2016-2006
Sassari	258	363	41%	2982	3687	24%	24920	27206	9%
Nuoro	166	256	54%	1443	1538	7%	11575	11329	-2%
Cagliari	363	566	56%	3703	4639	25%	47640	47716	0%
Oristano	112	163	46%	1236	1393	13%	11093	10296	-7%
Olbia-Tempio	562	726	29%	2813	3429	22%	17117	20195	18%
Ogliastra	115	167	45%	484	579	20%	3720	3694	-1%
Medio Campidano	49	65	33%	603	634	5%	6100	5806	-5%
Carbonia – Iglesias	117	122	4%	963	1154	20%	7841	7406	-6%
Sardegna	1742	2428	39%	14227	17053	20%	130006	133648	3%

Tourism is an important economic sector for Sardinia. According to the provisional data of the Regional

Statistical Service provided in the "Report on the Economy of Sardinia" (CRENoS, 2017), in 2016 tourist arrivals increased by 10.3% and overnight stays by 10%; foreigner visitors increased by 11.7%, a rate higher than the 8.5% registered for national tourists.

Official data of the National Statistical Office (ISTAT) for 2015 indicate a total of 2,609,692 arrivals and 12,392,827 overnight stays in Sardinia, a significant increase compared to 2014 (+ 9.1% for both indicators).

The number of tourists in the former provinces of Medio-Campidano, Nuoro, Sassari and Oristano grew more than the regional average (+21.4%, +21.3%, +15.1% and +10.1% respectively), these are followed by the former provinces of Olbia-Tempio (+7.0%), Carbonia-Iglesias (+6.4%), Cagliari (+5.6%) and finally Ogliastra (+3.8%). Compared to 2014, when Carbonia-Iglesias and Nuoro showed up some difficulties, tourist flows in 2015 increased in all the areas.

In 2015 the arrivals and overnight stays of foreigners grew to a greater extent than those of Italians (+10.3% vs +8.1% arrivals; + 9.8% vs + 8.4% tourist number). The average stay of tourists, 4.8 days, is stable compared to 2014. Foreigner tourists come mainly from Germany, France, Switzerland and the United Kingdom. The marked seasonality of tourist flows is a feature of the destinations that, in the case of Sardinia, are mainly oriented to sea-bathing tourism. In 2015, more than 53% of tourists arrived in Sardinia on the months of July and August; this figure increases up to 84% if we consider the period June-September.

An indicator that measures the severity brought by this concentration is the "seasonal peak factor", calculated as the ratio between the maximum monthly overnight stay number and average monthly overnight stay number. In Sardinia, in August 2015 overnight stays are 3.4 times higher than average overnight stays.

Moreover, a high number of tourists spent holiday time in Sardinia in unofficial accommodation structures, basically secondary homes rented during summer months, and located in coastal municipalities (and in very recent years, also in municipalities surroundings coastal areas). CRENoS (2017) estimated that 41% of tourists spent their holidays in private unofficial accommodation.

This situation creates a wide range of problems in coastal areas (where most of Sardinia's population lives): from congestion in beaches and tourist facilities, to shortage or malfunction of public services such as water provision and wastewater treatment.

In 2015 there were 4,648 official structures in Sardinia, for a total of 212,220 beds, the majority of which were offered by the hotels (54%). Compared to 2014, both total accommodation and beds in 2015 increased by the same percentage (2.6%). In 2015, the gross use index of accommodation facilities, which measures current production compared to potential output, is still quite low: 22% for hotel facilities and 9.1% for other categories, compared to, respectively, 32% and 13.5% at national level. The marked seasonality of the tourism is the main reason for the current low use of structures compared to the potential: while in August the occupancy rate for tourist accommodation facilities is 54%, this figure drops to 1% in winter time during the months of January and December.

1.3 Population

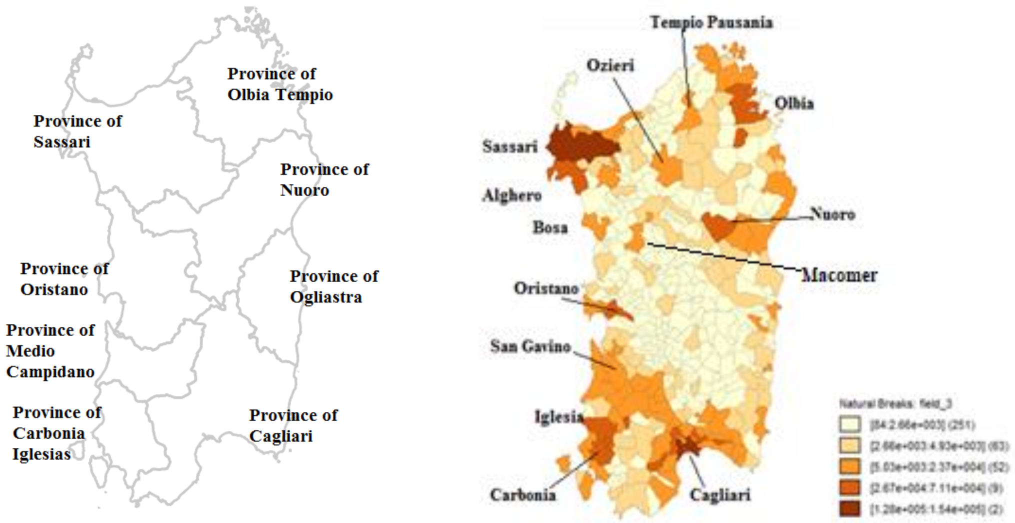
As of June 2016, the population of Sardinia was estimated to be of 1,658,000 inhabitants. The Figures below show that population is mainly concentrated along the coastal areas. Major densities are found in provincial capitals, particularly in Cagliari and Sassari, followed by Olbia, Nuoro, Iglesias and Oristano[2]. It should also be noticed that some of the other large municipalities (> 10,000 inhabitants) are included in the metropolitan area of Cagliari and in the Sassari-Alghero area.

Sardinia hosts a total of 377 municipalities, with 314 municipalities (83.29%) having less than 5000 inhabitants. In these smaller municipalities lives 31.27% of Sardinia's population, i.e. 518.497 inhabitants

[2] See previous footnote

(Comuniverso, 2016).
Some population clusters induced by the industrialization policies of ‘60s and ‘70s are concentrated in the surroundings of important mining areas, as in the case of Carbonia-Iglesias, or manufacturing areas as in the Medio Campidano and Macomer.
The distribution of population in the area of Medio Campidano and the southern part of the province of Oristano reflects the existence of important transport infrastructures, and in particular the following areas: 1) the railway line Cagliari - Decimomannu - San Gavino - Oristano (which continues to Sassari-Porto Torres and Olbia); 2) the highway 131, which connects Cagliari and Porto Torres; and 3) the Santa Giusta industrial port area. This intermodal transport system facilitates the connection between the regional capital and the local administrative centers. It also should be noted that along this axis there are some of the most important agricultural and agro-food poles of the region, starting from the artichoke crops in the northern area of Decimomannu up to the dairy farms of Arborea and the horticulture areas of Terralba (from the current northern area of the Province of South Sardinia to the current southern area of the Province of Oristano)
In other cases, residential patterns are influenced by the presence of administrative services and social facilities, as in the case of Ozieri and Tempio-Pausania, where there are hospitals, school infrastructures and, as in the case of Tempio-Pausania, also a courthouse. Around these centers, it is possible to have a relatively higher concentration of population, for the presence of one of the main agri-food poles in the island, related to wine production, and the granite and cork industry areas. There are also other important local administrative centers like Bosa, Muravera and Ittiri.

Figure 2 Population distribution in Sardinia



Important information about population in Sardinia comes from a trend analysis based on the National Census Data (ISTAT). The following table indicates the a slower increasing trend of Sardinia’s population compared to the National trend.

Table 3 Population growth in Sardinia

	1971	1981	1991	2001	2011	2016	Change Rate 2011-2001	Change Rate 2016-2011
Sardinia	1,473,800	1,594,175	1,648,248	1,631,880	1,639,362	1,658,138	0.46%	1.15%
Italy	54,136,547	56,556,911	56,778,031	56,995,744	59,433,744	60,665,551	4.28%	2.07%

This trend is the result of some characteristics of Sardinia's population. Such characteristics are better understood through a critical reading of population data and demographic indicators.

The ageing ratio measures the number of elderly over young people, allowing estimates of the aging population in a territory (this indicator is the ratio of the population aged 65+ to the population under 15). The change in the index over time depends on the dynamics of both the elderly and the young population. Values above 100 indicate a greater presence of elderly subjects compared to young people. Current data shows that there are 188 elderly people per 100 young people, while the national average is 161.4, thus denoting a higher ageing ratio in Sardinia when compared to the national one.

The working age population index is the percentage ratio between the working population aged 40-64 and the working population aged 15-39. This ratio indicates the aging degree of the working population by correlating the older (still active) generations to the younger generations that will be destined to replace them. Available data indicates that in Sardinia there are 141 people aged 40-64 over 100 aged 15-39, while national average is 132.3.

The structural dependency index calculates how many individuals are in inactive age in relation to active age, indirectly providing a measure of the sustainability of a population's structure. In fact, it's the percentage ratio between the inactive population (0-14 years and over 64 years) and the active population (15-64 years). The denominator represents the range of population that should provide for the support of the numeric mark. This ratio expresses the theoretical social and economic burden of the active age population: values above 50 percent indicate a situation of generational imbalance. In this instance, Sardinia shows a better indicator than Italy (respectively 51 and 55.5).

Table 4 Aging ration, working age population and structural dependency index in Sardinia and Italy

	Ageing ratio	Working age population index	Structural dependency index
Sardinia	188	141	51
Italy	161.4	132.3	55.5

The high percentage of old people is the main problem for population sustainability in Sardinia: this means that we have too many non-fertile people compared to people in a fertile age. The result is that the number of life births does not compensate for the number of deaths (i.e., the natural increase is negative). Unfortunately, we cannot benefit from the positive influence of migration: statistics for the year 2016 show that only 47,425 foreigners, nearly 3% of total population, were living in Sardinia, mainly in Cagliari and Olbia.

In addition, Sardinia registered low fertility rate in Italy (1.1), lower than the level granting an appropriate rate of replacement.

As already mentioned above, current low migration flows do not contribute to any improvement of the situation and, in addition, the Island's foreign population has a lower fertility rate when compared to other Italian regions. It should also be noted that the presence of a positive net migration index in small municipalities is due to aged people who migrated elsewhere at a young age, and now coming back once retired. This kind of migration does not provide any positive contribution to the demographic trend. On the contrary, it creates an even greater burden on the active population and on public health spending.

Overall, the seriousness of these situations is shown by figures presented in some demographic studies[3]: 270 municipalities have really bad demographic conditions; at the current trends, by the end of the century, 31 municipalities could completely disappear.

3 Bottazzi e Puggioni (2014) "Comuni in Estinzione, gli scenari dello spopolamento in Sardegna", SardiniaRegionalGovernment

2 Mapping of stakeholders

2.1 Description of stakeholders

Basin Authority-ADIS
Autorità del Bacino Idrografico della Sardegna-ADIS
Addresses, coordinates and monitors plans, programs and implementations of actions for:

- The soil defense and conservation
- The accomplishement of qualitative and quantitative objectives of all water bodies
- Safeguardin and rational use of all water resources and protection of ecosystems

Water Authority for Sardinia – ENAS
Ente Acque della Sardegna - ENAS
http://www.enas.sardegna.it/area/enas.html
Ente Acque della Sardegna - ENAS is the Water Authority and regional instrumental institution responsible for the management of reservoirs and the Multi Sector Regional Water System. Additional responsibilities of ENAS include:
- Planning, realization and management of plants and hydraulic works
- Ordinary and extraordinary maintenance of infrastructures, installations and works;
- The design, construction and management of hydroelectric power plants and, in general, of energy production facilities from renewable sources in order to reduce the costs of production and supply of water resources;
- Monitoring of water bodies so as to safeguard and improve the quality of water resources for different purposes;
- Promotion of development and participation in international cooperation programs within the specific activities of its institutional tasks.
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Assessorato dell'agricoltura e riforma agro-pastorale
Regional Ministry for Agriculture and Agro-pastoral reform
http://www.regione.sardegna.it/regione/assessorati/agricoltura/
This Regional Ministry is responsible for the reform of the agro-pastoral setup. Other responsibilities include:
- Livestock production and livestock breeding;
- Technical assistance, promotion and protection of agricultural products;
- Land repossession, land reclamation, agricultural transformation and rural improvements;
- Rural development planning, credit incentives,
- Administrative functions on the application of the milk quota scheme
- Arboriculture and forestry production and civic uses.
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Assessorato della difesa dell'ambiente
Ministry for the protection of the environment
http://www.regione.sardegna.it/regione/assessorati/ambiente/
Responsibilities include:
- Control of atmospheric, electromagnetic and acoustic pollution. Disinfection of areas with a high risk of environmental crisis, waste management and reclamation of polluted sites.

- Environmental Impact Assessment (EIA)
- Safeguarding and enhancing the flora and fauna.
- Regulation of hunting activity, environmental authority, forests and parks.
- Prevention and repression of fires.
- Provision of information, educational and information activities on the state of the environment. - Issuing of authorizations and concessions and indemnities relating to matters of competence.

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Assessorato del turismo, artigianato e commercio
Ministry of Tourism, Crafts and trade
http://www.regione.sardegna.it/regione/assessorati/turismo/
- Promotion and propaganda activities for tourism development.
- Hotel industry. Programming the infrastructures of tourist interest.
- Promotion and development of craftsmanship.
- Inspection of fairs and markets.
- Credit incentives in matters of competence of the Board.

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IRRIGATION CONSORTIA
- Irrigation Consortia were established under Royal Decree 13 February 1933, no. 215. The recent regional law no. 6/2008 has made some changes and innovations, redefining its tasks and functions. Irrigation Consortia are public-law entities that associate all property owners in the area who benefit from the reclamation. The Consortium is responsible for the ongoing management and maintenance of existing remediation works. The realization of new reclamation works, on the other hand, is the responsibility of the State and the Region, which can delegate the Consortium with the task of design and implementation through appropriate public funding. Activities of the Consortium are:
- the management of water for irrigation granted by ENAS, the distribution of water to the consortium, the implementation of efficiency measures and irrigation savings (including the installation of meters for the measurement of actual consumption);
- environmental management of the territory in the hydrogeological field in order to prevent and avoid floods;
- monitoring and environmental monitoring actions for the prevention of flooding of rivers and canals and landslides.

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LAORE – SARDEGNA
http://www.sardegnaagricoltura.it/assistenzatecnica/laore/compiti.html
LAORE is the agency for the implementation of regional programs in agriculture and rural development.
It promotes the integrated development of rural areas and the environmental compatibility of agricultural activities by promoting multi-functionality of agricultural enterprises, territorial specificities, quality productions and market competitiveness. Additional responsibilities of the Agency include:
- Supporting operators and firms through the promotion and dissemination of norms, regulations and tender;
- Acts as an intermediary between the production system and scientific research in order to facilitate an effective transfer in the area of process and product innovations and to transfer to the research institutions the needs highlighted by the business system;
- The Agency may, by means of special agreements, establish forms of cooperation with public and private bodies already active in the field of technical assistance to farmers, livestock and fisheries sector.
- On the basis of framework agreements approved by the Regional Council, the Agency may establish

relationships based on partnerships, consultancy, service and promotion with other public administrations and agencies.

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AGRIS – SARDEGNA

http://www.sardegnaagricoltura.it/innovazionericerca/agris/compiti.html

It is the agency of the Sardinia Region for scientific research, experimentation and technological innovation in the agricultural, agro-industrial and forestry sectors. It is part of the agency's mission to promote sustainable rural development, protect and enhance biodiversity, and increase the competitive qualification of its research facility.

- This Agency promotes technological and organizational innovation appropriate to local in order to foster the competitiveness of the territorial enterprise systems;
- Provides, on request, advice to institutions and other national and international bodies;
- Provides, on request, scientific and technological advice to companies operating in the fields of its expertise;
- Cooperates with universities and other public or private institutions in national and international technical research for the realization of joint scientific and technological development programs;
- Elaborates, through the use of scientific methodologies, the data of the agricultural, agro-industrial, forestry sector and, in collaboration with LAORE Sardegna, draws up specific reports;

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COPAGRI-Confederazione dei Produttori Agricoli

COPAGRI is a labour union of farmers with the general objective of protecting the economic, social andprofessional interests of rural and agricultural enterpreneurs.

CONFAGRI- Confederazione Generale dell'Agricoltura

Regional Ministry of Industry

Assessorato dell'industria

The regional ministry of Industry programes the development of industrial infrastructures and manages energy resources. Promotes investements in renewable energies and the green economy.

COLDIRETTI

http://www.sardegna.coldiretti.it/la-coldiretti.aspx?KeyPub=GP_CD_SARDEGNA_CHISIAMO|10024639

Coldiretti is a labour union that represents agricultural enterprises and enhances agriculture as an economic, human and environmental resource.

- It is the main agricultural organization at national level and among the first at European level.
- This is an organization strongly rooted in the country, consisting of 18 Regional Federations, 98 Provincial Federations, 765 Area Offices and 9,812 Peripheral Sections.
- Coldiretti's associates include over 568,000 agricultural enterprises, accounting for 52% of those registered in the Chambers of Commerce.

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FEDERALBERGHI

Federalberghi is an organization representing Italian hotel owners at the National level. Its activities include:

- Acting on behalf of hotel companies in representing their needs and proposals in relation to to political organizations, economic institutions and trade unions.
- Enhancing the economic and social interests of tourism entrepreneurs and promoting the recognition of their social role, the affirmation of the tourist economy, the promotion of the national tourism offer.
- Stipulating national employment contracts,
- Conducting and sponsoring scientific activity for sector analysis,
- Promoting entrepreneurial training of associates,

- Assisting and coordinating the organizational system for the protection of business activities at local and regional level.

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ECOLABEL HOTEL

Ecolabel is a voluntary membership certification granted to those products and services that comply with ecological and performance criteria established at European level.

- The brand is based on the scrupulous compliance of a set of criteria that enable the structures that receive it to stand out at European level for the commitment to improving environmental quality and provide users with assurances about the effectiveness of the protection measures adopted .

The presence of the Ecolabel brand provides tourists with guarantees about:

- The containment of atmospheric, water and soil pollution, mainly through the use of more environmentally friendly products;
- Proper waste management and differentiation;
- Reducing energy and resource waste;
- The preservation of biodiversity in areas under the direct control of the accommodation;
- A healthy and proper nutrition, which partly draws on regional organic produce.

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ENEL

ENEL (National authority for Electri Energy) was first established as a pubblic body in 1962. In 1999 it became a Joint-stock company with 23.5% of the actions owned by the Italian State.

ENEL produces and distributsof electricity and gas, operating in two different ways in Sardinia:

- On the one hand, it operates through e-distribuzione a company of the Enel Group that carries out the distribution of electricity for delivery to final customers. In addition to end customers, also the producers who bring the energy produced by their plants into the network are connected to its distribution network, consisting of medium and low voltage plants.

The activities of this company are regulated by the Authority for Electrical Energy, Gas and Water System (AEEGSI) and they include:

- Connection, which consists of linking customers and producers to the distribution network that the company manages with development and maintenance;
- Distribution, consisting of the transport and transformation of electricity, respectively, taken and entered by customers and network-connected manufacturers, with the expected characteristics (eg power and voltage);
- Measurement, consisting in the installation and maintenance of the meters and in the recording and recording and making available the electrical measurements.

On the other hand, ENEL operates as a multinational energy company, a producer of energy from fossil and renewable sources (https://www.enel.it/it/azienda/a201610-in-italia.html). In Sardinia, ENEL has licensed several dams producing hydroelectric power (http://www.isprambiente.gov.it/it/certificazioni/emas/elenco-organizzazioni-registrate-emas/enel-s-p-a-unita-di-business-sardegna/@@organization_listsites)

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Department of Electrical and Electronic Engineering (DIEE) – University of Cagliari
http://dipartimenti.unica.it/ingegneriaelettricaedelettronica/about-us/about-us/?lang=en

The Department of Electrical and Electronic Engineering (**DIEE**) of the University of Cagliari was founded 1995 to continue the research activity of the Institute of Electrotechnics founded in 1945.

The department has strong co-operations and relationships with several research labs (both industrial and public) and with other academic institutions world-wide. Being the only higher-education institution on Electrical and Electronic Engineering in Sardinia, the DIEE is strongly connected with the local industry and is

devoted to technology transfer activities.
DIEE has received a mandate from the regional government to develop the Regional Energy Plan

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World Wide Fund for Nature (WWF)

Le Oasi WWF in Sardegna - http://www.wwf.it/oasi/sardegna/

WWF is a world-wide association for the conservation of nature. The association is structured in national offices that operate in individual countries independently but in line with the programs and goals set by WWF International.

In Sardinia, WWF has established some oases, thus protecting about 3.608 hectares from building speculation and hunting activities. Within the Oasi di Monte Arcosu and the Oasi Steppe Sarde, the association conducts educational and scientific research activities.

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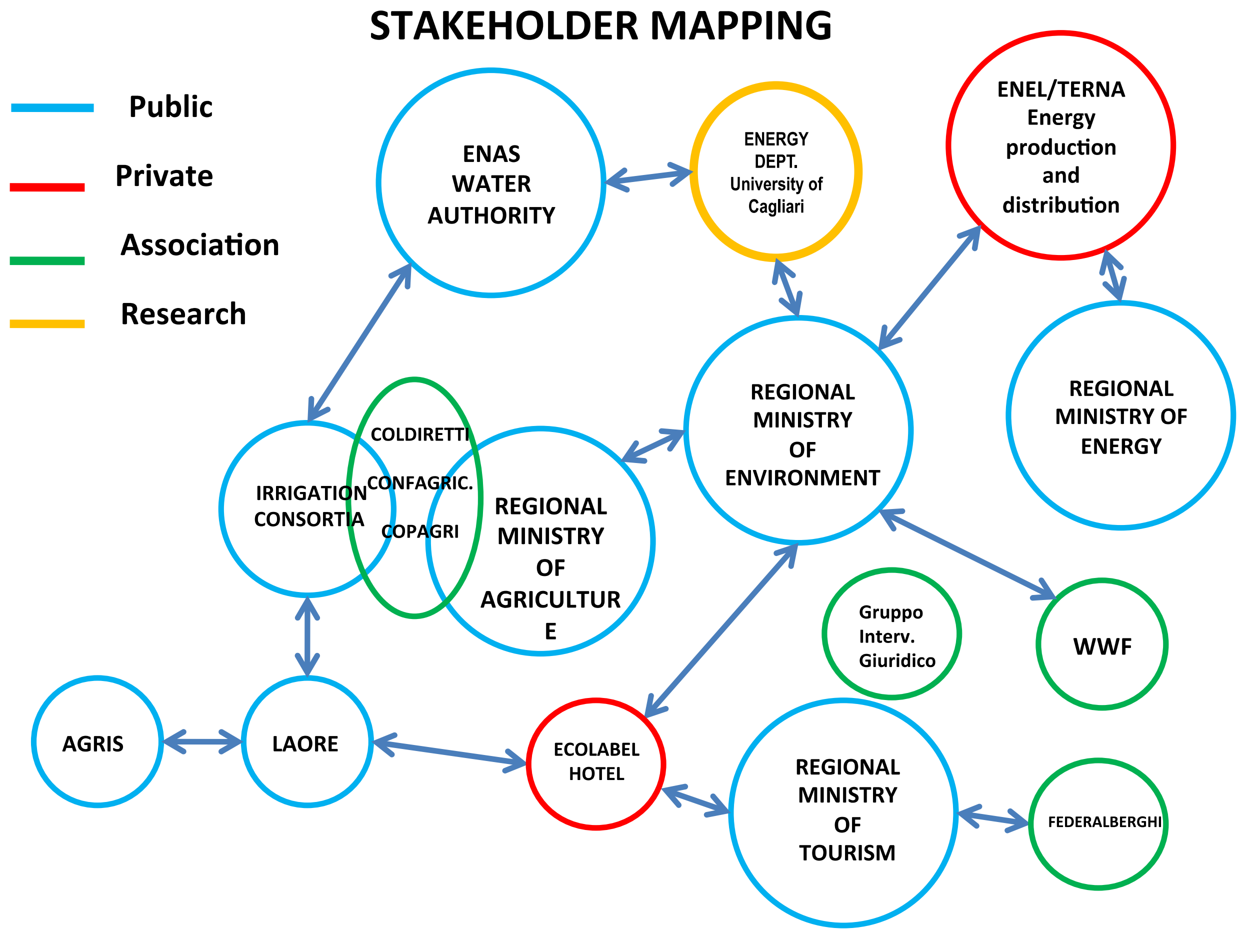
Gruppo d'Intervento Giuridico Onlus

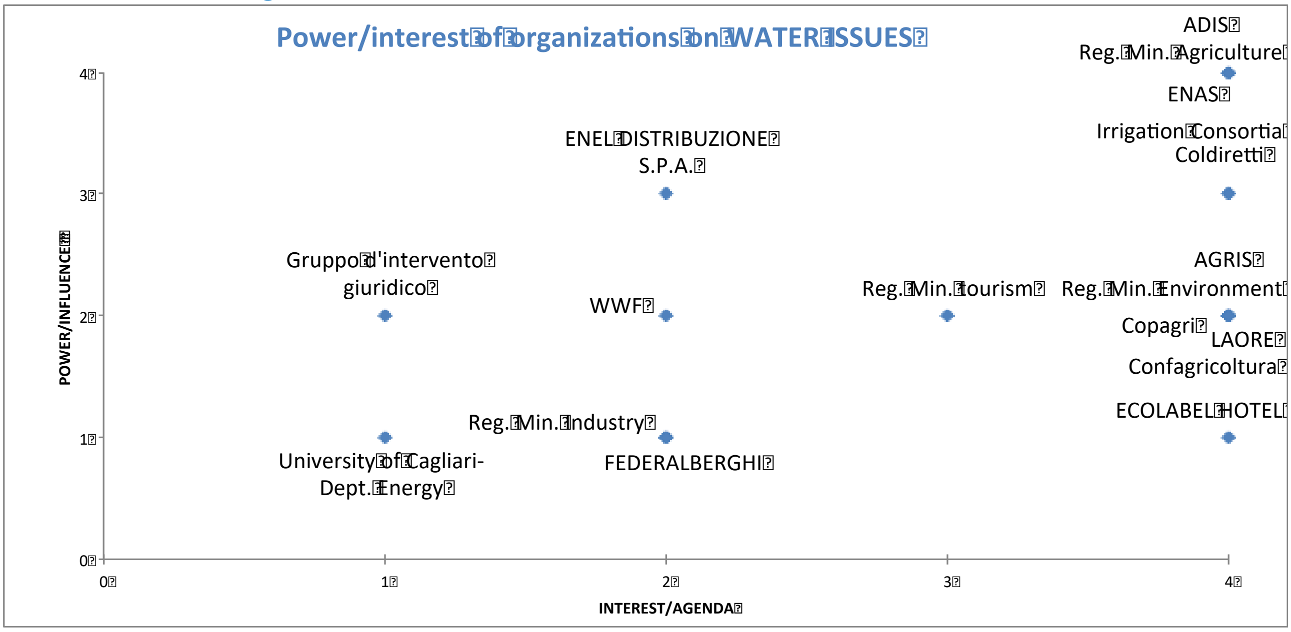
GIG is an ecologist association formally active since 1992. Their activity leverages on using existing laws to address environmental issues.

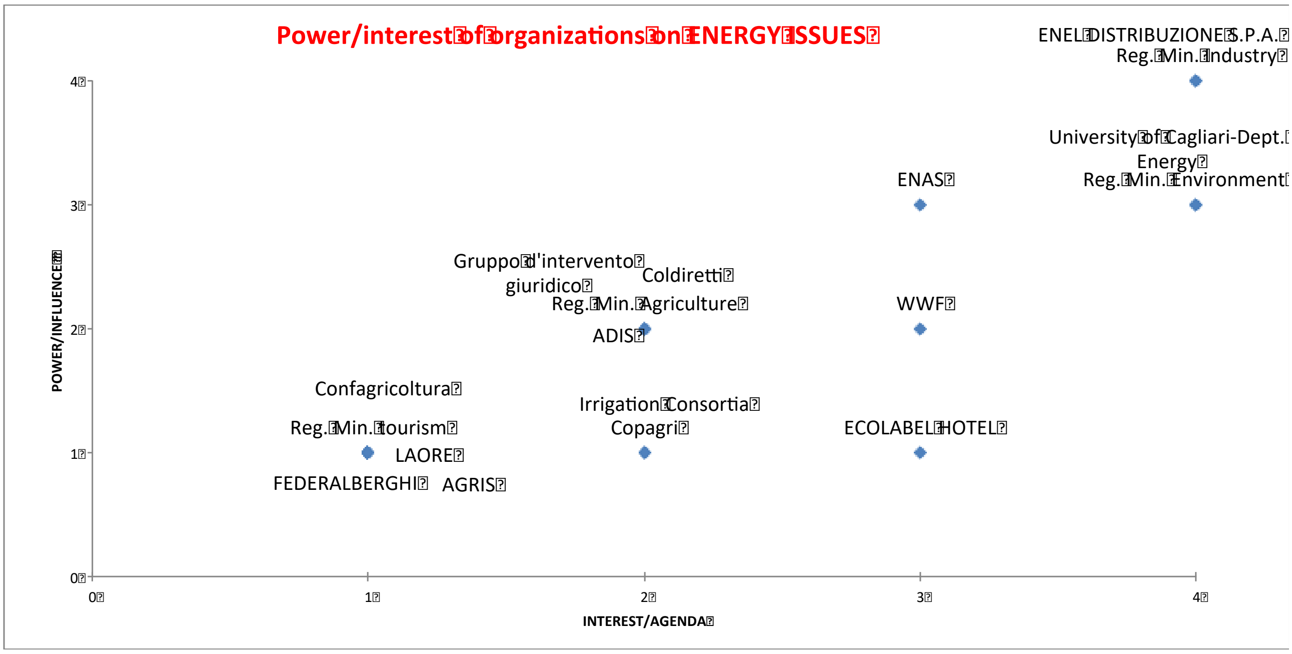
Since its establishment it has completed 2500 legal actions. Besides direct legal actions, GIG organizes courses in Environmental Law and has a "green desk" to offer services to citizens, and public administrations.

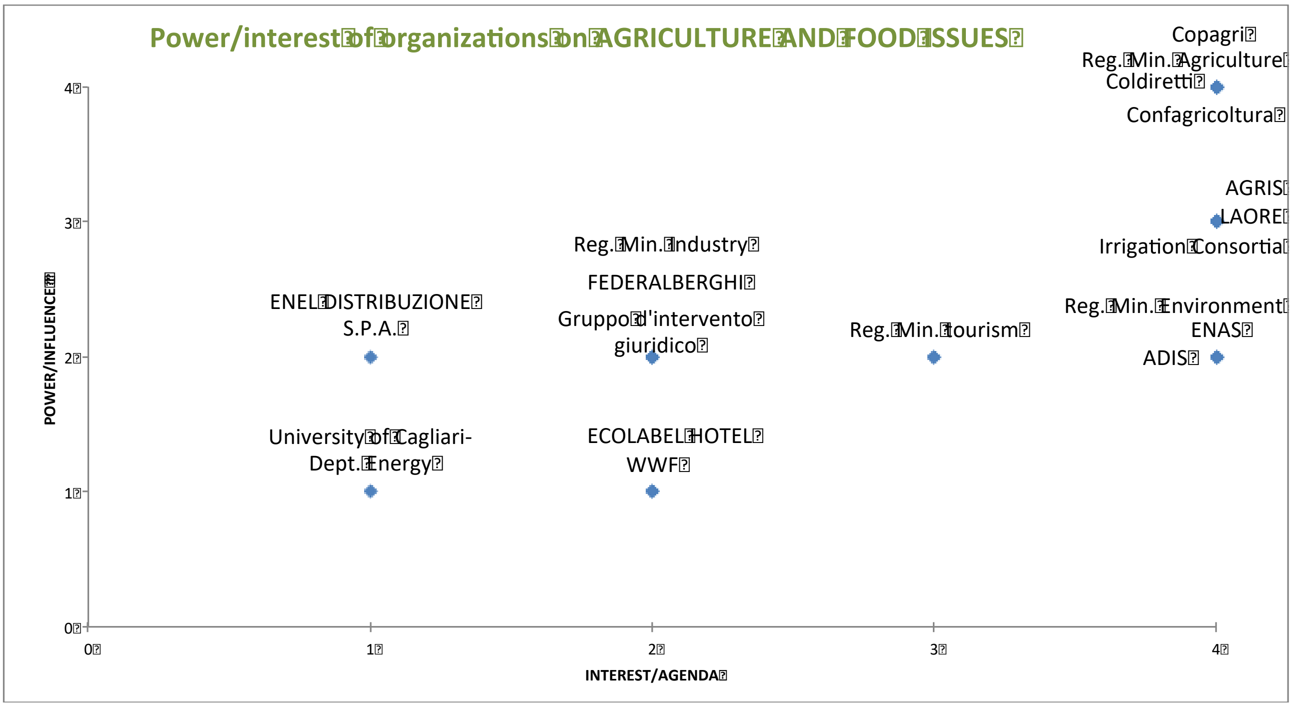
2.2 Map of relevant stakeholders and relationships



2.3 Power/interest grid






Power/interest of organizations on AGRICULTURE AND FOOD ISSUES
Copagri
Reg. Min. Agriculture
Coldiretti
Confagricoltura
AGRIS
LAORE
Irrigation Consortia
Reg. Min. Industry
FEDERALBERGHI
Gruppo d'intervento giuridico
ENEL DISTRIBUZIONE S.P.A.
Reg. Min. tourism
Reg. Min. Environment
ENAS
ADIS
University of Cagliari-Dept. Energy
ECOLABEL HOTEL
WWF
POWER/INFLUENCE
INTEREST/AGENDA
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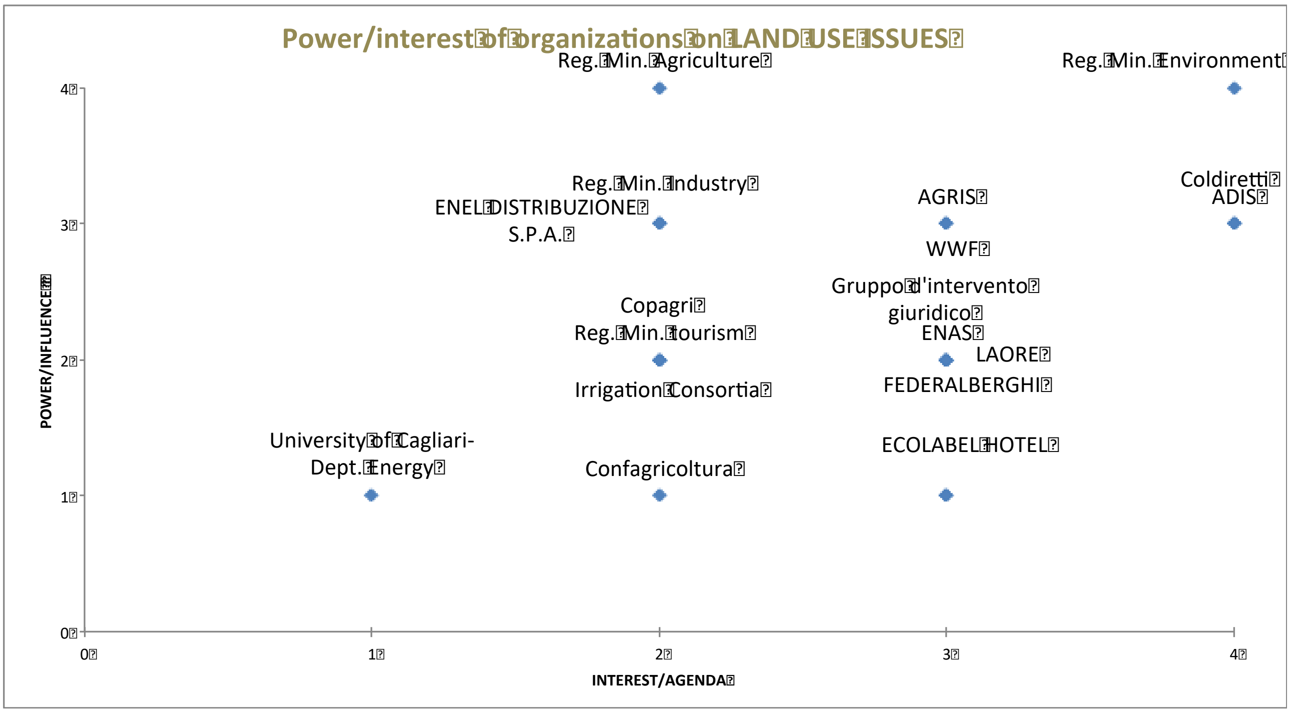
Power/interest of organizations on LAND USE ISSUES
Reg. Min. Agriculture
Reg. Min. Environment
Reg. Min. Industry
ENEL DISTRIBUZIONE S.P.A.
AGRIS
Coldiretti
ADIS
WWF
Gruppo d'intervento giuridico
ENAS
LAORE
FEDERALBERGHI
Copagri
Reg. Min. tourism
Irrigation Consortia
University of Cagliari-Dept. Energy
Confagricoltura
ECOLABEL HOTEL
POWER/INFLUENCE
INTEREST/AGENDA
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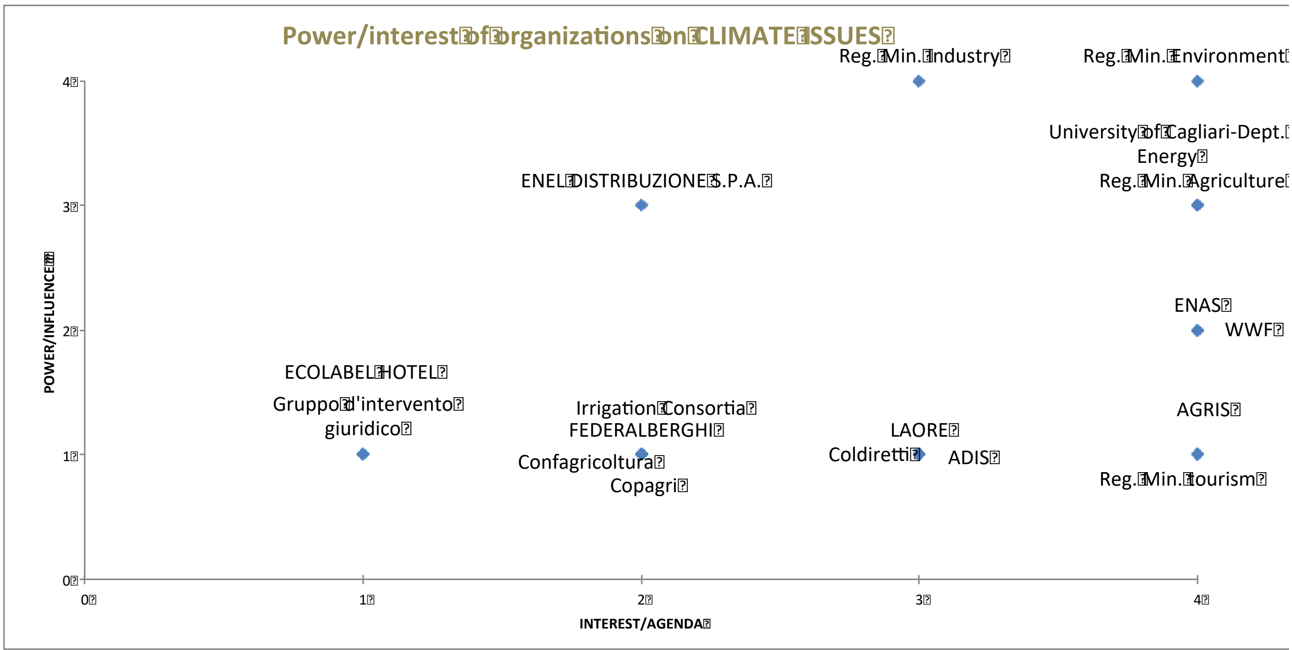
4



Power/interest of organizations on CLIMATE ISSUES
Reg. Min. Industry
Reg. Min. Environment
University of Cagliari-Dept. Energy
Reg. Min. Agriculture
ENEL DISTRIBUZIONE S.P.A.
ENAS
WWF
ECOLABEL HOTEL
Gruppo d'intervento giuridico
Irrigation Consortia
FEDERALBERGHI
Confagricoltura
Copagri
LAORE
Coldiretti
ADIS
AGRIS
Reg. Min. tourism
POWER/INFLUENCE
INTEREST/AGENDA
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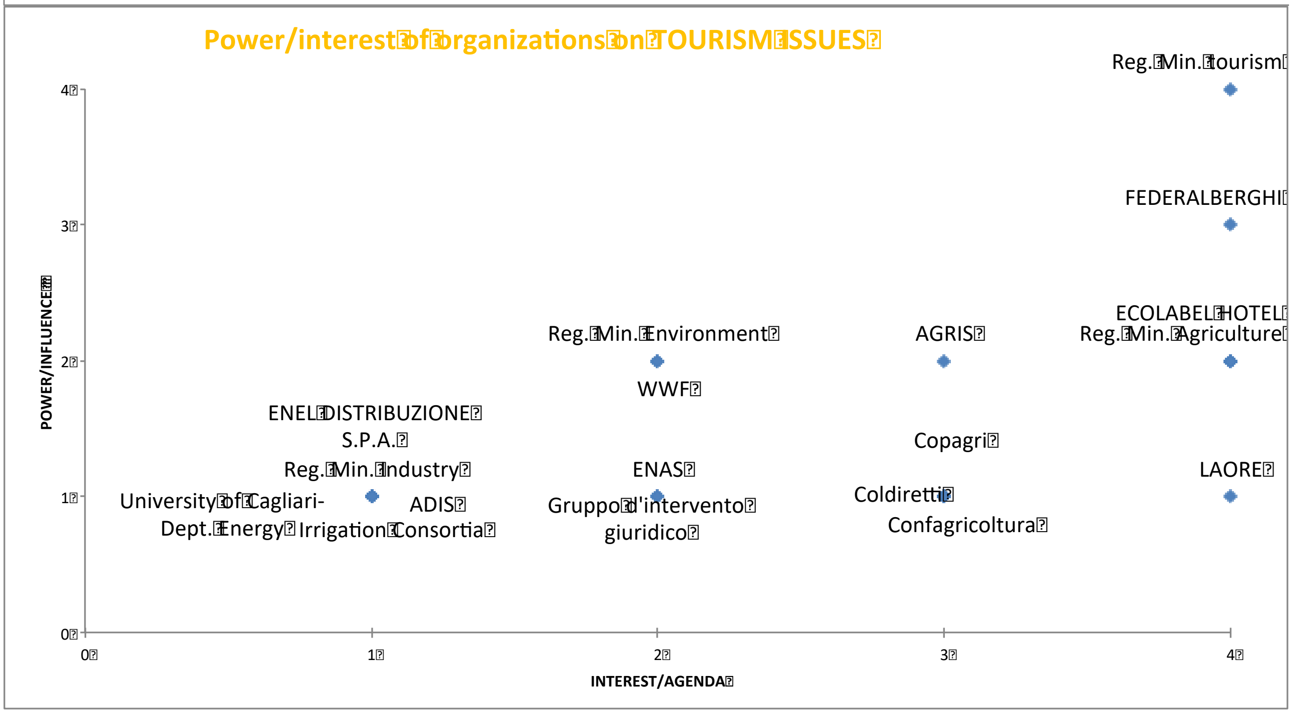

Power/interest of organizations on TOURISM ISSUES
Reg. Min. tourism
FEDERALBERGHI
ECOLABEL HOTEL
Reg. Min. Agriculture
Reg. Min. Environment
AGRIS
WWF
ENEL DISTRIBUZIONE S.P.A.
Reg. Min. Industry
University of Cagliari-Dept. Energy
ADIS
Irrigation Consortia
ENAS
Gruppo d'intervento giuridico
Copagri
Coldiretti
Confagricoltura
LAORE
POWER/INFLUENCE
INTEREST/AGENDA
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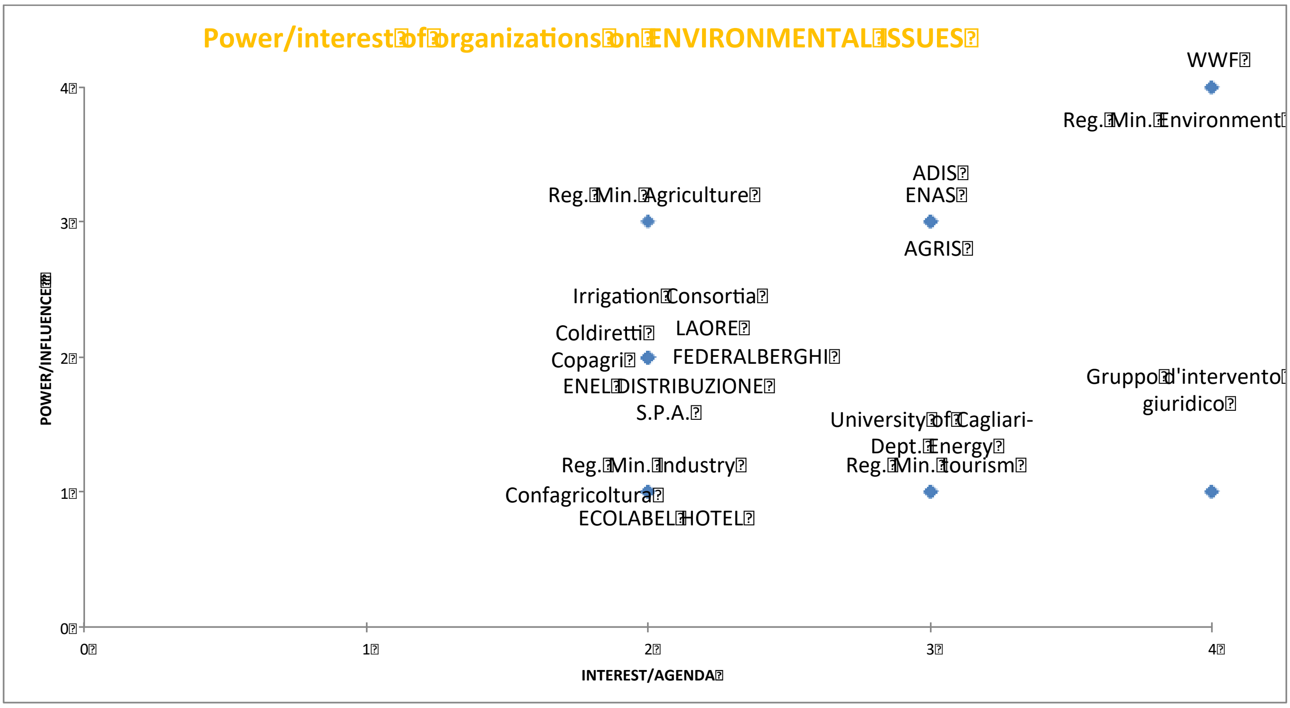
Power/interest of organizations on ENVIRONMENTAL ISSUES
WWF
Reg. Min. Environment
Reg. Min. Agriculture
ADIS
ENAS
AGRIS
Irrigation Consortia
Coldiretti
LAORE
Copagri
FEDERALBERGHI
ENEL DISTRIBUZIONE S.P.A.
Gruppo d'intervento giuridico
University of Cagliari-Dept. Energy
Reg. Min. Industry
Reg. Min. tourism
Confagricoltura
ECOLABEL HOTEL
POWER/INFLUENCE
INTEREST/AGENDA
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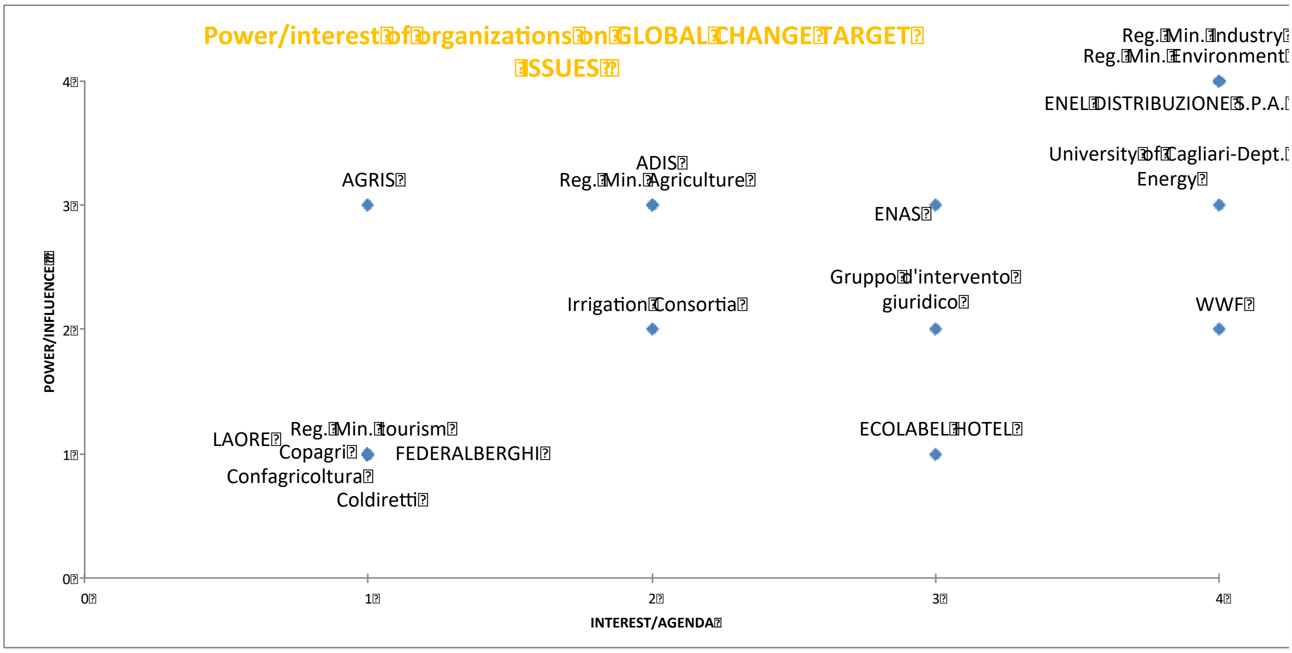
Power/interest of organizations on GLOBAL CHANGE TARGET ISSUES
Reg. Min. Industry
Reg. Min. Environment
ENEL DISTRIBUZIONE S.P.A.
University of Cagliari-Dept. Energy
AGRIS
ADIS
Reg. Min. Agriculture
ENAS
Gruppo d'intervento giuridico
Irrigation Consortia
WWF
LAORE
Reg. Min. tourism
Copagri
FEDERALBERGHI
Confagricoltura
Coldiretti
ECOLABEL HOTEL
POWER/INFLUENCE
INTEREST/AGENDA
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3 Mapping of policy goals and instruments

3.1 Agricultural policy

The Common Agricultural Policy (CAP) for the 2014-2020 is oriented to ensure a more sustainable development of agriculture and rural areas throughout the European Union (EU). It means that the CAP would promote a bundle of objectives jointly devoted to create a smart, social inclusive, environmental-friendly agricultural and rural development.
The CAP as it stands today maintains the existence of two pillars but tightens up the links between them, thus offering a more holistic and integrated approach to policy support.

Concerning Pillar I, it introduces a new architecture for direct payments that is better targeted, fairer and greener. The system based on decoupling agricultural aid from production and providing generic income support introduced in 2003 has been replaced by one in which each component is linked to specific objectives. Basically the single farm payments have been replaced by a system of multi-purpose payments, with seven components:

1. a 'basic payment' per hectare. It is a compulsory component, the level of which is harmonised according to national or regional economic or administrative criteria and subject to an 'internal' convergence process.

2. a 'greening' component. It is an additional support to offset the cost of providing environmental public goods that are not remunerated by the market. It is a compulsory component and Italy as well as other Member States must use 30% of the total CAP budget for financing this component;

3. an additional payment for young farmers. It is a compulsory component (up to 2% of the CAP budget).

4. a 'redistributive payment', where farmers may be granted additional support for the first hectares of farmland. It is a voluntary component.

5. additional income support in areas with natural constraints. It is a voluntary component.

6. coupled support for production, granted in respect of certain areas or types of farming for economic and/or social reasons. It is a voluntary component.

7. a voluntary simplified system for 'small farmers', offering payments of up to EUR 1 250. It is a voluntary component.

Furthermore, only active farmers (defined with reference to a 'negative list' to be drawn up by each Member State) will be eligible for the new payments per hectare. Finally, payments will also be subject until 2019 to a process of 'external' partial convergence among the Member States, although this will not eliminate all the variations (caused by the support allocated to areas deemed eligible in each Member State in 2015) across the EU as a whole.

Pillar II concerns Rural Development policy, promoted in Sardinia by the Rural Development Program (RDP). The RDP was formally adopted by the European Commission on August 2015 and the financial contribution corresponds to about € 1.3 billion of public money available for the 7-year period (€ 628 million from the EU

budget and nearly € 700 million from national co-funding).
Sardinia's RDP puts particular emphasis on environment-climate-friendly farm investments, enhancing actions related to restoring, preserving and enhancing ecosystem.
Sardinia covers an area of more than 24,000 km², of which more than 81 % is rural. Sardinia has nearly 1.7 million inhabitants, of which 83% live in rural areas. Of the total area, agricultural land covers 44% and forest land 17% and another 35% consists of natural grassland and natural areas.

According to the European rural development framework, Sardinia's RDP individuates six priorities:

1. Knowledge transfer and innovation in agriculture, forestry and rural areas (expenditure shared with the other priorities). Demonstration activities, information actions and exchange visits will be funded through specific training to farmers in regard to climate change, sustainable agriculture and food quality. Particular attention will be paid to the training of new entrepreneurs, especially young farmers. Over 9,000 places will be made available in information activities and the programme will give farmers access to advisory services on topics related to the RDP priorities. The Region is planning to help launch more than 77 co-operation projects of which 6 will be Operational Groups under the European Innovation Partnership for Agricultural Productivity and Sustainability.

2. Competitiveness of agri-sector and sustainable forestry (€ 259 million). Requests for support to farm investments and modernisation are ranked first among the RDP measures and priority will be given to innovative potential, projects of young farmers, organic farming and integrated projects. The sustainability of agricultural production is taken into account also by promoting a rational use of water resources and an efficient use of renewable energy resources. Diversification activities will also be supported. Over 1,800 holdings are expected to receive investment support to restructure and modernize and more than 1,100 young farmers will receive support to launch their business.

3. Food chain organisation, including processing and marketing of agricultural products, animal welfare and risk management in agriculture (€ 328 million). Under this priority, Sardinia will support the promotion of quality products. The RDP is expected to support 400 farms to participate in quality schemes. The RDP will also support the development and strengthening of supply chains, including short supply chains and local markets, in order to help achieve a higher income for farmers (support is expected for 500 farms). Support for animal welfare is also available for farmers who adopt high standards of animal husbandry which go beyond the relevant mandatory standards (nearly 11,000 farms will be supported). Nearly € 226 millions are expressly devoted to animal welfare.

4. Restoring, preserving and enhancing ecosystems related to agriculture and forestry (€ 492 million). Under this priority, Sardinia will focus on environment-climate-friendly investments with particular emphasis on quality of water as well as biodiversity and soil protection. Nearly 17% of the agricultural land will be under management contracts supporting biodiversity, 15% for contracts to improve water management and another 19% for contracts to improve soil management. A total of 43,000 hectares will receive support to convert to organic farming and another 117,000 ha to maintain it. Additionally, the RDP includes a cooperation measure for joint climate change adaptation and mitigation actions.

5. Resource efficiency and climate (€ 58 million). Under this priority, RDP in Sardinia will pursue carbon conservation and sequestration mainly by supporting afforestation, agroforestry systems, the prevention and restoration of damage to forests, the improvement of the resilience and environmental value of forest

ecosystems as well as their conservation. Additionally, the co-operation measure will support enhanced sustainability through the European Innovation Partnership and through co-operation for climate change adaptation and mitigation.

6. Social inclusion and local development in rural areas (€ 161 million). The RDP of Sardinia pays particular attention to social inclusion and economic development in rural areas. This priority is implemented mainly by the bottom-up approach through Local Development Strategies, expected to be drawn up by 13 Local Action Groups (LAGs). Local Development Strategies will cover 40% of the rural population and create around 500 additional jobs. More than245 beneficiaries will receive support for investments in non-agricultural activities in rural areas.

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3.2 Inventory of policy documents

WATER			
Type of document	Title of document	Short description of document	Life span of policy
Regional Water Plan	Sardinian Hydrologic district management plan	Instruments for water planning of the Sardinian Hydrological district. Describes the system, sets monitoring standards, defines environmental objectives for superficial and groundwater as well as for protected areas. It also sets the measures to be adopted to reach the objectives	Renewed every 6 years up to year 2027
Regional Law	Regional law 19/2006	Dispositions on water resources and hydrological basins	NA
Irrigation regulation	Oristano Irrigation Consortium regulation	Describes modalities used to allocate water to farmers and prices	NA
Irrigation regulation	Central Sardinia Irrigation Consortium regulation	Describes modalities used to allocate water to farmers and prices	NA
Irrigation regulation	Nurra Irrigation Consortium regulation	Describes modalities used to allocate water to farmers and prices	NA
Irrigation regulation	North Sardinia Irrigation	Describes modalities	NA

	Consortium regulation	used to allocate water to farmers and prices	
Irrigation regulation	Campidano Irrigation Consortium regulation	Describes modalities used to allocate water to farmers and prices	NA
Regional regulation	Regional deliberation n. 19/16 2015 "Coordination table for the implementation of EU directives 2000/60/CE and 2007/60/CE	Sets up a coordination team to address water issues for the Sardinian hydrological district	NA

ENERGY			
Type of document	Title of document	Short description of document	Life span of policy
Strategic Plan	Sardinia Energy plan 2016-2020	Determines criticalities of the energy sector to reach 2020 targets and identifies strategies to meet the objectives	2020
Regional regulation	Regional delibaration 12/21 2012 "Documento di Indirizzo sulle fonti energetiche rinnovabili"	Defines how and which Renewable energies will be supported	NA
Regional regulation	DGR 27/12 2011	Defines regional guide lines for authorization of Renewable energy power plants	NA

FOOD AND AGRICULTURE			
Type of document	Title of document	Short description of document	Life span of policy
Programme	Sardinian Rural development programme 2014-2020	CAP instrument to support innovation of farming systems, water efficiency, transition to low input agriculture, coordination of research	2020

FORESTRY			
Type of document	Title of document	Short description of	Life span of policy

		document	
a)- Regional Forestry Law b)- Regional plan	a)- Forestry Law of Sardinia 27 April 2016, n.8 b)- Regional plan for the forecasting, prevention and active fight against wildfire 2014 – 2016. Update 2016.	a)- Regional law that provides for the planning, programming and tools for forestry protection and management. The law establishes also a Regional Council for forestry policy. b)- Detailed plan comprising a general report and eight technical documents	a)- Ongoing b)- 3 Years and subject to yearly updates.

HORIZONTAL POLICIES			
Type of document	Title of document	Short description of document	Life span of policy
Regional Programme	Regional Development Programme 2014 - 2019	The document sets out a general program for the development of various sectors in the region of Sardinia according to the strategy Europe 2020	Up to 2019

LAND USE			
Type of document	Title of document	Short description of document	Life span of policy
Plan	Hydrogeological Risk Plan	Defines areas and type of hydrological risk and determines the type of activities that can be undergone in these areas	2020
Plan	Regional Landscape Plan	Defines landscape types and the type of activities that cannot or can be implemented in these areas	2025

CLIMATE			
Type of document	Title of document	Short description of document	Life span of policy
Regional regulation	Establishment of inter-departmental	The Decree approves the establishment of an	NA

	coordination for a regional climate change adaptation strategy	inter-departmental coordination committee and delegates the Regional Ministry for the Environment to prepare the document "Regional Strategy for the Adaptation to Climate Change"	
Regional regulation	Adaptation Strategy to Climate Change. Signing of the protocol "UNDER 2 MOU"	The document endorses the "Subnational Global Climate Leadership Memorandum of Understanding"	NA

TOURISM			
Type of document	Title of document	Short description of document	Life span of policy
Regional regulation	LR N°16, 28-07-2017: Normatives for the Tourist sector	Describes the general objectives of the region Present normatives on how and who should address specifc issues with the general aim of promoting tourism in the region. E.g. Creates a "permanent conference" Indicates the Regional Strategic plan for tourism as the main instrument for coordinating and programing activities	NA
Regional Programme	Regional Development Programme 2014 - 2019	The document sets out a general program for the development of a sustainable tourism	Up to 2019

3.3 Inventory of objectives of each relevant policy sector

WATER		
Overarching objectives	Specific objectives	Reference documents

Preserve water resources	- Increase irrigation efficiency in agriculture using more efficient irrigation systems and water pricing - Reduce leakages in the water distribution systems - Review and updating the Sardinia river basin management plan - Establishment of water authority for riverbeds below great dams	- Regional Rural Development programme - Irrigation regulations of Irrigation Consortia - Sardinian Hydrologic district management plan - Regional Decree N. 1 of 15.03.2016 - Regional Decree N. 33/31 of 10.6.2016
Increase water quality	- Reduction of fertilizers and pesticides in agriculture - Reclaiming of land polluted from mine activities - Reduction of industrial wastes	- Regional Rural Development programme - Sardinian Hydrologic district management plan
Integrated water management	- Implementing the integrated monitoring system - Meeting the demands of different sectors while guaranteeing minimum environmental flows	- Sardinian Hydrologic district management plan - Regional water district management plan 2016-2020

ENERGY		
Overarching objectives	Specific objectives	Reference documents
- Definition of governance and implementation strategy for Plan monitoring - Increase energy security	- Increase the flexibility of the energy system. - Developing an energy system as a tool for economic and social growth and compatible with policies of environmental protection. - Promotion of distributed energy production for auto-consumption - Methanization of the island Use of regional energy resources	Energy Environmental Plan for Sardinia 2015 – 2030 POR FESR Sardegna 2014/2020 priority axis 4 “sustainable energy”
Increase energy saving and Energy efficiency	- Increase Energy efficiency of buildings and transport systems - Development of smartgrids	Energy Environmental Plan for Sardinia 2015 – 2030 POR FESR Sardegna 2014/2020 priority axis 4 “sustainable energy”
Promotion of research	- Enhancing the "governance" of the regional energy system; - Promotion of energy awareness by ensuring active participation in the	Energy Environmental Plan for Sardinia 2015 – 2030 POR FESR Sardegna 2014/2020 priority axis 4 “sustainable

	implementation of plan choices; - Monitoring the energy sector	energy"
Transform the Sardinian Energy System towards an integrated and Smart grid	- Use of ICT to integrate electric, thermal and transport systems - Development and implementation of energy accumulation technologies - Increase the economic competitiveness in the energy market and a full integration in the European market.	Energy Environmental Plan for Sardinia 2015 – 2030 POR FESR Sardegna 2014/2020 priority axis 4 "sustainable energy"

FOOD AND AGRICULTURE		
Overarching objectives	Specific objectives	Reference documents
Programming rural development in accordance with the strategy Europe 2020, the National Partnership Agreement, National Programs as well as with Regional Programs 2014/2020	- Promoting knowledge transfer and innovation in the agriculture and forestry sectors and in rural areas (horizontal priority). - Improving the competitiveness and profitability of the agricultural sector and agricultural firms. - Promoting the organization of the agri-food production and risk management in the agricultural sector. - Preserving, restoring and enhancing ecosystems dependent on agriculture and forests. - Encouraging the efficient use of resources and the transition to a low-carbon and climate-friendly economy in the agri-food and forestry sectors. - To work for social inclusion, poverty reduction and economic development in rural areas.	- Rural Development Programme for Sardinia 2014-2020. - European Commission implementing Decision C(2015)5893 and amendment approval C(2016)8506/

FORESTRY		
Overarching objectives	Specific objectives	Reference documents
a)- To protect the complexity and multi-functionality of the forestry system b)- Forecasting, preventing and	a)- The protection and care of woods as an indispensable asset; - Sustainable forest management to meet the needs of the present and future generations	a)- Forestry Law of Sardinia 27 April 2016, n.8 b)- Deliberation for Regional Plan for the forecasting, prevention and active fight against wildfires

fighting wildfires	- The protection of forest heritage from the threat of fires; b)- Updating the regional plan for the prevention of wildfires. Authorizing the Commander of the Forest Corp and the Dept. of Civil Protection to use available funds for the control of fires and firefighting activities.	2014 – 2016. Updated 2016. 2016 Updated General Plan

LAND USE		
Overarching objectives	Specific objectives	Reference documents
Preventing risks deriving from improper land use.	- identification of risk areas. - enclosure of risk areas and definition of protection criteria - Programming mitigation measures and protection from hydrogeological risk	- Hydrogeological Risk Plan - Action plan for Protected areas (Natura 2000 and SIC) - Regional Landscape Plan

CLIMATE		
Overarching objectives	Specific objectives	Reference documents
Drafting a regional strategy for adaptation to climate change that is in accordance to the National Strategy for Adaptation to Climate Change (SNAC)	Establishment of inter-departmental coordination for a regional climate change adaptation strategy	- Regional Decree 1/9 – 13.1.2015 – National Strategy for Adaptation to Climate Change (SNAC) Establishment of an interdepartmental Committee for the preparation of the regional strategy.
Support the choices of activities for adaptation to climate change at National, regional and urban level	Reduce the vulnerability of natural, social and economic systems Increase their adaptive capacity Find possible synergies between adaptation and sustainable development Favor the coordination of the activities	National Adaptation Plan to climate change (PNACC)
Subnational commitment for the reduction of emissions from 80 to 95% with respect to values of 1990.	Endorsement of “Subnational Global Climate Leadership Memorandum of Understanding” in cooperation with the State of	Adaptation Strategy to Climate Change. Signing of the protocol “UNDER 2 MOU” (“Sub-national Global Climate Leadership

	California and the Region of Baden-Württemberg.	Memorandum of Understanding”).

TOURISM		
Overarching objectives	Specific objectives	Reference documents
Implement the Tourist sector	1) promote tourism by creating a stronger relationship with natural and cultural heritage 2) De-seasonal tourism 3) Coordination activities 4) Qualification and requalification of tourist infrastructures and offers	LR N°16, 28-07-2017: Normatives for the Tourist sector Regional Development Programme 2014 - 2019

3.4 Inventory of instruments of each relevant policy sector

WATER		
General instrument	Specific policy instrument	reference documents
Governance	Coordination of public bodies for monitoring water resources	LR N4 2 febbraio 2015
Management	Optimized water management with monitoring system	PAEER 2013-2020
Normatives	Normes for use of treated waste water	Regional directive for reuse of treated waste water
measures	Technical measures to increase water efficiency for irrigation, industry and domestic use Water pricing Adaptation to climate change Managing runoff and Min Env Flows	Regional water district management plan 2016-2020
Raising awareness	consultancies for farmers	Regional water district management plan 2016-2020 POR FESR Sardegna 2014/2020 Sardinian rural development plans 2014-2020
Funds	Technical measures to increase water efficiency for irrigation, industry and domestic use	POR FESR Sardegna 2014/2020 Sardinian rural development plans 2014-2020
normes	irrigation rules (max amounts, managing water scarcity	irrigation rules of Irrigation consortia

ENERGY		
General instrument	Specific policy instrument	Reference documents
Subsidies	energy efficiency for public buildings energy efficiency of private buildings and production of energy with renewables for self consumption	POR FESR Sardegna 2014/2020 priority axis 4 "sustainable energy" LEGGE 11 dicembre 2016, n. 232 DM 28/12/12, il c.d. decreto "Conto Termico"
Monitoring	monitoring methodology for burden sharing regional objectives	DM 11 maggio 2015 "Metodologia da applicare per rilevare i dati necessari a misurare il raggiungimento degli obiettivi regionali in materia di fonti rinnovabili di energia - Burdensharing"
Trade	Energy saving for gas and electricity distribution companies	DM 20 luglio 2004 "certificati bianchi"
Subsidies	Subsidies for renewable energy power plants other than domestic	DM_6_luglio_2012
regulation	electric energy market rules	DM 21_settembre_2016
regulation	normes for simple systems of production and consumption	DEL 12 DICEMBRE 2013 578_2013_R_EEL
funds for projects/infrastructures	regional and European funds for methane distribution network regional and European funds for smart grid regional funds for self energy sufficiency of water authority (ENAS) Energy efficiency of water authority	Regional Energy Plan Del. 26_37 30/5/2017 DM 19 October 2016-state aids for infrastructures PON 2014-2020 IV axis POR FESR Sardegna 2014/2020 priority axis 4 "sustainable energy" PAEER 2013-2020
Action lines	Analysis and orientation of policies to meet H2020 targets	Regional Energy Plan

FOOD AND AGRICULTURE		
General instrument	Specific policy instrument	reference documents
Rural development aids	Improve competitiveness 158 M Promote Generational turnover 100 M Improving holdings competitiveness 312 M Risk management 16 M Biodiversity conservation, water management, soil erosion 485 M	Sardinian Rural Development plan 2014-2020

	Increase irrigation efficiency 16 M Increase the use of renewable energies 16 M Carbon sequestration and Conservation of C pools 34 M	
Water pricing	Regional aids to reduce price of water	POR FESR Sardegna 2014/2020 priority axis 4 "sustainable energy" PAEER 2013-2020
Subsidies	Increase efficiency of irrigation systems Increase efficiency of conveyance water distribution systems	National rural development programme
Loans and insurance	Insurance against atmospheric events Instrument to stabilize annual income	National rural development programme
Funds for projects	Increase efficiency of water management (quantitative and qualitative)	POR FESR Sardegna 2014/2020

FORESTRY		
General instrument	Specific policy instrument	reference documents
Rural development aids	Biodiversity conservation, water management, soil erosion 7 M	Sardinian Rural Development plans 2014-2020
Subsidies	Reduce fire risk 27 M	POR FESR Sardegna 2014/2020

LAND USE		
General instrument	Specific policy instrument	reference documents
Plans	Development plans	Regional Urban Plan Regional Landscape plan
Regulations	Land planning normative Municipal regulations	
Penalties	Land use change actions without licence	
Subsidies	Reduce hydrological risk 27 M	POR FESR Sardegna 2014/2020

CLIMATE		
General instrument	Specific policy instrument	reference documents
Action lines	NA	National Adaptation Plan to climate change (PNACC)
Subsidies	Increase the use of renewable energies 16 M	Sardinian Rural development plan (2014-2020)

	Carbon sequestration and Conservation of C pools 34 M	
Subsidies	energy efficiency for public buildings energy efficiency of private buildings and production of energy with renewables for self consumption	POR FESR Sardegna 2014/2020 priority axis 4 "sustainable energy" LEGGE 11 dicembre 2016, n. 232 l DM 28/12/12, il c.d. decreto "Conto Termico"
Awareness raising	Education, demonstration	POR FESR Sardegna 2014/2020
Governance	Establishment of inter-departmental coordination for a regional climate change adaptation strategy	- Regional Decree 1/9 – 13.1.2015

TOURISM		
General instrument	Specific policy instrument	reference documents
Subsidies	Conserve and promote natural and cultural heritage	POR FESR Sardegna 2014/2020
Regulations	Allowable expansion of buildings up to 20% along the coastline	Regional Urban Plan
Subsidies	Improve the regional foot and bike path network	POR FESR Sardegna 2014/2020
Action lines	Increase tourist flows in low season months (transport to the island, offer of natural and cultural heritage sites)	Regional tourist strategic plan
Governance	Establishment of a permanent conference for the tourist sector	LR 28 LUGLIO 2017, N. 16
Subsidies	Agri-tourims facilities in rural areas	Regional rural development plan

4 Assessment of policy coherence

4.1. Assessment of interactions between nexus critical objectives

This sub-chapter includes the description of the nexus critical objectives and explanation of the reason these instruments are considered particularly critical or interesting to investigate in a nexus perspective for the Sardinia case study. In total 15 Nexus critical objectives (NCOs) covering Energy, Food & Agriculture, Water, Land, Forestry and Climate policy sectors have been selected to assess interactions for the Latvia case study (See Table 5). A nexus critical objective is defined as the policy objective that according to the stakeholders and the policy analysis is highly relevant for the issues under investigation in the case study and has a potentially high number of interactions with other objectives in the nexus (Munaretto and Witmer, 2017).

Table 5 Nexus critical objectives for which to assess interactions for the Sardinia case study

ENERGY		
Code	Heading (short description)	Detailed description (including specification of context)
E1	Increase use of renewable energy sources (RES)	Refers to the increased share of renewable energy to reduce CO_2 emissions well below the targets of the Paris Agreement
E2	Transform the Sardinian Energy System towards an integrated and Smart grid system	Refers to the increased efficiency of energy use with the aid of smart grids (it increases energy loadings from RES)
E3	Methanization	Refers to the construction of gas pipes in the island for distribution as well as technologies to ship methane to the island
E4	Development of advanced RES plants to satisfy energy demands for water pumping in agriculture	Refers to the energy autonomy of the water management authority.
FOOD AND AGRICULTURE		
Code	Heading (short description)	Detailed description (including specification of context)
FA1	Increase the efficiency of use of resources	Encouraging the efficient use of resources and the transition to a low-carbon and climate-friendly economy in the agri-food and forestry sectors.
FA2	Agricultural expansion	Refers to increasing competitiveness and profitability of the agricultural sector and of the agri-food chain
FA3	Increase of economic development of rural areas	Refers to reduction of poverty, social integration, and entrepreneurship
WATER		
Code	Heading (short description)	Detailed description (including specification of context)
W1	Reduction of water demand in agriculture	Refers to the uptake of efficient irrigation systems in agriculture and reduction of leakages in the conveyance system
W2	Satisfying multiple demands	Refers to improved allocation of resources to meet

		multiple demands including MEV
W3	Improving water quality	Refers to measures to reduced water pollution and forecast systems of water quality
LAND USE		
L1	Land for RES	Sets limits to the use of Agricultural or forest land for solar energy plants
L2	Reduction of hydrological risk	Refers to soil protection and sets limits to activities depending on hydrological risk
CLIMATE		
C1	Climate change mitigation	Refers to the reduction of GHG emissions by setting GHG emission targets
C2	Climate change adaptation	Refers to selection and application of measures for adaptation to climate change in various sectors
C3	Climate forecast	Refers to the use of climate change projections in resource management plans
TOURISM		
T1	Tourism promotion	Refers to the promotion of tourism by re-qualifying tourist infra-structures and offers
T2	De-seasonalization	Refers to the promotion of tourist offers un related to coastal activities.
FORESTRY		
FO1	Fire protection	Refers to the protection of forest heritage from wild fires
FO2	Sustainable forest management	Refers to the protection and management of forests as an indispensible asset.

The scoring of the interactions was performed in a step-wise, iterative fashion, using multiple sources of information (expert judgement, interviews with stakeholders, scientific and grey literature) as guided by a project document (Munaretto and Witmer, 2017). A scoring matrix has been used to illustrate the interactions among the selected objectives in the relevant nexus policy sectors. A scoring scale of +3, +2, +1, 0, -1, -2, -3 is used to assess the interactions where negative scores identify conflicts between pairs of objectives and positive scores identify synergies between pairs of objectives. The score 0 indicates the absence of a significant interaction. The scoring of interactions between pairs of NCOs has been done in both directions (see Table 6). The table reflects what happens to the objective x (in rows) if a progress is made on the objective y (in column).

Table 6 The scoring matrix for the assessment of objectives' interaction in the relevant Nexus policy sectors

	E1	E2	E3	E4	E5	FA1	FA2	FA3	W1	W2	W3	L1	L2	C1	C2	C3	T1	T2	FO1	FO2
E1		3	-2	1	0	1	1\-1	1	0	0	0	-2	0	2	1	0	0	0	0	2
E2	3		2	2	0	1	0	1	0	0	0	-1	0	2	2	2	0	1	0	0
E3	0\-1	1		0	0	0	0	0	0	0	0	1	0	1	2	0	1	1	0	0
E4	2	2	0		0	1	1\-1	1	1\-1	1	0	-1	0	1	3	1	0	0	0	0
E5	1	2	-1	0		1	0	1	0	0	0	0	0	2	3	1	1	1	0	0
FA1	0	0	0	1	0		1\-1	2	1	0	0	0	0	2	2	1	0	1	0	2
FA2	0	1	1	2	1	1		2	2	2	1	1	-1	-1	1	1	2	1	1	1
FA3	1	1	2	2	1	2	2		1	1	1	-1	-1	1	1\-1	1	2	2	1	2
W1	0	0	0	-1	0	2	-2	2		0	0	0	0	0	2	1	-1	0	0	0
W2	1	1	0	2	0	1	-1	1	0		2	0	0	0	3	3	-1	1	0	0
W3	0	0	0	1	0	3	-1	1	1	0		0	1	0	1	1	-1	0	1	2
L1	-1	1	1	-1	0	0	0	1	0	0	0		1	0	0	0	0	1	1	1
L2	0	0	0	0	0	2	0	1	0	0	0	1		1	2	2	1\-1	0	2	2
C1	3	3	1	2	3	2	1	1	1	0	0	-1	0		1\-1	1	-1	1	2	2
C2	1	2	2	2	3	3	1	2	3	3	1	0	1	1\-1		3	1	2	2	2
C3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3		0	0	0	0
T1	1	1	0	0	2	1	1	2	1	2	2	0	1	1	1	1		2	1	2
T2	1	1	1	0	2	1	1	2	0	0	2	2	2	1	2	2	2		2	2
FO1	0	0	0	0	0	1	0	2	1	1	0	0	0	2	2	2	0	0		1
FO2	1	0	0	0	1	2	0	1	0	1	1	1	1	2	2	1	0	2	2	

The assessment of interactions showed that the objectives related to Food and Agriculture, to Tourism and to Climate have the highest density of interactions while NCOs related to the Energy have the highest number of interactions (both synergies and conflicts) with the NCOs of other Nexus sectors. The relevance of Food and Agriculture and Tourism reflect the role that these sectors have in the economic structure of the region. Interestingly, Climate objectives of adaption are affecting nearly all other NCOs.

The assessment of interactions showed that the objectives related to the Energy Nexus have the highest level of interactions (both synergies and conflicts) with the NCOs of other Nexus sectors. Particularly the objective to increase the share of renewable energy sources is interacting with almost all NCOs of the sectors.

Synergies are ten times higher than conflicts. *Most synergies occur between energy-energy, energy-climate, climate-energy, food-water, water-food policies. The highest number of conflicts occur between, food-water, tourism-water.*

The food-water, food-tourism, climate-food and climate-tourism objectives have the highest density of interactions. These interactions are largely synergistic, except for the food-water, in which the objective of expanding agricultural production would increase the demand for water that is already a scarce resource.

'Increase the economic development of rural areas', 'Increase the efficient use of resources' (*Food and Agriculture*), 'Climate change adaptation' and 'climate forecast' (*Climate*) show the highest density of interactions, mostly positively influencing other nexus domains.

As for affected objectives, 'Increase the economic development of rural areas' and 'agricultural expansion' (*Food and Agriculture*) show the highest number of interactions, followed by 'climate change adaptation'

(*Climate*), 'Tourism promotion' and 'de-seasonalization' *(Tourism)*.

Ambiguous scoring were only 2.5% of the interactions. 'Expansion of agriculture' was the objective with the highest number (3) of ambiguous interactions, this because the effect of an increase in agricultural yield and economy on other objectives strongly depends on the measures adopted and on the coordination with other sectors. For example, an increase in irrigated area if not supported by measures to reduce and limit water consumption may have a counter effect on the objective to reduce water demand for agriculture.

Notably, most binding interactions are found for the *climate* sector (influencing or influenced) and especially the 'climate adaptation' objective. Here, there is a common agreement that all sectors must innovate in order to adapt to climate change and that adaptation cannot be achieved without funds, policy measures and sufficient energy at a lower price (costs for energy in Sardinia are considerably higher than in the rest of Italy).

The *tourism* objectives are positively influenced by all other objectives, however the may have a negative effect on water objectives and land-use.

No strong conflicts among the NCOs have been identified. However, according to stakeholders, in practice, conflicts often arise because of ambiguities in measures and lack of coordination among sectors. For example, one stakeholder brought to our attention that measures for the implementation of the bird directive, of the Water Framework Directive and of the habitat directive all set limits and measures on water bodies, however the boundaries of the system for the three directive either overlap or leave some parts of the system not accounted for by neither three. This creates ambiguity in responsibilities that often remains unsolved and precludes action in these areas.
In general, stakeholders all found difficult to provide examples of synergies or conflicts between policies, rather almost all stakeholders reported a lack of measures for many sectors and a lack of coordination and planning for the management of incentives. Despite this, some conflicts and inefficient use of resources were mentioned:
Growing of energy crops (maize) raises worries on water security given the high water demand of this crop;
Energy biomass from forests could be used (Sardinia has a very large wooded area) with potential synergies with many NCOs, but there are little incentives and management to organize the supply chain.
Experts in the water sector also reported that the increase of irrigated area is largely driven by increase in irrigation efficiency and market drivers, however this increase in irrigated area may well cause or worsen water scarcity issues.
Reduction of energy costs would reduce water prices and potentially promote increase in irrigated area or inefficient irrigation systems.

4.2. Assessment of interactions between nexus critical instruments and nexus critical objectives

This sub-chapter reflects on selected nexus critical instruments in a nexus perspective and the assessment of interactions between nexus critical instruments and nexus critical objectives. A nexus critical instrument is defined *as the policy instrument that according to the stakeholders and the policy analysis is highly relevant for the issues under investigation in the case study and has a potentially high number of interactions with the nexus critical objectives* (Munaretto and Witmer, 2017).
In Sardinia case study are 26 nexus critical instruments identified: 4 in energy, 5 in food and agriculture, 4 in water, 3 in land, 3 in forestry, 2 in climate and 4 on Tourism nexus domains (Table 5). The selection of these

instruments has been based on previous (Block 1) analysis and the communication with stakeholders.

Table 7 List of the nexus critical instruments in nexus sectors

ENERGY		
Code	Heading (short description)	Detailed description (including specification of context)
Ea	Subsidies for energy efficiency of private and public buildings	Determined subsidies for improving energy efficiency (50 to 65% reimbursement)
Eb	Subsidies for RES production in private buildings	Determined subsidies for implementing or increasing RES energy production in private buildings including energy storage systems
Ec	Regional and European funds for implementing smart grid	Determined funds for smart grid infrastructure
Ed	Regional and national funds for methane	Determined funds to guarantee access to methane to Sardinian citizens
FOOD AND AGRICULTURE		
Code	Heading (short description)	Description (including specification of context)
Fa	Direct payments and subsidies to farmers to increase RES	Determined direct payments and subsidies (for agricultural activities beneficial to climate and environment) to farmers under support schemes within the framework of the common agricultural policy.
Fb	Subsidies to improve efficiency of irrigation system	Determined subsidy for increasing high efficiency of irrigation systems including irrigation scheduling technologies
Fc	Regional aids to reduce price of water	Regional government covers the energy bill of ENAS for water pumping
Fd	Direct payments to increase carbon sequestration and preserve soil C pools	Determined direct payments and subsidies (for agricultural activities beneficial to climate and environment) to farmers under support schemes within the framework of the common agricultural policy
Fe	Loans and insurance for farmers	Loans and Insurance against atmospheric events
WATER		
Code	Heading (short description)	Description (including specification of context)
Wa	Optimization of water management	Coordination of authorities for monitoring and allocating water resources and advanced monitoring system of water resources
Wb	Irrigation rules	Regulation for net water applications for crops
Wc	Raising Awareness	Consultancies for farmers on value of water and technologies and methodologies to reduce irrgation
Wd	Technical measures to preserve downstream ecosystems	Technical measures to manage runoff and MEF

LAND USE		
La	Hydrological risk	Determined subsidies to reduce hydrological risk
Lb	Wind turbine and solar plants location	Determined limitations for location of wind turbines and solar plants e.g. with respect to nature protection areas, high value landscape, conservation of biodiversity, hydrological risk
Lc	Land use regulation	Determined regulation for new constructions e.g. distance from shoreline, landscape conservation
FORESTRY		
Foa	Subsidy for fire risk	Determined subsidies for private land management to reduce fire risk
Fob	Tree cutting limitations	Requirements for tree cutting in forests
Foc	Subsidies for soil erosion and conservation of biodiversity	Determined subsidies to conserve forested land and its biodiversity
CLIMATE		
Ca	Establishment of a regional task force for CC adapation	Governance system for inter-departmental coordination
Cb	Raising Awareness	Determined funds for Awareness campaign and education
TOURISM		
Ta	Subsidies for agri-tourism facilities	Governance system for inter-departmental coordination
Tb	Improve the regional foot and bike path network	Determined funds to increase foot and bike paths
Tc	Increase volume of buildings	Determined regulations to allow building expansion (20%) close to the shoreline
Td	Natural and cultural heritage sites	Funds to improve access and quality of service in heritage sites

The scoring of the interactions was performed in a step-wise, iterative fashion, using multiple sources of information (expert judgement, interviews with stakeholders, scientific and grey literature) as guided by a project document (Munaretto and Witmer, 2017). The scoring matrix (Table 6) is built on considerations of only direct interactions between nexus critical instruments and nexus critical objectives with additional considerations, when relevant, of the long-term objectives and the context factors (e.g., geographic, socio-economic domains).

Table 8 Interactions between nexus critical instruments and nexus critical objectives

	E1	E2	E3	E4	E5	FA1	FA2	FA3	W1	W2	W3	L1	L2	C1	C2	C3	T1	T2	FO1	FO2	Tot +	Tot -	Tot-\+
Ea	0	0	0	0	3	0	1	2	0	0	0	0	0	3	3	0	2	2	0	1	8	0	0
Eb	3	3	0	0	1	3	1	2	0	0	0	0	0	3	2	0	1	1	0	1	11	0	0
Ec	2	3	2	3	2	2	1	1	0	1	0	0	0	2	2	0	0	1	0	0	12	0	0
Ed	0	1	3	0	1	0	1	2	0	0	0	1	0	1	2	0	1	1	0	1	11	0	0
Fa	3	2	-1	0	1	2	1	2	0	0	0	0	0	3	3	0	2	1	0	0	10	1	0
Fb	0	0	0	1	0	2	2	2	2\-2	1\-1	1	0	0	0	2	2	0	0	1\-1	0	7	0	3
Fc	0	0	0	-1	0	-2	2	2	-2	-2	0	0	0	-1	-2	0	1	0	0	0	3	6	0
Fd	0	0	1	1	0	3	2	2	1	0	2	0	1	3	2	0	1	1	-1	3	13	1	0
Fe	0	0	0	0	0	1	2	2	1	0	0	0	1	1	2	1	1	0	1	0	10	0	0
Wa	0	0	0	1	0	1	2	2	1\2	3	3	0	2	1	3	1	1	1	1	0	13	0	1
Wb	0	0	0	-2	0	-2	1	1	-2	-2	-1	0	0	-1	-2	0	0	0	-1	0	2	8	0
Wc	1	1	1	2	0	3	2	2	3	3	3	2	1	1	3	1	0	1	1	1	18	0	0
Wd	0	0	0	0	0	2	1	2	3	3	3	0	3	2	2	0	1	2	0	1	12	0	0
La	0	0	0	0	0	2	1	2	0	0	1	2	3	1	2	0	1	1	0	2	11	0	0
Lb	-1	-1	0	-1	0	-1	0	-1	0	-1	1	3	2	-1	-1	0	2	2	0	2	6	8	0
Lc	0	0	0	0	0	1	1\-1	-1	0	0	2	2	3	2	1	0	2\-2	2	2	2	9	1	2
Ca	2	3	1	2	0	2	2	2	1	3	1	0	1	3	3	3	0	1	2	1	17	0	0
Cb	3	2	1\-1	1	2	2	0	1	2	1	1	0	0	3	3	3	0	1	3	3	15	0	1
Ta	1	1	0	0	0	0	1	2	0	0	0	1	0	0	1	0	2	3	1	1	10	0	0
Tb	0	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	1	3	0	1	6	0	0
Tc	0	0	0	0	1\-1	0	0	-1	0	0	0	0	0	-1	0	0	2	-1	0	0	1	3	1
Td	0	0	0	0	0	1	0	2	0	0	0	2	2	1	2	0	2	3	0	2	9	0	0
Foa	0	0	0	0	0	0	0	1	0	0	1	1	1	2	2	0	0	0	3	2	8	0	0
Fob	1	0	0	0	0	1	0	0	0	0	1	2	2	2	2	0	1	2	-1	3	10	1	0
Foc	0	0	0	0	0	3	0	1	1	0	2	2	3	2	1	0	1	2	0	3	11	0	0
Tot +	8	8	5	7	6	16	16	21	7	6	13	11	13	18	21	6	17	19	8	17			
Tot -	1	1	1	3	0	3	0	3	2	3	1	0	0	4	3	0	0	1	3	0			
Tot-\+	0	0	1	0	1	0	1	0	2	1	0	0	0	0	0	0	1	0	1	0			

5 Success stories and failures

This chapter highlights the success stories and failures regarding the nexus policies in the case study area. Taking into consideration the issues analysed so far, the available literature sources and communication with stakeholders, the success stories and failures have been reflected with respect to policy design and policy implementation. The success stories and failures are briefly presented in the Table 9.

Table 9 Success stories and failures

Type of successful policy arrangement	Description	Factors of success, do's
Regulation on land use for energy production	After a nearly uncontrolled installation of solar and Eolic energy plants promoted by incentives for RES production, citizens asked to halt the use of agricultural land for these purposes and also the installation in high natural and cultural landscapes. The regulation sets limits to the use of these land types.	• Landscape plan • Efficient use of agriculture land resources
Type of unsuccessful policy arrangement	Description	• Factors of failure, don'ts
Use of forest Biomass for Energy production	Sardinia has a large natural capital in forests, but there biomass is largely left unused with negative effects also on fire control.	• Insufficient cost-benefit estimation • Lack of funds and organization of the biomass value chain

Success and failure in implementation of policies rather depend on economic factors, such as available funding and design of economic instruments. One of the key success factors is related to well structured environmental impact assessment. Failures are attributed to weak management, sectorial bound perspectives and short term thinking of development.

South West England
Policy analysis

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Contents

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Executive summary

This report gives an overview of the relevant nexus sectors (water, energy, agriculture/food and land-use) and the key research questions in the UK case study, located in the South West region of England. It describes the socio-economic context using indicators, graphs and statistical data. It reports on the mapping of a selection of key stakeholders from each of the identified sectors, and includes summaries of stakeholder power and interests, indicating which are key stakeholders for the UK case study. A detailed inventory of key policy documents for each sector, including breakdowns by objectives and instruments, follows.

After presenting a breakdown of the stakeholders interviewed across the nexus sectors, the report moves on to a detailed assessment of policy coherence. This includes:

- Identification of nexus critical objectives (NCOs) and assessment of their interactions using a 'pairs of policy' approach;
- Identification of nexus critical instruments (NCIs) and assessment of the interactions between the NCOs and NCIs; and
- Assessment of the vertical interactions between policies – i.e. national to regional, including how these can hamper or support the achievement of the NCOs.

Drawing on stakeholder interviews which added to the findings and expert knowledge, the report identifies formal and informal rules and practices that are being used to handle conflicts, negotiate trade-offs and exploit synergies on the ground. It also details success stories and failures that emerge from the assessment.

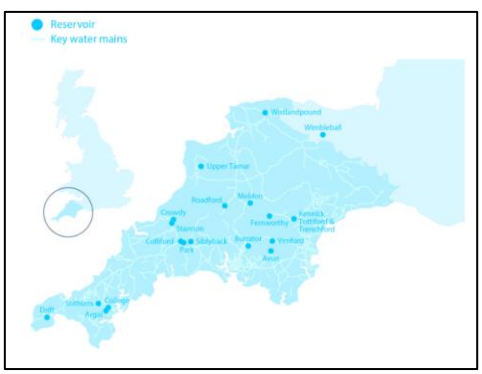
Finally the report provides a validation of the assessment, drawing on input from key stakeholders at a workshop held in June 2018.

1 Introduction

1.1. Case study description

The South West of England, as defined in this case study, includes the counties of Cornwall, Devon and parts of Somerset and Dorset totaling an area of approximately 10,300 km2 (Figure 1). There are 1.7 million residents with the majority of the population (45%) located in just 13 urban centres.

Figure 1 Map of South West region and map of reservoirs and key water mains



Source: South West Water

This predominantly rural region is dominated by the industries of agriculture and tourism. The unique landscapes within the South West region have led to many designated Areas of Outstanding National Beauty (AONB) and with two national parks, and a coast path stretching 630 miles, there is a significant draw to the region of tourists with around 8 million visitors a year and with 529,000 during a peak week. These attributes add additional pressure on land use, energy and water resources.

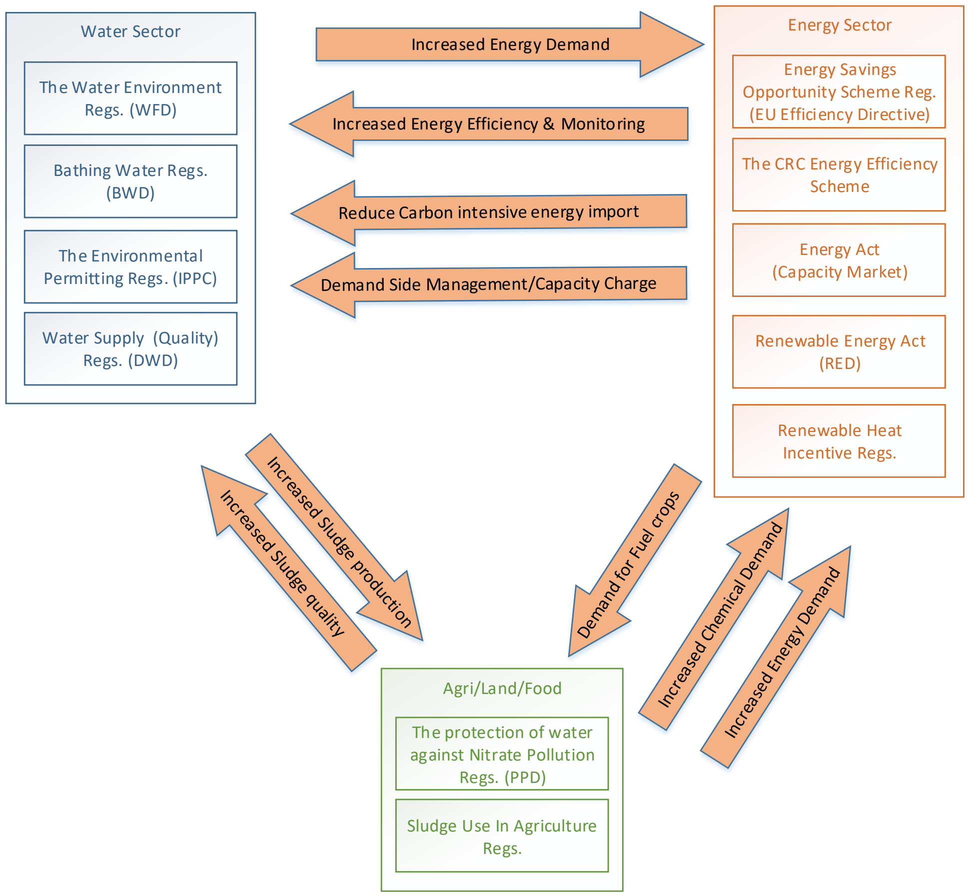
The case study in the South West of England will investigate how the governance of energy, water and agriculture/land use in the UK effects sustainable food production, the provision of water and waste water services and the move to a smart and flexible system of energy provision within the South West of England. In this case study, governance is understood to be (1) policies, institutions, regulations (and their rules and incentives) and (2) the underlying political economy of how those policies, rules and incentives are decided upon and who they benefit (or not)[1].

1.2. Nexus dimensions

The three main nexus sectors that are to be investigated in the SW are water, energy and agriculture/land use. Each of these dimensions is intrinsically related to the other – behaviours in one dimension can lead to both synergies and trade-offs with another dimension. These dimensions need to be managed in a way that is sympathetic to the global trends of climate change; poverty and affordability; and population growth.

Figure 2 Relationships, indicative policies and outcomes between water, energy and agriculture/land use sectors in the SW

[1] See http://projects.exeter.ac.uk/igov/ (accessed 5 Nov 2017)



Source: Matthew Griffey (author)

As Figure 2 (above) Illustrates, the objectives of key regulations associated with the nexus from the perspective of greatest impact on the water sector, can compete or have contradictory impacts in practice. In general terms the regulations directly associated with water focus on protecting local environments and human health through a quality control approach. One adverse effect of this is a tendency towards an increase of sludge production and energy/chemical demand of treatment processes. This can be viewed as a prioritisation of the local environment at a negative cost to global environment through the increased emissions of GHGs.

The key regulations influencing the energy sector are derived from EU directives and are largely focused on reducing energy consumption, carbon intensity of generated energy or otherwise mitigating total carbon emissions.

Some key agricultural land and food policies relevant to operation of the water sector are related to agricultural run-off. These regulations both conflict and complement several objectives of the water centric regulations as they demand higher quality sludge with reduced potential for pollution. The decreased potential for pollution plays into the drive for improved drinking water quality and reduced energy demand of drinking water treatment, but makes it significantly more difficult for the water industry to dispose of sludge. Additionally, increasing demand for biofuels increases the demand for fertiliser and pesticides and this further impacts groundwater quality.

1.2.A. Water

The water system in the SW is quite distinctive, involving an expansive and spread network, and a dispersed set of customers. Based in Exeter, South West Water is the sole provider of water and wastewater services in the region and has been since 1989 when the water industry was privatised. Its main responsibilities are the provision of drinking water in the region, the treatment and disposal of sewage, and the protection of inland and bathing waters.

The water system faces unique environmental challenges in the SW. The SW of England is home to one third of the UK's designated bathing beaches and a wide range of environmentally designated/protected areas (for example Exmoor, Dartmoor and the Jurassic Coast). This landscape puts pressure on the issue of water quality related to heavy rain and waste water disposal. Water and wastewater services are required year round for the inhabitants (and for approximately 11 million tourists in peak summer periods) in a way that avoids any 'adverse' impacts on the unique environment that in itself underpins the two pillars of the region's economy – tourism & agriculture. Due to the dispersed population within the SW, extensive pumping (and associated electricity) for water services is required within the region. This makes water more expensive in the SW compared to other, more densely populated regions. For this reason, were actors in the water system to utilise the opportunity to employ more renewable energy technologies, there would be the potential to lower energy bills and use resources more efficiently.

There is also an issue with flooding in the SW. The main areas prone to flooding are in the north and the east of the region. Recent floods in the SW have led to significant disruption to travel and business. Properties have been flooded, major transport links disrupted and whole villages have been cut off. It is possible that changes to agricultural practices could help lessen the likelihood of floods and agricultural land could form part of the solution to flood defences, with designated areas to take flood water in order to protect other infrastructure.

A report by the Joseph Rowntree Foundation has highlighted the interaction between floods and social vulnerability across the UK, creating a flood disadvantage. According to the report, two thirds of cities experiencing relative economic decline face above average flood disadvantage (Sayers et al, 2017). This is an example of the social issues that are present around nexus issues and an example of an issue which is only going to be exacerbated by climate change.

1.2.B. Energy

With regard to the energy landscape within the SW, the region is at the forefront of emerging low carbon economies with plentiful natural resources for solar, wind, wave, geothermal and bioenergy. The South West is also home to Hinkley point C, a nuclear power plant approved by the government in September 2016. The approval of this power plant has significant implications for the SW region. Nuclear power, because of its characteristics, and because of Hinkley Point C's geographic position undermines the development of a 'smart' flexible energy system in the SW. The approval for Hinkley point C going ahead has become political rather than solely about energy, but it nevertheless explains part of the narrative around why we in Great Britain do not yet have an efficient energy system. In the South West, the go-ahead for new nuclear has led to reduced grid capacity for renewable generation. In turn, this has made the move to a smart, flexible, sustainable and efficient energy system more difficult economic and system operation reasons.

The SW of the UK represents a unique case study for what is happening with regards to changes in the energy system and the difficulties in transforming to a new smart energy system. The SW sees energy distributed through Western Power Distribution (WPD), the distribution network operator (DNO). WPD and all DNOs own and operate the distribution network of towers and cables that take electricity from the transmission network into homes and businesses. They aren't responsible for selling electricity to consumers as this is done by suppliers.

The system of distribution that operates within the UK energy system is one built on the technologies and the one-way delivery of electricity that is becoming outdated and increasingly ineffective. With the rise of distributed generation, renewable sources of energy, energy storage and micro grids, the traditional model of distribution is changing. These changes have the potential to change the design, and operation of distribution networks, delivering greater efficiency of energy use, sustainability in terms of reduced GHG, and cost savings which arise through reduced infrastructure, and greater efficiency of use. Distributed generation, demand response and energy storage have brought new variables to the UK energy system that require a flexible system operation, and that requires a new way of operating the system, and necessitates investment in a new network infrastructure.

Distribution system operators (DSOs) are increasingly seen as an essential element of a new energy system. DSOs would have greater prominence and control over assets on their systems, and be able to utilise the distributed energy resources available to them in a more cost-effective and resource efficient way. Unfortunately, change is happening relatively slowly. While the UK has increased spending on R&D and demonstration projects in relation to 'smart grids' over the last decade, and now has a Clean Growth Plan (BEIS 2017) and Industrial Strategy[2] which has flexible smart energy systems at their core, transformation has been marginal in comparison to the rate of technological change (Lockwood, 2014). Alongside this, current network operators still have a basic interest in growing their network and increasing the amount of electricity that passes through their cables, since these statistics are reflected in their profits.

The speed at which the network begins to operate in a manner that supports smarter, flexible operation is dependent on the legislation and regulation coming from governing bodies. We can currently see how this varies across countries and regions. In New York, for example, 'Reforming the Energy Vision (REV)'

[2] https://www.gov.uk/government/policies/industrial-strategy (accessed 5 Nov 2017)

was a fundamental reconsideration of regulatory paradigms and markets, examining how policy objectives are served both by clean energy programmes and by the regulation of distribution utilities (DPS, 2014). It is actively supporting renewable energy innovation, providing certainty for RE investment and improving consumer choice and affordability. The UK needs to follow suit by bringing network operations in line with overarching energy policy to give opportunities for demand side management and local generation and advancing with goals to create a sustainable, smart, secure and affordable energy system. The network needs to be run in the most efficient manner, using minimal energy, connecting more renewable energy and harnessing smart and flexible operation at the local level. People will need to play an increasingly active role in the energy system and need to be rewarded for doing so. In order for them to do this, they need be connected more closely to their energy use and its impacts and be assured that the energy system is working with their interests at the heart.

A system optimised from the bottom up is needed in order for it to become truly smart and flexible. Individuals will play a big part in ensuring the system functions in a smart way and in order for this to happen people need to be involved in the transformation, making meaningful decisions and consenting to the new system, and the costs and behaviours needed for it to transform (for more details see [3]).

1.2.C. Agriculture and Land Use

Land use plays an important role in the SW. Three quarters of the land area in the South West (1.8 million hectares) is devoted to agricultural land with a large proportion of the population (around 61,000) employed in the sector, and hundreds of thousands more derive their livelihoods from a wide variety of ancillary trades and businesses. The red meat sector alone employs 25,000 people and is valued around £2billion. As a whole, the agricultural sector contributes more to the regional economy than the UK average, as the following summary Table 1 shows.

Table 1 Comparison of the contribution to the regional economy from the agricultural industry in the SW versus the UK average

Agricultural industry

	South West		UK
	Total	%	%
Economic output	£1.4 billion	1.2%	0.7%
Employees	27,300	1.2%	0.7%
Businesses	8,800	7.0%	4.0%

Source: Commons Library Briefing: Brexit's effect on agriculture and fisheries in South West England CDP2016-0177 14 October 2016

[3] http://projects.exeter.ac.uk/igov/ (accessed 5 Nov 2017)

Climate change, coupled with harmful land management practices put the highly productive agricultural land in the South West at risk of becoming unprofitable due to the impacts of soil erosion and the loss of organic carbon. It has been acknowledged that there needs to be a firm commitment to enhance the natural capital of land and water in order to sustain agricultural productivity (in a changing climate), maximise carbon sequestration, and safeguard the economic and amenity benefits the natural environment provides (CCC, 2015). In failing to conserve and invest in natural capital assets, opportunities within farming and forestry have been overlooked, bring greater costs and lower performance in the long term (EC, 2015).

Changes in land use and new farming practices also pose a risk of their own, as many important semi-natural habitats in the South West are being fragmented and less resilient to climate change and less viable in the long term. Diffuse water pollution from agriculture continues to be a problem facing the water and agricultural sectors (EC, 2015).

The Rural Development Programme (RDP) for England, 2014-2020 was formally adopted by the European Commission in February 2015. It sets out the priorities for spending an envelope of EU funding available from 2014-2020. The key priority within the programme is improved management of natural resources and the increased adoption of farming practices that are climate friendly with the aim of protecting farmland through environmental land management targeted to specific biodiversity and water objectives.

As well as being on the frontline of climate change impacts, the agricultural sector also has a role to play in implementing strategies to tackle emissions, with agriculture and forestry contributing to around 10% of all UK greenhouse gas emissions. There is some uncertainty surrounding the estimates of GHG emissions in the sector and with the current, voluntary industry-led GHG Action Plan to reduce emissions, there is some doubt as to the role the sector will play in future abatement (CCC, 2017). However, in addition to agriculture and livestock, 30% of the country's farms producing renewable energy are located in the South West region. The RDP clearly states support for tourism, broadband infrastructure and renewable energy and sees this diversification as an important part of future climate strategy.

1.3. Key research questions

1.3.A. Water

The dispersed population, dependency on tourism and the fact that 75% of the land area is devoted to agricultural use, will continue to put pressure on the water system in the SW – a situation also currently exacerbated by flooding. With Brexit also pending, a key challenge is how to manage the inter-dependencies and trade-offs associated with the future economic context, regulatory burden and environmental standards. Thus a key research question is:

How can local and global environmental protection objectives be addressed, including the reduction of flood risk, while meeting an increasing demand for low cost and high quality water/waste water services?

1.3.B. Energy

Extensive water pumping to the dispersed population, together with tourism-related peaks, is putting growing pressure on electricity supply in the region. Although the SW is at the forefront of emerging low carbon economies, it is a slow transition, as current network operators want to grow their networks and maintain profits (Lockwood, 2014). Managing the economic, environmental and socio-economic interdependencies and trade-offs through legislation and regulation is a key challenge for a smarter, flexible network operation that impacts water and waste water systems. Thus a key research question is:

To what extent can renewable energy generation, energy efficiency and demand management reduce or otherwise offset the need for grid imported energy in the provision of water/waste water services?

1.3.C. Agriculture and land use

The resilience of water and wastewater services is critical for land use and agriculture in the SW region, including for the large number of associated trades and businesses. However, coupled with climate change, changes in land use and farming practices have increased water pollution, especially through the disposal of bio solids (Palmer and Smith, 2013). Improving the natural capital of land and water in the SW region poses a key challenge for the nexus. Thus a key research question is:

How can SWW and the agricultural sectors work together to improve future farming practices in order to protect food security, biodiversity and water objectives, tackle GHG emissions and increase renewable energy outputs from local farms?

2 Socio-economic context

2.1.A. Key socio-economic indicators and context: Population, Gross Domestic Product and Employment

This section details the socio-economic context of the South West of England using key demographic indicators including population, Gross Domestic Product (GDP) and unemployment using data from Eurostat[4]. The main counties included, Devon and Cornwall, are used to demonstrate key demographic characteristics rather than the south west region because of the lack of availability of statistical data for the exact area demarcated for this case study (which includes only a small part of Somerset and Dorset, and excludes Bristol and the surrounding area usually included in statistics for the South West region).

Devon and Cornwall represent only a small percentage of the total UK population (1.22% and 0.87% respectively) and this has remained stable over the 2008-2016 period. Table 2 (below) shows a steady

[4] Available from: http://ec.europa.eu/eurostat/data/database

population increase between 2008 and 2016 for the counties of Devon and Cornwall, shown in comparison to Great Britain as a whole.

Table 2 Population for Devon, Cornwall and Great Britain 2008-2016

Year	Devon (numbers)	Devon (%)	Cornwall (numbers)	Cornwall (%)	Great Britain (numbers)
2008	739,900	1.23	525,000	0.87	60,044,600
2009	741,000		526,400		60,467,200
2010	743,900		529,800		60,954,600
2011	747,700		533,800		61,470,800
2012	753,100		538,200		61,881,400
2013	757,900		541,700		62,275,900
2014	764,700		546,000		62,756,300
2015	772,400		550,300		63,258,400
2016	778,800	1.22	555,100	0.87	63,785,900

Source: *ONS Labour Market Statistics (nomisweb)*[5]

The Gross Domestic Product within the region (Table 3 below) reflects the more general economic downturn experienced in 2008 to 2013 in the whole of the UK and elsewhere, precipitated by the global credit crunch. In 2016 the GDP per capita of Devon corresponded to 80% of the EU28 average GDP per capita, and Cornwall to 69%.

Table 3 GDP per capita (in Euros) for Devon and Cornwall (NUTS2 regions)

Year	GDP per capita for Devon	GDP per capita for Cornwall
2016	23,300	20,100
2015	23,300	20,100
2014	22,300	19,000
2013	21,900	18,800
2012	21,300	18,800
2011	20,900	17,800

[5] Available from: https://www.nomisweb.co.uk/

2010	21,000	17,900
2009	19,700	17,300
2008	21,300	19,200
2007	21,700	18,900

Source: *Eurostat*[6]

The proportion of the economically active population in employment dipped in 2010-2012 and then increased slightly to 2016 (Table 4), also reflecting the economic downturn post-2008. At the same time unemployment peaked around 2011-2012 then fell slightly to 2017 (Table 5).

Table 4 Numbers and percentage of economically active population classed as in employment in Devon, Cornwall and Great Britain

Year	Devon (numbers)	Devon (%)	Cornwall (%)	Great Britain (%)
2009	350,800	75.6	69.5	70.7
2010	343,700	72.9	68.9	70.2
2011	347,400	73.2	71.1	69.9
2012	355,300	75.4	68.8	70.6
2013	353,800	75.9	70.3	71.3
2014	362,100	76.8	74.3	72.4
2015	385,100	78.2	74.3	73.6
2016	387,300	78.8	74.7	73.7

Source: ONS Labour Market Statistics (nomis)[7]

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[6] Available from: http://ec.europa.eu/eurostat/data/database
[7] Available from: https://www.nomisweb.co.uk/

Table 5 Numbers and percentage of economically active population classed as unemployed in Devon, Cornwall and Great Britain

Year	Devon (numbers)	Devon (%)	Cornwall (%)	Great Britain (%)
2008	11,000	3	4.4	5.7
2009	21,200	5.7	5.7	7.7
2010	20,200	5.6	6.6	7.6
2011	21,700	5.9	6.4	8
2012	14,400	3.9	5.9	7.9
2013	17,800	4.8	5.9	7.5
2014	16,000	4.2	5.1	6.2
2015	12,300	3.1	3.9	5.2
2016	18,100	4.8	4.1	4.8
2017	7,800	1.9	3	4.4

Source: ONS Labour Market Statistics (nomis)[8]

The percentage of the self-employed as a proportion of the economically active population in employment is significantly higher than for the general population and rose steadily from 12.8% in Devon and 15.8% in Cornwall in 2008 (8.9% in Great Britain) to 16% in Devon and 17.6% in Cornwall (10.6% in Great Britain). Self-employed earnings tend to be lower than for those in employment (Cornwall Council 2017).

According to socio-economic, demographic and health data for Devon compiled by Devon County Council (DCC) / Public Health Devon (PHD) (DCC / PHD 2017), Devon is the third largest county in England, covering 2,534 square miles and has a higher proportion of older people than the national average. It is

[8] Available from: https://www.nomisweb.co.uk/

also one of the most sparsely populated counties, with few large settlements and a dispersed rural population. Other key socio-economic characteristics (many of which are shared with Cornwall) include:

- An ageing population which is also growing faster than the national average.
- The sparse and predominantly rural population creates additional challenges around access to services and social isolation. Therefore, making effective utilisation of local resources, voluntary / community organisations and community assets is particularly important.
- Patterns of deprivation and inequality are marked by isolated pockets and hidden need within communities and higher levels of rural deprivation.
- Average earnings below the national average with house prices and cost of living above the national average contribute to a number of issues including food poverty, homelessness, mental ill-health, and fuel poverty.
- A disparity between the quality of indoor and outdoor environments - according to the Indices of Deprivation 2015 over half the Devon population (54.55%) live in areas in the most deprived 20% in England for the quality of the indoor environment (decent homes standard and central heating). However, none of the areas are in the most deprived 20% in England for the quality of the outdoor environment (air quality and road traffic accidents).

The following sub-sections provide a description and graphical representation of the key socio-economic indicators within the sectors of agriculture, land use, energy, water and tourism.

2.2. Agriculture and land use

In relation to climate change, agriculture accounts for approximately 10 % of greenhouse gas emissions in the UK. Nitrous oxide, methane and carbon dioxide are the three main contributing gases to come from agricultural practices. Agriculture is the predominant form of land use in the UK, accounting for approximately 70 % of our land cover. This figure has remained relatively unchanged since 1990. While it contributes less than 1% to the UK economy, it provides around three-quarters of the indigenous food that is eaten in the UK. Although total productivity of the agricultural industry is estimated to have fallen 0.4 % between 2014 and 2015, this follows particularly high production levels in 2014 and compared to 2010, productivity is up by 5.3 %[9]. Alongside this, agriculture provides other benefits to society; recreational, spiritual and cultural.

The ecological condition of the farmed countryside is of particular risk of suffering from the impacts of climate change, suffering from existing pressures already. Soil degradation is exacerbated by intensive farming, deep ploughing and short rotation periods and with climate change expected to lead to water shortages and drier soils, the sustainability of agricultural productivity is thrown into question.

[9] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/615859/agriproductivity-statsnotice-25may17.pdf (accessed 6 Nov 2017)

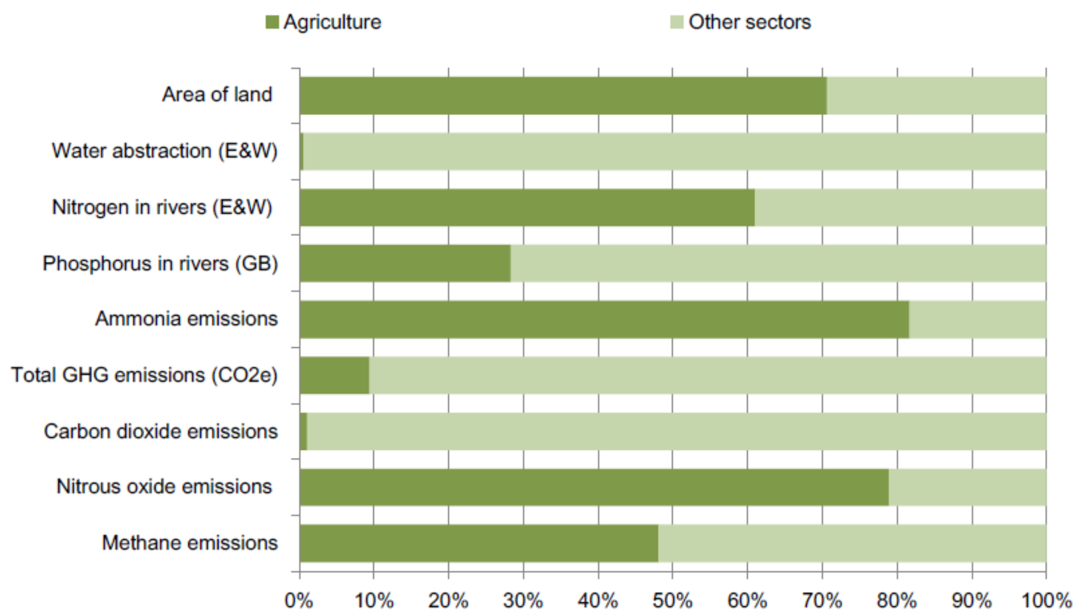
Agricultural farm management in the SW of England is very likely to further damage soil structure and change the hydrological processes of the soil. Processes such as capping (the binding of surface soil particles creating an impermeable layer), slumping (collapsed soil prone to erosion), smearing (where fine soil particles bind together to create an impermeable layer) and compaction (where air is displaced from the pores within soil grains) all lead to soils that are less porous, increasingly dense, coarser in structure and in some cases leading to structure-less layers of soil.

In 2013, a study was published that presented the findings of field investigations between 2002 and 2011 on the soil structure and surface water run-off generation in 31 farms in the SW of England. It is enhanced water run-off that is more likely to lead to the pollution of water bodies which is a topic of importance in the South West (see section 1.2). Thirty-eight percent of sites were found to have high or severe levels of soil structural degradation, with a further fifty percent showing moderate levels (Palmer and Smith, 2013). They concluded that SW England is more vulnerable to soil structural damage than many other agricultural areas of the UK owing to higher rainfall levels and more strongly sloping land than in other areas of the country, along with the cropping in SW England, which carries a high risk of damaging soil structure in the area (Palmer and Smith, 2013).

Key indicators of biodiversity in the farmed countryside are in long-term decline (CCC, 2015) and while there are government targets to improve the state of this, and other, vital habitats, there is uncertainty around how these targets will be met.

The types of agricultural production and the management of agricultural land have the most significant impact on the environmental impacts form the sector. A desire to increase production from agricultural land has to be weighed up against the environmental impacts of doing so. Figure 3 below shows the environmental footprint of agriculture comparative to other sectors.

Figure 3 Agriculture's environmental footprint in the UK

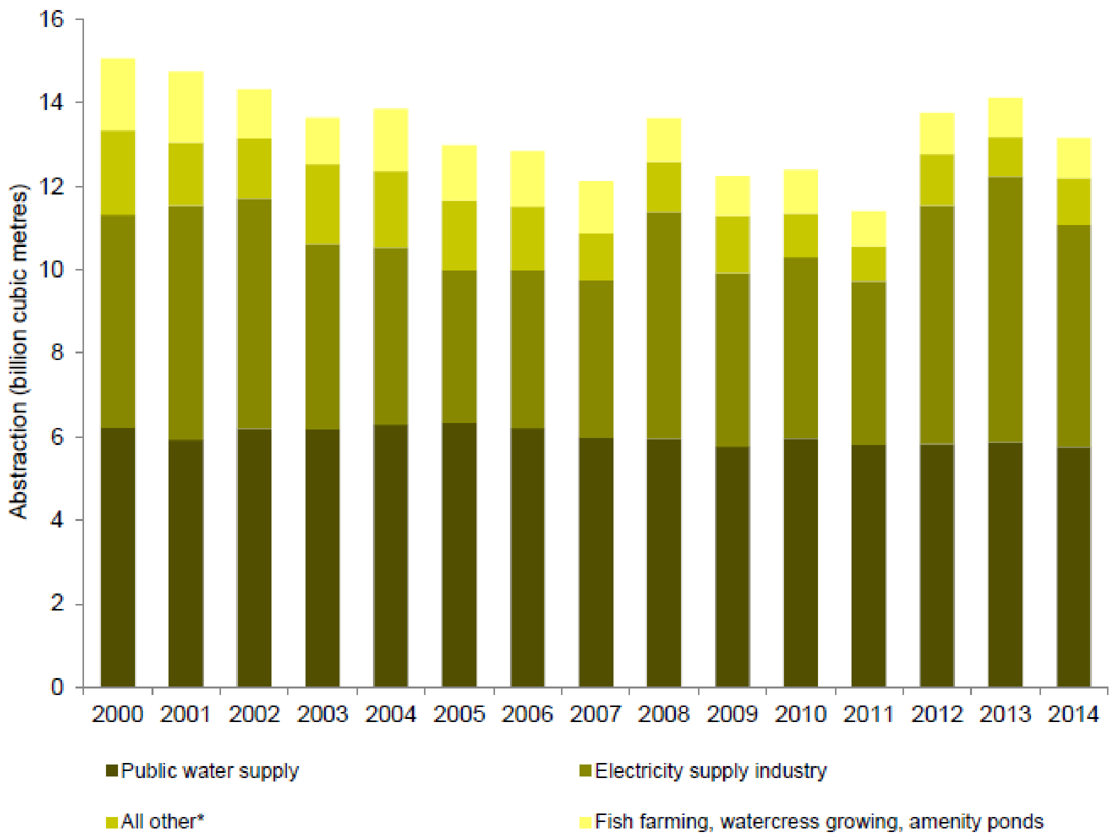


Source: Collated by DEFRA for ONS

There are various schemes within the UK that incentivise farmers to adopt land management and farm practices that are beneficial to the environment and in 2015, farms within agri-environment schemes accounted for 43 percent of the Utilised Agricultural Area, which has more than trebled since 2000 (Defra, 2016). The agriculture sector has a voluntary scheme regarding take up of low carbon schemes and practices which allows devolved governments to deliver bespoke schemes in particular areas.

The use of water for agricultural purposes can have both positive and negative impacts for the environment. Water use in agriculture can lead to soil erosion and flooding and over-abstraction can be detrimental to sensitive aquatic habitats (DEFRA/ONS, 2016). Figure 4 below shows the estimated amount of water abstracted each year since 2000. As the figure shows, levels of water abstraction are decidedly variable from one year to the next and the recent rise and fall between 2012 and 2014 can be explained by the increases and decreases in water abstracted for electricity generation.

Figure 4 Estimated abstractions from non-tidal surface water and groundwater in England and Wales, 2000-2014



Source: Environment Agency, Natural Resource Wales in (DEFRA 2016)

Agricultural practices can also impact on water quality. Water bodies can become polluted through the application of plant protection products and the use of fertilisers to increase crop growth. These products most often enter water bodies through rainfall run-off, filtering directly into groundwater or directly entering through close application to water bodies. The EU Water Framework Directive (WFD) is the tool within the UK used to assess water quality (European Parliament, 2000). It requires countries within the EU to manage their water environments to consistent standards.

2.3. Energy

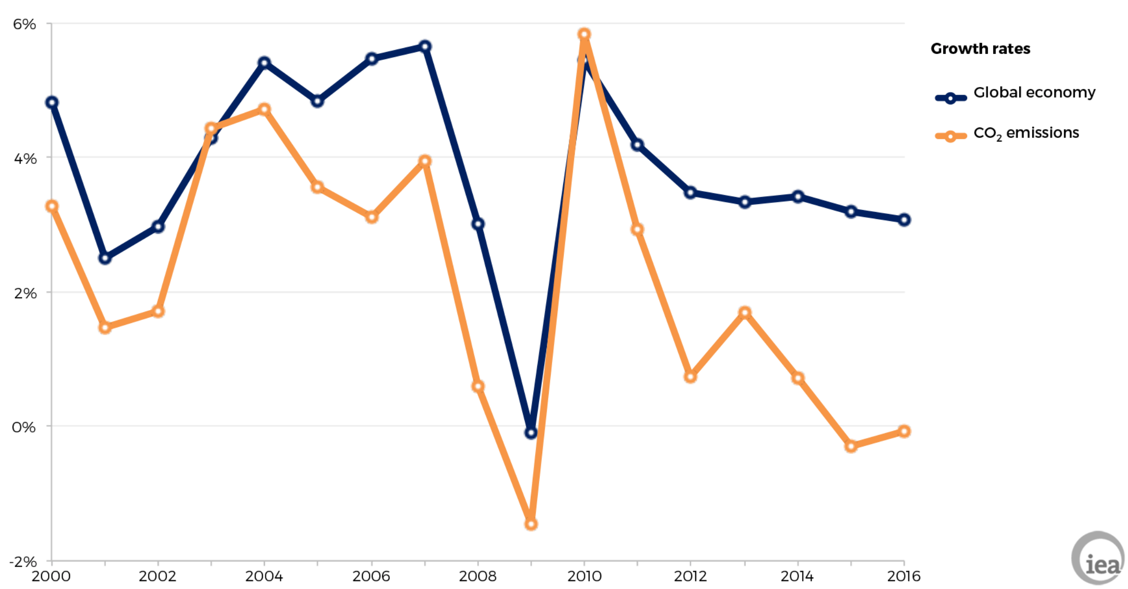
Since 1999, when UK energy production peaked, there has been a sharp rise in imports of fuel (coal, crude oil, petroleum products and gas)[10]. In 2016, primary energy production rose by 1.4%on the

[10] https://archive.uea.ac.uk/~e680/energy/energy_links/statistics/sector-indicators/UKESI_2015.pdf (accessed 6 Nov 2017)

previous year due to rises in oil and gas output. Renewable energy production rose by 2.3% in 2016 and nuclear output up 2%[11]. Since 1997, coal and gas have been the primary fuel used in UK electricity generation but in 2015, renewables overtook coal to become the second largest generator of electricity. In 2015, renewable energy sources accounted for 25% of total UK electricity generation, of which 60% came from wind and solar power.[12]

These statistics go some way in showing the transition that the energy system is going through in the UK. The move from fossil fuels to increased use of renewable energy is having positive implications on our climate. In March 2017, the International Energy Agency stated that global energy related carbon dioxide emissions were flat for a third straight year in 2016 even as the global economy grew, indicating the decoupling of emissions and economic activity (see Figure 5). A large part of this was down to a growing share of renewable power generation alongside switches from coal to natural gas and increased levels of energy efficiency.

Figure 5 CO_2 emissions and global economy growth rates



Source: *IEA 2017*

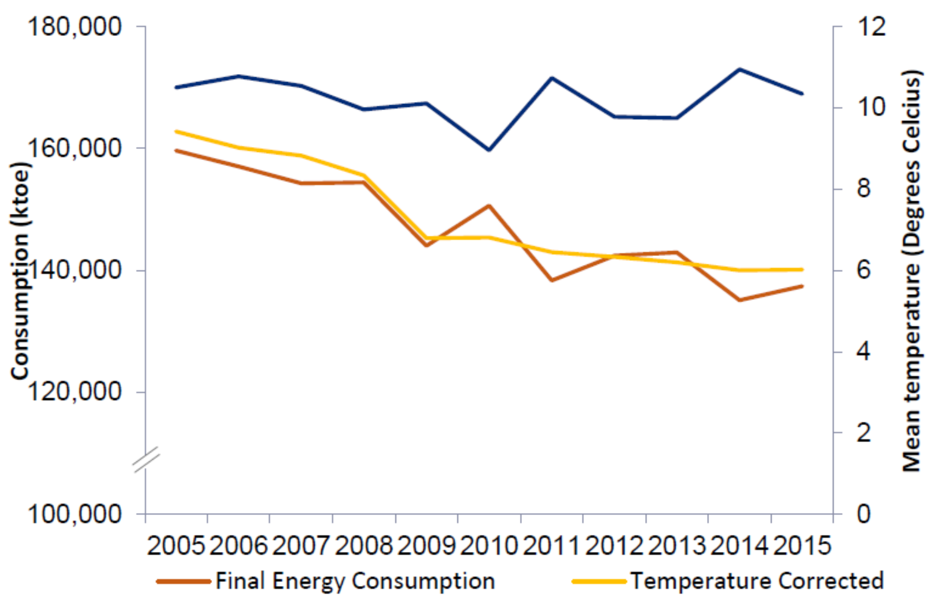
11 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/639098/Energy_Trends_June_2017.pdf (accessed 7 Nov 2017)

12 https://visual.ons.gov.uk/uk-energy-how-much-what-type-and-where-from/ (accessed 7 Nov 2017)

Within the UK, the proportion of energy supplied from low carbon sources continues to grow. In 2014, the UK obtained around 14% of its primary energy from low carbon source, with 51% of this coming from nuclear power and 31% from bioenergy[13].

In 2016, final energy consumption in the UK stood at 137,430 ktoe. This was slightly higher than the previous year due to an increase in use of domestic gas relating to an increase in space and water heating. Over the last ten years in the UK, energy consumption has decreased by 14%, on both an actual and temperature corrected basis as shown in Figure 6 below.

Figure 6 Final Energy consumption, actual and temperature corrected



Source: BEIS 2016

When looking at final users of energy, transport remains the largest consumer; a position it has occupied since 1988, accounting for more than a third of total energy consumption (40%). The industrial sector has fallen significantly in its consumption of energy, largely down to a reduced UK economic share and the increase in efficiency of industrial processes.[14]

13 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/338750/DUKES_2014_printed.pdf (accessed 6 Nov 2017)

14 https://www.theccc.org.uk/wp-content/uploads/2016/06/2016-CCC-Progress-Report.pdf (accessed 7 Nov 2017)

Nationwide and in the South West there is energy system transformation happening at a local level. There is an abundance of generation from both solar and wind in the region and this has the opportunity to lead to the development of new localised energy networks. However, nuclear power poses issues to the UK in the transition to a smart, flexible and responsive system. Not only is it a very expensive source of low carbon power, but having nuclear power on the system makes it harder rather than easier for system operation with a high proportion of renewables (Mitchell, 2016). The variable power renewables than the UK has in abundance (such as solar and wind) requires a system that complements rather than undermines variable power output.

The UK government has an opportunity to support small scale energy in favour of the large generators and actively govern to enable large and small to work together. At the moment there are severe restrictions around the production and connection of decentralised energy in the South West. However, Western Power Distribution (WPD)[15] has just published its plans to become a Distribution System Operator (DSO)[16]. The DSO transition document (2017) talks about Active Network Management which is being rolled out currently and which will have full availability across WPD networks by 2021.

2.4. Water

The water sector in the UK provides an essential service, fundamental to quality of life, health, environment and the economy. In the South West region, much of the population lives in small communities, in an area which is largely rural.

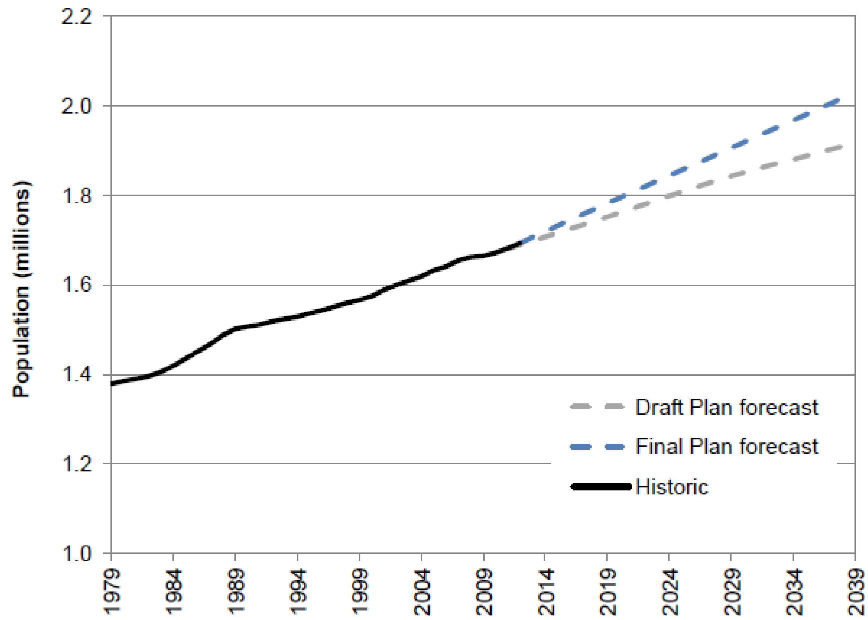
The water sector is facing significant challenges in relation to issues such as water scarcity, environmental water quality, resilience and affordability.

Demographic changes and societal trends are going to place increased pressure of water resources in the coming years. Increased pressure will come in the form of population growth, increasing demand for food production and increasing hydrological variability in a changing climate (Byers et al, 2014). The population of the UK is projected to have an annual growth rate of around 0.7% each year over the next decade, leading the UK to a projected population of around 75 million by 2040 (ONS, 2015).

In the South West, South West Water (SWW) are the water and sewerage company (WaSC) who supply the region (water only companies (WoCs) also exist across the country). SWW have forecasted growth in the resident population in the area they supply with water, shown in Figure 7 below.

Figure 7 Growth in the resident population in the area SWW supply with water

[15] https://www.westernpower.co.uk/docs/Innovation-and-Low-Carbon/Losses-strategy/WPD-Innovation-Strategy-2016_FINAL_v1.aspx (accessed 6 Nov 2017)
[16] https://www.westernpower.co.uk/docs/About-us/Our-business/Our-network/Strategic-network-investment/DSO-Strategy/DSO-Transition-Strategy.aspx (accessed 6 Nov 2017)



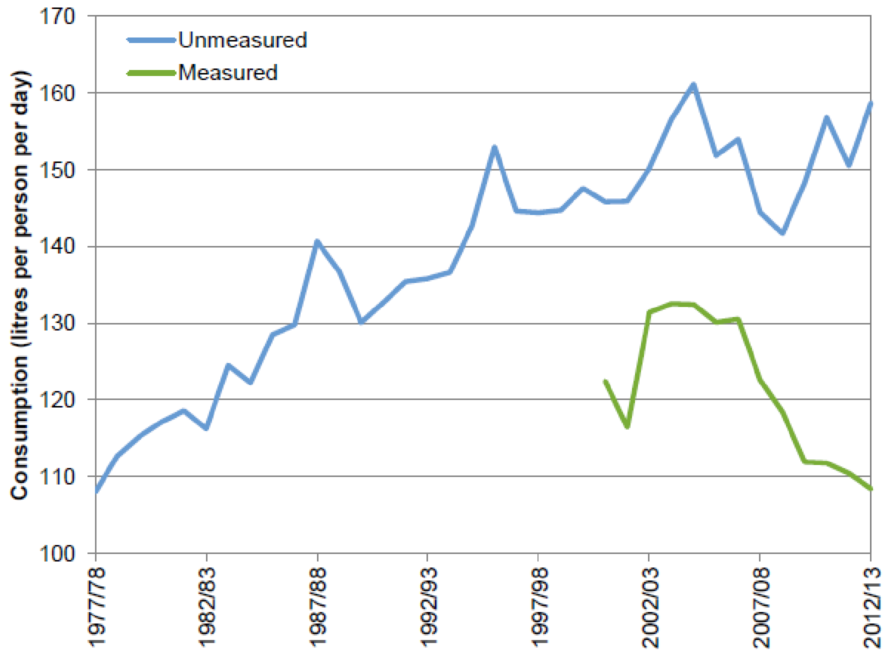
Source: SWW Water Resources Management Plan June 2014

Alongside this, the population is ageing and more and more people are living alone or in households with smaller occupancy. Nationally, the Average Household Size (AHS) has fallen from 3.1 per household in 1961 to 2.4 in 2012[17], a trend which is replicated in the South West. This leads to less efficient per-capita energy and water consumption.

In terms of what is happening within households, Per Capita Consumption (PCC) is the most widely used measure. Figure 8 below shows historic PCC for households under both measured and unmeasured water use. It related to water consumption in the area SWW serve with the measured data only beginning from the year 2000 as prior to this there were few household that paid according to the amount of water they used.

Figure 8 Historic PCC for measured and unmeasured households

17 https://www.southwestwater.co.uk/globalassets/documents/water_resources_management_plan_tables_june_2014.pdf (accessed 7 Nov 2017)



Source: SWW Water Resources Management Plan June 2014

South West Water has one of the highest levels of metering in the industry, with 75% of household customers and 92% of non-household customers paying by metered billing (SWW, 2014) and much higher than in the rest of the country. It has enabled SWW to more accurately forecast the future consumption from households and in doing so they believe that initially, the continued reduction in PCC will significantly exceed the additional demand from a rising population. This reduction is down to more unmeasured customers switching to metered billing and continued savings from metered properties. These will both slow over time and in the long term forecast there is likely to be an increase in demand.

The water industry in the UK is worth over £10 billion p.a. in the UK, with over £250 billion having been invested in water infrastructure of varying age and condition, and with a regulated water industry that spend about £8 billion per year on capital and operating costs.[18]

As explained in section 1.2, flooding is an issue in the South West, often leading to significant disruption to the region and its infrastructure. With the 2007 floods costing the UK approximately £3.5 billion and with flood events likely to become more frequent, UK infrastructure is at risk without a comprehensive plan for mitigating this risk.

2.5. Tourism

[18] https://www.theukwaterpartnership.org/wp-content/uploads/2015/10/UKWRIF-Summary.pdf (accessed 7 Nov 2017)

As already noted, tourism is interconnected with and interdependent on the water, energy and agriculture/land use nexus; its related socio-economic issues require further exploration.

Tourism has one of the largest effects on climate change (UNEP, 2008). Its activities have profound impacts on ecosystems (such as soil erosion, air and marine pollution, and natural habitat loss), on local infrastructure (such as roads, rail, airports), and in appropriating and expanding local services (such as resorts, restaurants, marinas, shops). The industry is recognized as a significant water, energy and food-consuming sector (Wang et al, 2017).

The South West's population is in constant flux given that it is a popular holiday destination and known for its natural and cultural heritage, which include two national parks, two world heritage sites, a biosphere reserve and countless sandy beaches. These assets are fueling the tourist economy, with 26.7m visitor nights/year.[19] Food, water and energy supplies in the South West must accommodate each one of these visitors alongside those required by local residents.

In 2001[20], tourists spent an estimated £4,535 million in the South West region and consumed 4,512 GWh of energy. Of the 16,000 tourist accommodation outlets, there was an estimated 120,000 tonnes of waste, of which:

- 32,620 tonnes was recycled (27%).
- 45% went to landfill.

Tourists travelled an estimated 9.8 billion kilometres to and from the region:

- 91% was by car, and 4% by train for domestic visitors,
- 76% was by air for overseas visitors.

Tourists consumed an estimated 26,109 million litres of water in all types of accommodation, an average of 394 litres of water per guest bed-night.

[19] http://www.naturaldevon.org.uk/wp-content/uploads/2013/01/Local-Environment-and-Economic-Development-toolkit-report-%E2%80%93-Heart-of-the-South-West-LEP-area-2014.pdf
(accessed 7 Nov 2017).

[20] http://www.steppingforward.org.uk/summ/tourism.htm (accessed 30 October 2017)

3 Mapping of stakeholders

A list of relevant stakeholders was drawn up based on expert judgement. Descriptions of 19 of these stakeholders were detailed, including their role, power and interest structures in the relevant policy sectors. These are clustered in types of organization (Table 6) and span: 1.) public bodies 2.) an independent inspectorate; 3.) business; 4.) trade union federation; 5.) CSOs and 6.) social enterprise partnerships.

Table 6 Selection of relevant stakeholders

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
Public body (water)	Ofwat https://www.ofwat.gov.uk/	Economic regulator of water sector in England and Wales. It is a non-ministerial govt dept. and an independent National Regulatory Authority, recognised by EU Directives. Formal power: Must act in accordance with the statutory strategic policy statements published by Defra and the Welsh Government. Informal power: Aims to deliver for societal needs, encourage strong working relationships along supply chain and speak and work with govt and regulators. Source of power: Duties laid down in sections 2 and 3 of the Water Industry Act 1991 (WIA91). Stakeholder interest: Works closely with: customers, customer representatives, depts. of UK and Welsh govts, local govts , regulators, financial orgs, legislators, water sector and other interest groups.
Public body (energy)	Ofgem https://www.ofgem.gov.uk/about-us	Ofgem is the Office of Gas and Electricity Markets. It is a non-ministerial government department and an independent National Regulatory Authority, recognised by EU Directives. Formal power: Determines strategy, sets policy priorities and makes decisions on a wide range of regulatory matters, including price controls and enforcement. Informal power: Principal objective is to protect the interests of existing and future electricity and gas consumers in a variety of ways including: promoting value for money promoting security of supply and sustainability, supervision and development of markets and competition

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		regulation and delivery of government schemes. Source of power: The Authority's powers are provided for under the following: Gas Act 1986 Electricity Act 1989 Utilities Act 2000 Competition Act 1998 Enterprise Act 2002 measures set out in a number of Energy Acts. Stakeholder Interest: Ofgem aims to work effectively with, but be independent of, government, the energy industry and other stakeholders within a legal framework determined by the UK government and the European Union
Public/Govt dept. (Agriculture and land use)	Department for Environment, Food and Rural Affairs (Defra)	Responsible for safeguarding the natural environment, supporting the food and farming industry, and sustaining a thriving rural economy. Formal power Responsible for policy and regulations on environmental, food and rural issues. Responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities. Informal power Priorities are to grow the rural economy, improve the environment and safeguard animal and plant health. Source of power Policies for environment, food and rural affairs are delivered in the regions by Defra's executive agencies and delivery bodies, in particular Natural England, the Rural Payments Agency, Animal Health and the Marine Management Organisation. Supported by 33 agencies and public bodies. Stakeholder interest: Purpose is to unleash the economic potential of food and farming, nature and the countryside, champion the environment and provide security against floods, animal and plant diseases and other hazards.
Public/ statutory advisor	Natural England	Statutory adviser to the Government on the Natural Environment. Formal power

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
(Agriculture and land use)		Established under the Natural Environment and Rural Communities Act 2006 (the NERC Act). Informal power To promote an integrated approach, creating a resilient ecological network across England. Source of power Administers the various agri-environment schemes on Defra's behalf and have statutory powers to administer its own schemes. Stakeholder interest: Provisions to enter into management agreements with those responsible for land to support statutory purpose in the delivery of environmental outcomes.
Public (Agriculture, land use and water)	Environment Agency	Established in 1996 under the Environment Act 1995. It is a non-departmental public body part-funded by DEFRA. Informal power To protect and enhance the environment of England; includes flood and coastal risk management; protection from flooding and pollution (including from agriculture). Source of power The Agency acts as an operating authority, a regulatory authority and a licensing authority. Stakeholder interest: Its regulatory, enforcement and licensing role is important for the nexus.
Public/Local authority (cross-sectoral)	Devon County Council	Administers the county of Devon, the largest local authority in SW England. Councillors are elected every 4 years and currently, conservative councillors hold the majority. The county council's area is also administered by eight smaller authorities that have their own district, borough or city councils. Formal power: Fulfill statutory duties. Responsibilities include schools, social care for the elderly and vulnerable, road maintenance, libraries and trading standards. Informal power: Works with partners to help people and communities control their own future. Source of power: Operates local government Cabinet. However, operating with 50% govt cuts means focus on new strategic

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		partnerships. Stakeholder interest: Statutory duties and community partnerships span the nexus.
Public/ local authority (cross-sectoral)	Cornwall Council	The unitary authority for the county of Cornwall. 123 Councillors form full Council. Formal power: Cornwall Council's decision making process is underpinned by a framework of policies, strategies and plans that are collectively referred to as the Policy Framework. Informal power: Responsibilities include: care for the elderly, children's safeguarding, libraries, road maintenance, fire and rescue service, recycling, parks, street cleaning, countryside management, social housing, town planning, tourism support and trading standards. Source of power: The Policy Framework consists of statutory documents that have to be adopted or approved by the Council as well as locally determined policies and strategies that form an integral part of the decision making process. Stakeholder interest: The main aim of strategy is to create a sustainable Cornwall. This means a prosperous Cornwall that is resilient and resourceful. A place where communities are strong and where the most vulnerable are protected.
Public/ local authority (cross-sectoral)	Exeter City Council	Exeter City Council is the council and local government of the city of Exeter, Devon. Formal power: Provides a range of services within the city including housing, refuse collections and recycling, planning, economic development, tourism, leisure and arts facilities and activities. The Council also provides housing and council tax benefits as well as collecting the council tax on behalf of the city council, county council, police and fire services. Informal power: Recognises that community and voluntary groups have an important role to play in helping shape and deliver services in new ways. Source of power:

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		Exeter City Council is responsible for ensuring that its business is conducted in accordance with the law and proper standards, and that public money is safeguarded and properly accounted for, and used economically, efficiently and effectively. The Council also has a duty under the Local Government Act 1999 to make arrangements to secure continuous improvement in the way in which its functions are exercised, having regard to a combination of economy, efficiency and effectiveness. Stakeholder interest: Provides support to the community and voluntary sector to achieve a range of positive outcomes for our communities through co-design and co-delivery.
Public / local authority (cross-sectoral)	Torbay Council	The unitary authority for the non-metropolitan county of Torbay, Devon. Formal power: Provides a range of local government services including Council Tax billing, libraries, social services, processing planning applications, waste collection and disposal, and is a local education authority. Derives its powers and functions from the Local Government Act 1972 and subsequent legislation. Informal power: Provides support to the community and voluntary sector to achieve a range of positive outcomes for communities. Stakeholder interest: Statutory duties and community partnerships span the nexus.
Independent inspectorate working on behalf of Govt. (Water)	Drinking Water Inspectorate http://www.dwi.gov.uk/about/what-we-do/index.htm	The Drinking Water Inspectorate (DWI) provides independent reassurance that water supplies in England and Wales are safe and drinking water quality is acceptable to consumers. Formal power: Chief Inspector of Drinking Water is appointed by the Secretary of State for Environment, Food and Rural Affairs and Welsh Ministers and acts independently on behalf of these authorities. Informal power: Provides information and advice to consumers on the quality of drinking water. Source of power:

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		The legislation is set out in the Water Industry Act 1991 as amended by the Water Act 2003. Enforcement Policy (EP) is in accordance with the Regulators' Compliance Code and the regulatory principles required under the Legislative and Regulatory Reform Act 2006. Stakeholder interest: Works with water and other regulators. Produces guidance notes for regulations and procedures and codes of practice that the water industry must adhere to.
Public (Water)	UK Water Industry Research (UKWIR)	Water industry research institute. Formal power: Set up by the UK water industry in 1993 to provide a framework for the procurement of a common research programme for UK water operators. UKWIR's members comprise 20 water and sewerage organisations in England, Wales, Scotland, Northern Ireland and the Republic of Ireland. Objectives include to: Identify research requirements to meet the water industry's strategic business needs; Procure research competitively; Work with the water industry's regulators; Provide value for money for members; Transfer research outputs to members. Informal power: Collaborates with government departments and regulators including the Department for Environment, Food and Rural Affairs; the Drinking Water Inspectorate, the Environment Agency and research organisations internationally. Stakeholder interest: Research topics important for nexus including: climate change; drinking water quality & health; environmental quality; regulation; sewerage; sludge & waste management; toxicology; wastewater treatment; water mains & services & leakage and water resources.
Private (Energy)	DNO/DSO Western Power Distribution	Western Power Distribution is the company responsible for electricity distribution in the Midlands, South West and Wales. Formal power Aims to transition from Distribution Network Operator

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		(DNO) to deliver as a Distribution System Operator (DSO) with operational responsibility for the whole of its distribution network. Informal power Looking to maximise the use of smart meter data, apply additional network sensing as required and implement simple control schemes Source of power Regulated by Ofgem. Stakeholder interest: Flexibility is a major priority. WPD says: 'Recent changes in the composition of the UKs generation fleet and future uncertainties in low carbon technology deployment mean that there is an increasing impetus for network operators to adapt in order to develop and maintain networks of the future.'21
Private (energy)	Centrica	British multinational energy and services company operating in the UK, Ireland and North America (25 million customers overall). Largest supplier of gas to domestic customers in the UK and one of the largest suppliers of electricity (operates under the trading names Scottish Gas in Scotland and British Gas in England and Wales and owns Bord Gáis Energy in Ireland). Formal power: Centrica formed out of split of British Gas in 1997. British Gas originally established after gas boards merged and privatised as British Gas plc under the Gas Act 1986. Informal power: Regulated by Ofgem. Stakeholder interest: Provides smart home technologies. Interests in nuclear energy generation - purchased 20% stake in nuclear power generator British Energy from EDF Energy (2009). Now produces 14.3% of its electricity from nuclear (the second highest rate in the UK).
Private (water)	South West Water https://www.southwestwater.co.uk/	Provides drinking water and waste water services to 1.7 million customers and 8 million annual visitors throughout Cornwall and Devon and in small areas of Dorset and Somerset. South West Water was created in 1989 with the

[21] https://www.ofgem.gov.uk/ofgem-publications/113391 (accessed 30 October 2017)

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		privatisation of the water industry. Part of the Pennon Group Plc. Formal power: Originally formed by the Water Act 1973. Informal power: Codes of practice set out legal obligations and responsibilities as well as customers' rights and responsibilities. Sources of power: Closely regulated by Ofwat, the Water Services Regulation Authority, being required to conform to stringent United Kingdom and European Union standards. Stakeholder interest: Business Plan for 2015-2020 sets out 8 outcomes which reflect the things that matter most to customers and the environment.
Trade Union Federation (agriculture and land use)	National Farmers Union	Largest organisation in England and Wales representing farmers and growers. Formal power: The NFU is governed by its Constitution and Rules. Under these, the NFU maintains a number of bodies which are responsible for the Governance of the NFU. Informal power: Works to protect and enhance the economic well-being and quality of life for family farmers, fishers, ranchers and rural communities through the advocacy of policy positions developed by the grassroots membership and adopted as official policy at national convention. Sources of power: Membership (55,000) who adopt official policy. Stakeholder interest: Purpose is to champion British agriculture and horticulture, to campaign for a stable and sustainable future for British farmers and to secure the best possible deal for its members.
CSO/ Charities (agriculture and land use)	Devon and Cornwall Wildlife Trusts	Each is part of a network of 47 wildlife trusts inspiring people to protect wildlife and wild places. More than 800,000 members, 40,000 volunteers, 2,000 staff and 600 trustees. Formal power: Each Trust is an independent charity, with independent

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		finances, governance and structure. Informal power: Federated structure offers a strong collective voice when required. Source of power: Federated structure means national voice and local needs are equally important. Stakeholder interest: People-focussed in way deliver work – working with local people to improve the local environment and quality of life.
CSO/ charity (water)	Westcountry Rivers Trust	The Westcountry Rivers Trust is a waterway society and registered charity. Formal power: The Trust aims to protect and enhance the West Country's rivers and streams, and to work with the region's landowners, farmers and the wider community, mainly through education projects. Informal power: Alongside partners from Devon Wildlife Trust, Cornwall Wildlife Trust & Exmoor National Park Authority, the Westcountry Rivers Trust is currently delivering the second phase of the South West Water-funded Upstream Thinking project. Source of power: Trust works with landowners to reduce or mitigate the pressures on the river system across 5 important river catchments in the Westcountry: the Fowey, Tamar, Exe, Dart and Otter. Stakeholder interest: The Upstream Thinking project aims to improve the quality of water in the rivers, which are the primary source of drinking water in the South West, and so reduce the need for costly and resource-intensive treatment processes at the water treatment works.
CSO (agriculture/ food)	Exeter Food Network	Exeter Food Network (EFN) was set up in 2014 as a forum which brings together almost 20 organisations in and around the city concerned with food. These include anti-food poverty groups, educational initiatives, faith communities, food sustainability work and neighbourhood growing schemes as well as emergency food providers. Formal power:

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		Approach involves developing a cross-sector partnership of local public agencies, businesses and NGOs committed to working together to make healthy and sustainable food a defining characteristic of where they live. Informal power: The Exeter Food Network brings together partners who have signed up to work towards priorities of Sustainable Food Cities Network Source of power: Food Strategy for Exeter - Food Exeter 2017[22] Stakeholder interest: Promoting healthy and sustainable food to the public; Tackling food poverty, diet-related ill health and access to affordable healthy food; Building community food knowledge, skills, resources and projects; Promoting a vibrant and diverse sustainable food economy. Transforming catering and food procurement; Reducing waste and the ecological footprint of the food system.
CSO/ NGO (energy)	RegenSW	Independent not for profit organization that works with industry, communities and the public sector to revolutionise the way we generate, supply and use energy. Formal power: Bring Pioneers, Experts and Convenors together to drive radical change in energy system. Informal power: Understand the technology, finance and public policies needed to make sustainable energy work. Source of Power: Need entrepreneurial businesses who are forming partnerships and driving innovation; finance providers looking for new opportunities and regulators and utilities backing innovation. We also need the engagement and support of the local people and communities who rely on energy in every aspect of their lives. Stakeholder interest: Believes that sustainable energy has a vital role at the heart of a successful economy and thriving local communities.

[22] http://geography.exeter.ac.uk/documents/Food_Exeter_Strategy_2017-Cultivating_Food_leaflet.pdf (accessed 30 October 2017)

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
CSO/ Co-op (energy)	Exeter Community Energy	Social enterprise that enables local people to take ownership of renewable energy projects. Formal power: Community-owned co-op Informal power: The more involved and active our members are, the more community ownership comes alive. Source of power: Investment from membership Stakeholder interest: Community energy projects are making a difference across the country, strengthening communities, helping the local economy and reconnecting people to the energy they use, as they became producers as well as consumers.
Social enterprise Partnership (agriculture/ food)	Cornwall Food Foundation	Inspire people in Cornwall through food and enable those in greatest need to achieve meaningful change. Formal power: Inspire people in Cornwall through food and enable those in greatest need to achieve meaningful change. Informal power: Projects involving vocational training opportunities and engaging communities through food-related activities focusing on health, education and employment. Source of power: Offers training, employment and better life opportunities, while adding real value to the local economy Stakeholder interest: Food for Change - £1.3 million programme to be part funded by European Social Fund. Will build four local food partnerships in Redruth, Truro, St Austell and Newquay. These partnerships will enable people who use foodbanks, mental health services and community centres to get more involved in the Cornish economy.23
Social enterprise Partnership (energy)	Cornwall New Energy Project	Provide small and medium enterprises (SMEs) in Cornwall and the Isles of Scilly with business support to improve their economic and environmental performance. Formal power:

[23] http://www.cornwallfoodfoundation.org/food-for-change/ (accessed 30 October 2017).

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		Provides expertise and funding support. The team can provide carbon and energy-related consultancy and other support to organisations. Informal power: Building small businesses to deliver better energy solutions Source of power: Co-financed by the European Regional Development Fund Stakeholder interest: The project's key objectives are to: Provide greater energy security in Cornwall and the Isles of Scilly Reduce operating costs and improve an SME's overall financial performance Enable new energy products and services to be brought to market
NGO/CSO (food/land/agriculture)	LEAF (Linking Environment and Farming)	Promotes sustainable food and farming; aims to enrich the environment and engage with local communities. Formal power: Disseminates knowledge and advice. Operates farm assurance system (LEAF marque). Stakeholder interest: Main objectives: Facilitating knowledge generation and exchange; Developing market opportunities through LEAF Marque; Engaging the public in sustainable food and farming.
NGO/CSO	Sustainable Food Systems Planning	Offers independent support to develop sustainable food system solutions from community level activity through to policy, focusing primarily on cities. Formal power: Disseminates research, knowledge and advice. Informal power: Partnerships with / previous work for key institutes (CCRI, Bristol Food Policy Council), RUAF, Soil Association etc. Stakeholder interest: Objectives / previous work includes: organic horticultural production and box schemes; direct producer/consumer links; marketing models; public sector food procurement; social enterprise approaches for local food networks; city region food system assessment and development;

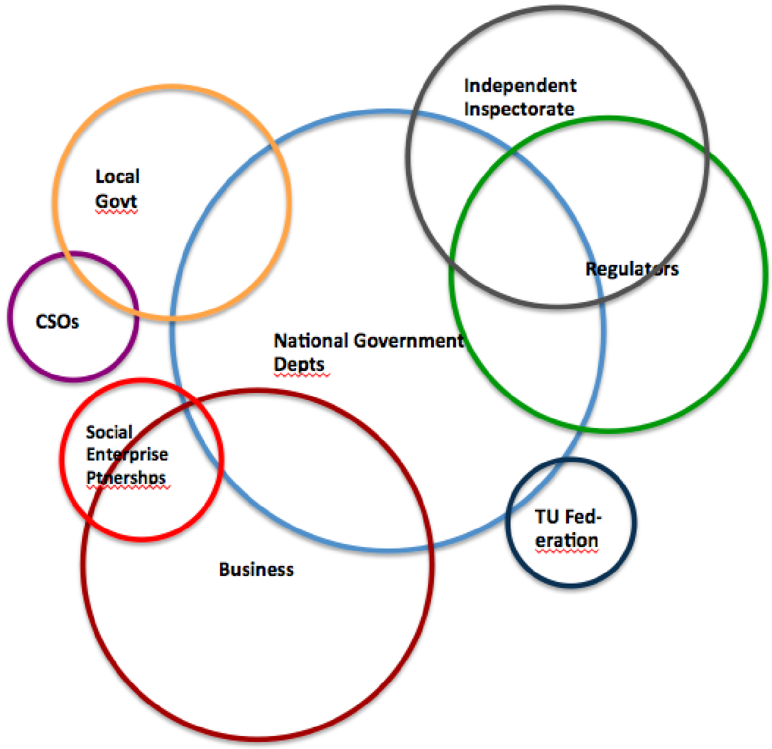
Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		strategic national programmes designed to change food culture and influence government policy.
Association /NGO (of businesses / public sector organisations) (Land - tourism)	South West Tourism Alliance	Formal power: Represents over 100 tourism industry groups in the region and supports a range of business and public sector organisations. Informal power: Disseminates knowledge, information and advice and provides support (across large and small businesses). Runs annual tourism awards promoting best practice in the industry and lobbies government. Stakeholder interest: Brings together land, water and business interests; joined-up policy making across nexus crucial to operation of tourism industry.
NGO/CSO (Association) (Land/agriculture)	Tenant Farmers' Association	Association formed in 1981. Formal power: Represents the interests of tenant farmers in England. Informal power: Provides advice, information and support to its members and lobbies government. Works with 70 Chartered Surveyors, accountants and solicitors selected by the regional committees, who help in solving members' problems and contribute to national strategy. Stakeholder interest: Represents key section of agricultural management workforce that would otherwise be under-represented.
Research (water, energy, land/agriculture, food)	University of Exeter	Centre for Water Systems is the research lead for SIM4NEXUS UK South West case study and the Energy Policy Group also a key partner. Academics in other departments (e.g. Geography, Politics) working on range of water, energy, agriculture, land and climate policy issues. Formal power: UK Higher Education and research institution. Informal power: Formal and informal partnerships with key organisations in public, business and NGO sectors. Regularly commissioned to do research for Defra etc. Stakeholder interest: Key HE institutional presence in both Devon and Cornwall.

Type of stakeholder	Name of stakeholder	Description of role, power and stake in the issues investigated by the case study
		Research interests in energy policy especially renewables in the South West and community energy; food and agriculture policy; climate change adaptation and mitigation.
Research	University of Gloucester CCRI (Countryside and Community Research Institute)	Specialist rural research centre – focus on sustainability and innovation. Formal power: UK Higher Education and research institution. Informal power: Formal and informal partnerships with key organisations in public, business and NGO sectors. Stakeholder interest: Research interests in range of food and agriculture policy and practice.

The stakeholder list includes eleven public bodies overall including regulators (3); local authorities (4), a government department (1), a government research institute (1) and two government agencies (2). There is one independent inspectorate (water). Business is represented by two private energy companies (Western Power Distribution and Centrica) and a private water company (South West Water). There is one trade union federation that represents farm and agricultural workers. Nine examples of CSOs (Community Supported Organisations) / NGOs (non-governmental organisations) / Associations span the sectors under consideration and also represent a range of formal and informal structures. Two research / higher education organisations are represented. Finally, three social enterprise partnerships are detailed that focus on local projects that build SME capabilities.

The resource capabilities within this snapshot of relevant stakeholders demonstrate a range of power structures. To illustrate these relative power dynamics – size, influence, role and relationships - the actor groups were mapped using colour coded circles (Figure 9).

Figure 9 Map of relevant stakeholder groups and their relations



The size of the circles indicates the size of stakeholder groups included, different colours represent different groups, and the distance/overlap between circles indicates the relationship between the groups in this study.

In addition, using this analysis, the power and influence of each stakeholder was scored across each of the nexus sectors included in the SW case study research i.e. Water, Energy, Agriculture and Food, and Land-use. Figure 10 to Figure 13 map these assessments.

Figure 10 Power/interest of organizations on water issues

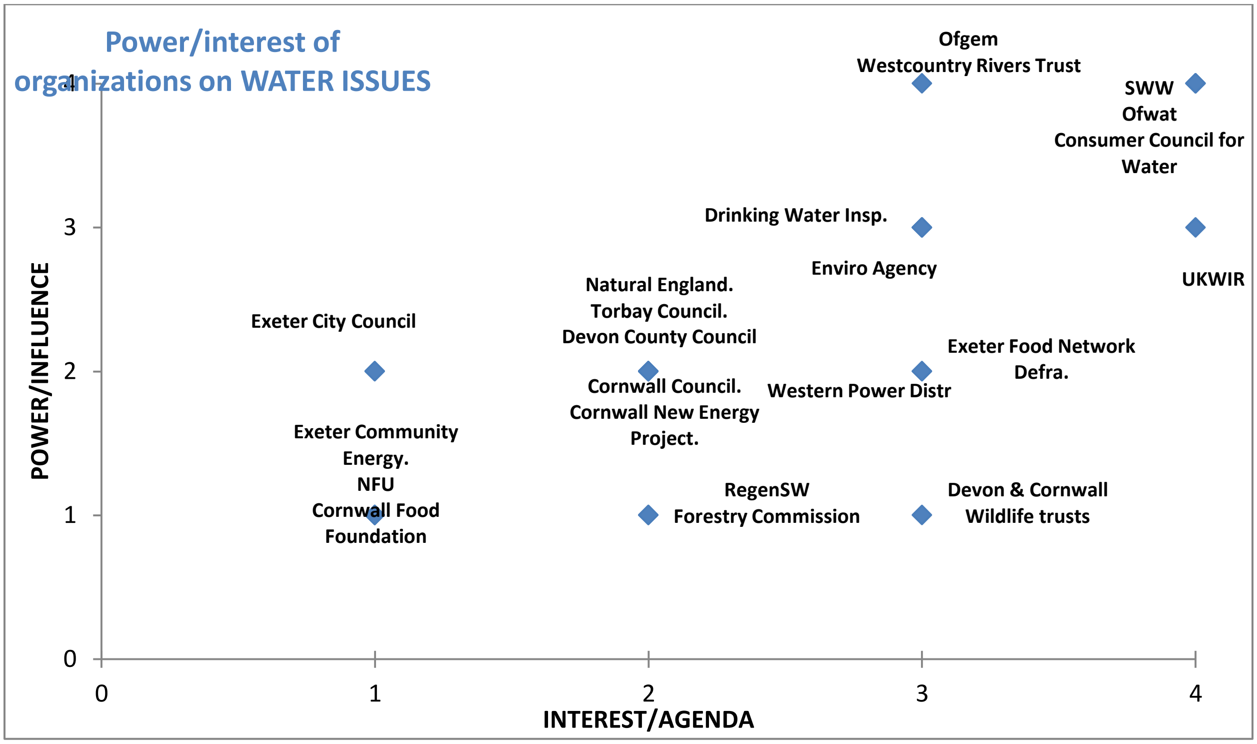


Figure 11 Power/interest of organizations on Energy Issues

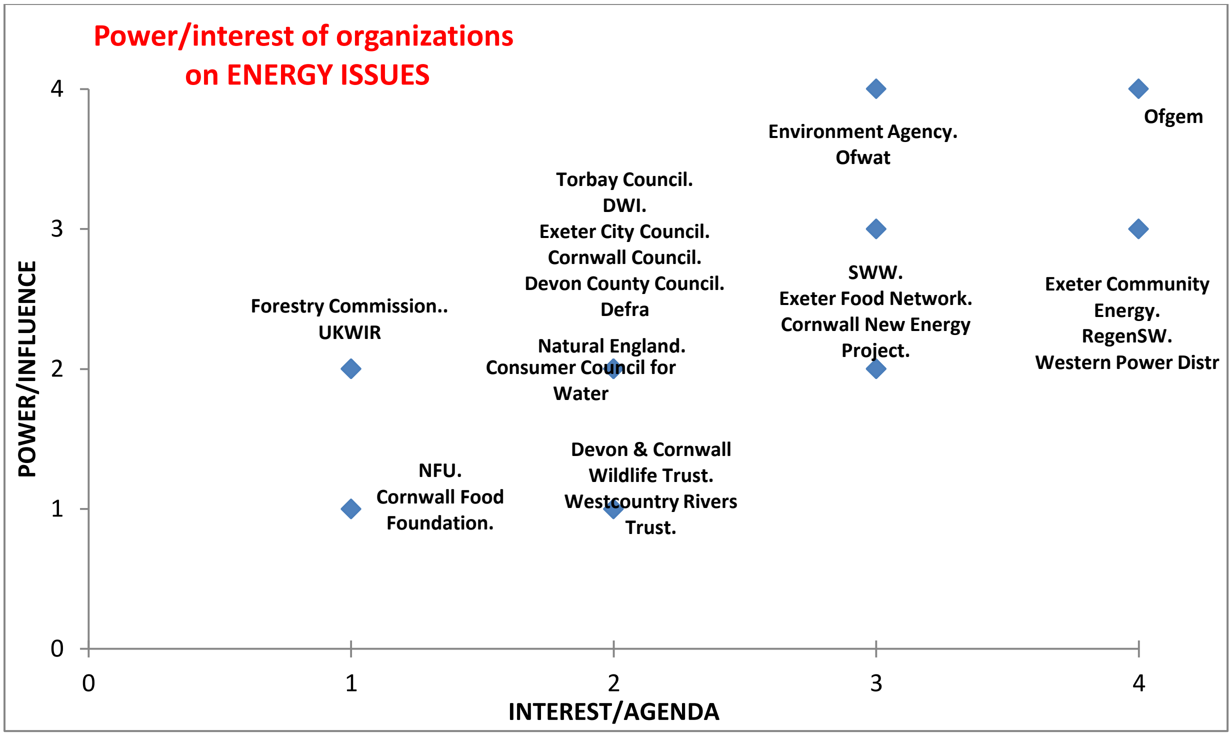


Figure 12 Power/interest of organizations on agriculture and food issues

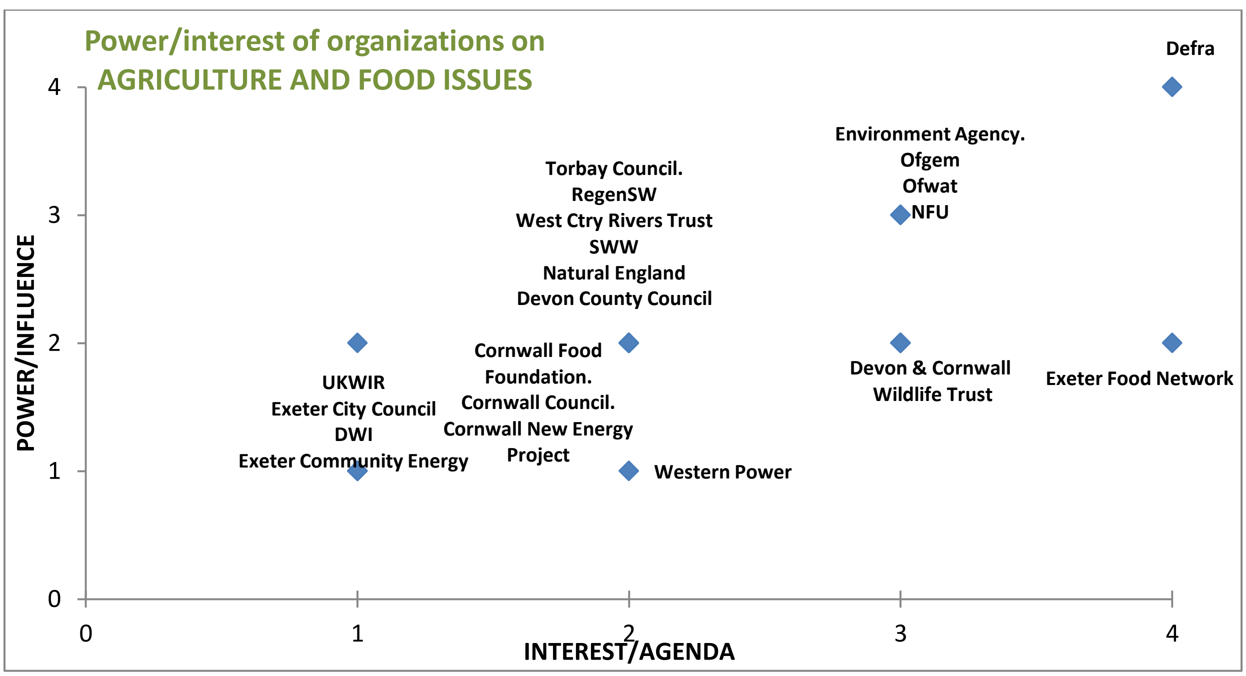
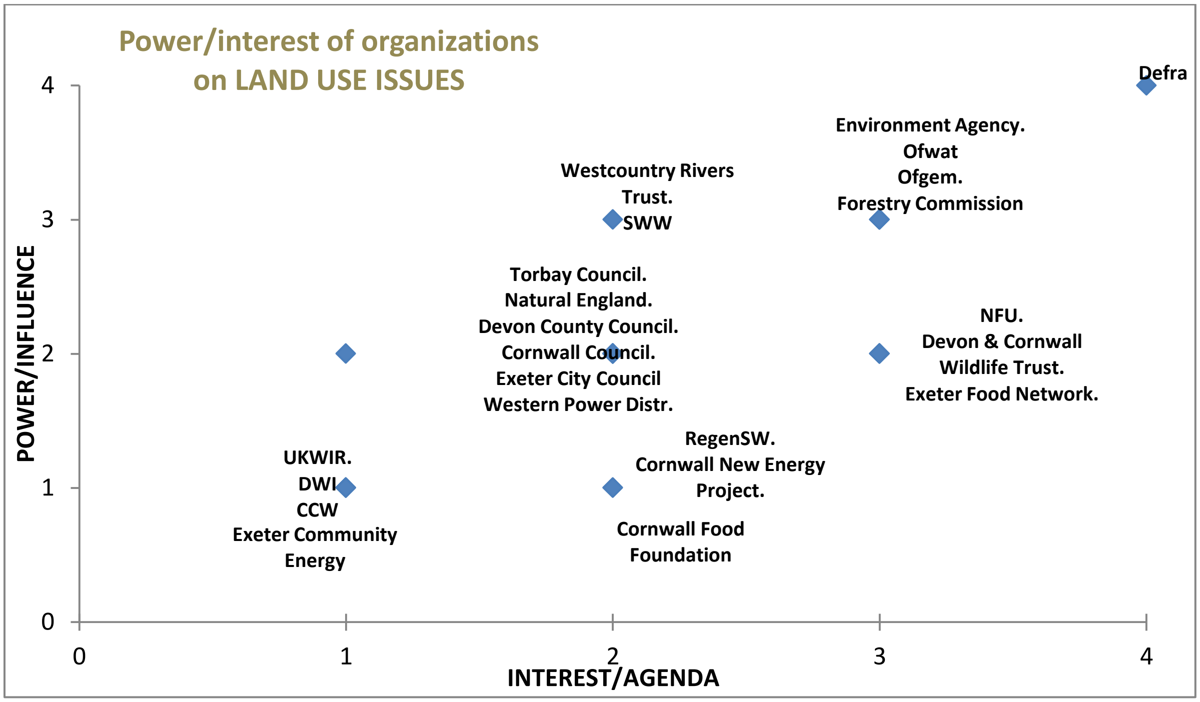


Figure 13 Power/Interest of organization on Land Issues



Key stakeholders with high power (strong to very strong) and high interest (strong to very strong) were identified for each sector based on the power-interest grids. Six stakeholders played a major role in more than two sectors; Ofwat, Ofgem, SWW, Environment Agency, Forestry Commission and DEFRA.

4 Mapping of policy goals and instruments

4.1. Inventory of policy documents

Key policy documents are detailed in Table 7 along with a short description of the document content and the planned lifespan of the policy.

Table 7 Key Policy Documents

Type of document	Title of document	Short description of document content	Life span of policy
Water			
National strategy	The government's strategic priorities and objectives for Ofwat	A discussion of priorities that the government wishes to set for Ofwat, the water regulator.	Out for consultation as of 2017
Strategic policy statement	Defra's strategic policy statement to Ofwat: Incorporating social and environmental guidance	This is the comprehensive strategy for Ofwat the water regulator.	May 2013-present
Act	Water Act 2014	The act sets out how to increase competition in the water market and liberalise the water regime by opening the wholesale and retail water markets. As of April 2017 it is possible for organisations to choose which company supplies their water retail services.	2014-present
Policy Paper	South West river basin district - River Basin Management Plan (RBBMP) (Water for life and livelihoods) 2015	sets out how organizations are minded to act to improve the water environment supporting the government's framework for the 25-year environment plan. Further the RMMP likes with the UK's implementation of Marine strategy framework	2015-present
Regulations on water quality	The Water Supply (Water Quality) Regulations 2016	Govern public water supplies in England and Wales	2016 - present
Regulation on water supplies	The Private Water Supplies (England) Regulations 2016	Govern private water supplies in England and Wales	2016 - present
White paper	Water for life	To address issues of water stress, the quality of water ecosystems and the increasing pressure from the effects of climate change and a growing population.	2011 - present

Type of document	Title of document	Short description of document content	Life span of policy
EU directives in the UK regulatory framework	EU Water Framework Directives: includes Urban Water Directive, Water Framework Directive, Bathing Water Directive and Drinking Water Directive.	To keep European waters clean	2000 - present
EU Directive	Drinking Water Directive24	Proposal for a revised Drinking Water Directive to improve the quality of drinking water and provide greater access and information to citizens.	2018-
Agriculture, food and land use			
Bill (to be published autumn 2018)	Environmental Principles and Governance Bill25	Proposals to ensure environmental protections will not be weakened as UK leaves the EU. Includes consultation on new body that would provide scrutiny and advice for protection and enhancement of landscapes, wildlife and natural assets and would be able to hold government to account on environmental legislation.	2018-
Plan	A Green Future: our 25 year plan to improve the environment26	Sets out how new environmental land management system based on providing public money for public goods (such as habitat enhancement) is proposed to replace current direct payments to farmers in England.	2017
Consultation document	Health and Harmony: The Future, for food, farming and the environment in a Green Brexit27	Consults on post-CAP domestic settlement for agriculture - agricultural support scheme that encourages farmers to protect the environment and invest in new technology to improve productivity.	Launched Feb 2018

[24] http://ec.europa.eu/environment/water/water-drink/review_en.html (accessed 14 May 2018)
[25] https://www.gov.uk/government/news/new-environment-law-to-deliver-a-green-brexit (accessed 14 May 2018)
[26] https://www.gov.uk/government/publications/25-year-environment-plan (accessed 5 March 2018)
[27] https://www.gov.uk/government/consultations/the-future-for-food-farming-and-the-environment (accessed 5 March 2018)

Type of document	Title of document	Short description of document content	Life span of policy
Bill	Agriculture Bill	Consultation doc. acts as a pre-cursor to the Agriculture Bill (expected in this session) which will set out post-Brexit support arrangements for farmers. (Fisheries Bill to follow)	2018
Policy	Common Agricultural Policy (CAP) reform	Continues the previous trajectory of reform that began with a move from product to producer support within the EU, and now moves to a more land-based approach, including the new 'greening payment'. CAP includes Pillar 1 – single farm payments based on land area (involves cross-compliance conditions for management and soil condition, etc); and Pillar 2 – range of agri-environment and stewardship schemes – must be applied for separately.	2013 - 2020
Policy	EU Rural Development Policy for England 2014-2020: Protecting farmland through environmental land management, targeted to specific biodiversity and water objectives.	Builds effective rural development and rural economic growth. Implemented at national level. 28	2014- 2020
Act	Natural Environment and Rural Communities Act (the NERC Act)	Broad remit to protect the environment and biodiversity while also promoting the needs of rural communities.	2006 (under review)
Act	Protection of water against nitrate pollution (England and Wales) Regulations	Provide for the protection of waters against pollution caused by nitrates from agricultural sources.	1996
Act	The Sludge (use in agriculture) Regulations	Act sets out the rules for using sludge to on agricultural land.	1989
Code of Practice	Sewage Sludge on Farmland: code of practice for England, Wales and Northern Ireland	Guidance to help those who need to follow the regulations on producing, supplying and using sewage sludge on farmland.	Updated June 2017
Act	The Plant Protection Products (Sustainable Use) Regulations	UK legislation governing the use of pesticides.	2012
Stewardship	Countryside and	Offers payments to farmers and other	2006-

[28] http://ec.europa.eu/agriculture/rural-development-2014-2020/index_en.htm

Type of document	Title of document	Short description of document content	Life span of policy
schemes	Environmental Stewardship Schemes	land managers in England for undertaking land management practices, beyond minimal regulatory compliance, to protect and enhance the environment and wildlife.	
Act	Energy Crops Regulation29	Encourage the development of the energy crops sector in the interests of increasing energy production from renewable sources and contributing to the fulfilment of international commitments. The Regulations enable assistance to be paid for projects under the RDP.	2000-
EU Directives in UK regulatory framework	Includes: Birds and Habitats Directives; Integrated Pollution Prevention and Control Directive and the Waste Framework Directive; Framework Directive on the Sustainable Use of Pesticides.	Play an important role in supporting and maintaining biodiversity and environmental conditions in UK.	1992-
Policy	Neonicotinoid pesticide restrictions	Further restrictions on neonicotinoid pesticides have been approved following a vote in the European Commission.	2018
Energy			
National UK energy strategy	UK Energy Policy set on 'smart and flexible path' - set out in Clean Growth Strategy (2017)30 which fits into the UK's Industrial Strategy (2017)31 and	UK energy policy set on 'smart and flexible path'.	2017

[29] http://www.legislation.gov.uk/uksi/2000/3042/made (accessed 14 May 2018)

[30] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/651916/BEIS_The_Clean_Growth_online_12.10.17.pdf (accessed 5 March 2018)

[31] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/664572/industrial-strategy-white-paper-print-ready-version.pdf (accessed 5 March 2018)

Type of document	Title of document	Short description of document content	Life span of policy
	Ofgem's Upgrading our Energy Systems (2017)32.		
Act	Climate Change Act	to reduce GHG by 80% from 1990 level	2008
Policy Paper	The UK Low Carbon Transition Plan National strategy for climate and energy	Sets out how the government intend to implement the carbon reductions specified in the climate change act	2009
EU Directive	Renewable energy directive	Sets out the national renewable energy targets for the UK.	2009 – 2020
Report to Parliament	Meeting Carbon Budgets: Closing the policy gap	Committee on Climate Change's ninth annual assessment of UK progress in reducing emissions and meeting carbon budgets.	2017
National renewable energy action plan	UK national renewable energy action plan.	Targets—to source 15% of all energy and 10% of transport fuels from renewables by 2020.	2010- (under review)
Obligations order	The Renewable Transport Fuel Obligations Order 2007	The document sets out how the UK will go about ensuring that a percentage of fuel supplied to vehicles will be from renewable sources	2007- present (currently under consultation)
Subsidy	The Renewable Heat Incentive (RHI)	Key policy to meet the 2020 targets in heat and transport.	2011 - currently under consultation for revision
EU Directive	EU Energy Efficiency Directive (2012/27/EU)	The Energy Saving Opportunity Scheme (ESOS) implemented in UK law, attempts to enhance energy management by obligating organisations to conduct energy audits and identify efficiency saving opportunities.	2014-
Act	Energy Act 2008	'to establish a scheme to facilitate and encourage renewable generation of heat'	2008 – 2013
Act	Energy Act 2013	The Energy Act of 2013 was mainly focused on setting targets for the decarbonisation of the UK energy	2013 -

[32] https://www.ofgem.gov.uk/system/files/docs/2017/07/upgrading_our_energy_system_-_smart_systems_and_flexibility_plan.pdf (accessed 5 March 2018)

Type of document	Title of document	Short description of document content	Life span of policy
		system alongside setting out guidance for reforming the UK electricity market. Introduced a framework for electricity market reform, including Contracts for Difference as a mechanism for incentivising particular generation technologies and the opening of the Capacity Market.	

4.2. Inventory of objectives of each sector

Table 8 Policy Objectives for each sector

Water		
Overarching objectives	Specific objectives	Reference documents
The main aims of the Water Act 2014 are to increase competition and liberalise the water regime	Specifically the act aimed to introduce more competition in the sector by encouraging new entrants to offer alternative water sources and innovative ways of treating sewerage. As of April 2017 it is possible for	UK Water Act 2014
To maintain water infrastructure and manage water resources effectively. To develop a resilient and customer focused water industry.	To encourage more efficient use of water, promoting the use and benefits of Sustainable Drainage Systems and ensuring that the regulatory process provides for a longer term view.	Water for life. Defra Dec 2011
To meet the challenges for water and waste water services in 2020.	Promoting discussion on future regulatory framework	Towards Water 2020 – meeting the challenges for water and wastewater services in England and Wales. Ofwat 2015
To set out a framework for planning decisions on large-scale waste water infrastructure.	Sustainable development, Public health and environmental improvement, To improve water quality in the natural environment To reduce water consumption	National Policy Statement for Waste Water. Defra 2012

	To reduce demand for waste water infrastructure capacity Climate change mitigation and adaptation	
To increase the UK's capacity to respond to civil emergencies	To manage responses to the issues of severe flooding arising from river, ground water and coastal regions.	Preparation and planning for emergencies: the National Resilience Capabilities Programme. Cabinet office 2013
Overarching objectives	Specific objectives	Reference documents
To ensure that the Water Act makes a strong contribution to building greater resilience into water resources	Sets out proposal to amend 'general duties' of both Ofwat and Defra. Clarifying the role of the regulatory framework in securing long-term resilience.	Updating the general duties with respect to the water industry to reflect the UK Government's resilience priorities. Defra 2013
To highlight the value of an integrated approach to water resource management that enhances the quality of the aquatic environment.	Delivering a better quality water environment, encouraging collaborative work and transparent decision-making, encouraging sustainable fund management,	Catchment Based Approach: Improving the quality of our water environment. Defra 2013
To highlight the legal obligation of water companies to develop and maintain long term water resource plans	Sets out framework: Ensure early engagement with regulators customers and interested parties, full public consultation of proposed plans, regular revision and review suitable timescales	Final Water Resources Planning Guidelines. EA 2016
To streamline and integrate Environmental Permitting Regulations.	Conversion of water abstraction licences into permits, under the EPR modification to permit volumes based on environmental risk different permitting levels applicable to water companies and other commercial organisations.	Water abstraction management reform in England: What would reform mean for abstractors? Defra 2016
To enhance existing policy framework to secure long-term resilience of water and wastewater services	Increased collaboration with water companies, required the water industry to develop a national water resources long-term planning framework with a 50 year time	Creating a great place for living; Enabling resilience in the water sector. Defra 2016

	horizon, support regional trading of water increased use of probabilistic analytics and resource modelling to inform the determination of service level, expectation that water companies will consider time horizons greater than the 25 year mandatory requirement, enhanced collaboration between neighboring water companies, collaboration between other sectors, enhancing natural resilience of the catchment, minimising leakage and maximising water efficiency development of wastewater plans similar to the 25 year water resource plan obligation	
To manage freshwater resources more appropriately to the increasing challenges of climate change and population growth.	Links permitted rate of abstraction to available raw water resource, twin track approach managing supply and demand, increased stakeholder collaboration and integration with land management.	Reform of Freshwater Abstraction. Houses of parliament 2017
To add to Ofwat's remit	added to OFWATs remit: "Primary duty to secure resilience" and "to further the resilience objective." Clause 22 and 22,2(e). to ensure that water companies secure long term resilience in their ability to supply primary services with regards environmental pressures, population growth and changes in consumer behavior; to promote appropriate long term planning, investment, and	Water Act 2014

	sustainable management of water resources, with a view to increased efficiency and demand reduction	

Energy policy		
Overarching objectives	Specific objectives	Reference documents
To ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline.	It is the duty of the Secretary of State to set for each succeeding period of five years beginning with the period 2008-2012 ("budgetary periods") an amount for the net UK carbon account (the "carbon budget"), and to ensure that the net UK carbon account for a budgetary period does not exceed the carbon budget.	Climate Change Act 2008
To ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline.	Committee on Climate Change's ninth annual assessment of UK progress in reducing emissions and meeting carbon budgets.	Report to Parliament Meeting Carbon Budgets: Closing the policy gap 2017[33]
To set energy policy on 'smart and flexible path'.	Issues that energy systems are facing, and plans for dealing with them and delivering a smart and flexible energy system.	Clean Growth Strategy 2017; GB Industrial Strategy 2017; Ofgem's Strategy for Future Energy Systems 2017; and Ofgem's Strategy for Future Energy Systems 2017[34]
To increase use of renewable sources	The UK is legally bound to provide for 15% of its energy needs—including 30% of its electricity, 12% of its heat, and 10% of its transport fuel—from renewable sources by 2020.	2020 Renewable heat and transport targets[35]
To reduce support for various renewable energy schemes	To reduce costs falling within the Levy Control Framework but	Solar farms: funding, planning and impacts

[33] https://www.theccc.org.uk/publication/2017-report-to-parliament-meeting-carbon-budgets-closing-the-policy-gap/ (accessed 5 March 2018)

[34] https://www.ofgem.gov.uk/system/files/docs/2017/08/our_strategy_for_regulating_the_future_energy_system.pdf (accessed 5 March 2018)

[35] https://publications.parliament.uk/pa/cm201617/cmselect/cmenergy/173/173.pdf (accessed 30 October 2017)

	curbing costs for schemes such as the renewables obligation and the feed-in tariff	
The Renewable Transport Fuel Obligation (RTFO) supports the government's policy on reducing greenhouse gas emissions from vehicles by encouraging the production of biofuels that don't damage the environment.	Under the RTFO suppliers of transport and non-road mobile machinery (NRMM) fuel in the UK must be able to show that a percentage of the fuel they supply comes from renewable and sustainable sources. Fuel suppliers who supply at least 450,000 litres of fuel a year are affected. This includes suppliers of biofuels as well as suppliers of fossil fuel.	RTFO Guidance Part One – Process guidance RTFO Year 10 15th April 2017 to 14th April 2018.
The 2009 Renewable Energy Directive set a target for the UK to achieve 15% of its energy consumption from renewable sources by 2020	The UK renewables policy framework was then made up of three key components: -financial support for renewables -unblocking barriers to delivery -developing emerging technologies.	Renewable Energy Directive 2009
Renewable Heat Incentive - The RHI was designed to help the UK meet its renewable energy targets	More specifically, the RHI was designed to drive a step change in the uptake of renewable heat technologies in order to help deliver an increase in renewable heat (from the 1.5% level of total heat technologies in 2008 to a level of 12% by 2020).	Domestic RHI – April 2014 Non-domestic RHI – November 2011
Electricity market reform – The EMR was designed to attract the £110 billion of investment needed to replace and upgrade the UK's electricity infrastructure	To incentivise investment in secure, low-carbon electricity, improve the security of GB's electricity supply and improve affordability for consumers	Energy Act 2013

Agriculture, food/ land use policy		
Overarching objectives	Specific objectives	Reference documents
Improved management of natural resources and the increased adoption of farming practices that are climate	Protecting farmland through environmental land management, targeted to specific biodiversity and water	Rural Development programme for England 2014 -2020.

friendly.	objectives.	
To address potential implications for the natural environment post-Brexit	This includes the withdrawal from the CAP	House of Commons Environmental Audit Committee on the Future of the natural environment after the EU referendum (UK Parliament, 2016). Health and Harmony: The Future, for food, farming and the environment in a Green Brexit[36] A Green Future: our 25 year plan to improve the environment[37]
To promote an integrated approach to the agri-environment	To create resilient landscapes and seas, put people at the heart of the environment, and grow natural capital.	Natural England 2016. Conservation 21: Natural England's conservation strategy for the 21st century. NE642.
Agri-technology strategy	In partnership with industry, to improve the flow of ideas and solutions from the laboratory to the farm,	UK Strategy for Agricultural Technologies. HMSO 2013. And Feeding the Future: Innovation requirements for Primary Food Production in the UK to 2030. Joint Commissioning Group, 2017.
Policy change post-Brexit must align to enable sustainable and more strategic use of land.	Connect to broader issues - like public health, technology, migration and the shape of our future economy. Policy is important, but not only driver of change. Need to recognize not simply about changing regulations or government subsidies.	Food and Farming Commission: Growing a mandate for change. 2017.
To ensure that food safety is given priority when pesticides are authorised.	the use of pesticides in the production of food as long as: • regulatory bodies follow a precautionary approach when approving the use of pesticides • independent scientific advice says that the safety of pesticides is	Food Standards Agency website: https://www.food.gov.uk/business-industry/farmingfood/pesticides Neonicotinoid pesticide restrictions 2018.

[36] https://www.gov.uk/government/consultations/the-future-for-food-farming-and-the-environment (accessed 5 March 2018)
[37] https://www.gov.uk/government/publications/25-year-environment-plan (accessed 5 March 2018)

	within acceptable limits • acceptable levels can be set for residues in food • enough good-quality information is available to the regulatory bodies on which to base these decisions	

4.3. Inventory of instruments of each relevant policy sector

Table 9 Policy Instruments for each sector

Energy Policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Subsidy reduction	Declining tariff rates for solar – currently standing as 4.14 p/kwh for solar PV under 10 kW and 4.36p/kWh for solar between 10-50kW, with an export tariff of 5.03 p/kWh for all installations with an eligibility date on or before 31 March 2018. The UK Government has also limited the Common Agricultural Policy (CAP) funding to solar farms on agricultural land to bring down spending and to reduce energy bills for consumers, as well as freeing up agricultural land for farming.	Solar farms: funding, planning and impacts
Obligation	Obligated suppliers may meet their obligation by redeeming Renewable Transport Fuel Certificates (RTFCs) or by paying a fixed sum for each litre of fuel for which they wish to 'buy-out' of their obligation. RTFCs are gained by supplying sustainable renewable fuels.	RTFO Guidance Part One – Process guidance RTFO Year 10 15th April 2017 to 14th April 2018.

Carbon budgeting	The Committee on Climate Change and the Adaption Sub-Committee were set up to advise on targets and scrutinise the programme for adapting. Legally-binding 'carbon budgets' set a cap on the amount of greenhouse gases emitted in the UK over a five-year period. BEIS and Defra lead on policies for mitigation and adaption respectively.	Climate Change Act 2008
Financial support for renewables	The feed-in tariff, Renewable Obligation certificates and the RTFO all support greater levels of renewable energy. The Green Investment Bank A smarter grid	
Financial support for renewables	The RHI consists of tariffs paid to companies who choose to add to the generation of renewable heat. The policy differentiates support levels by technology, size and consumer groups to better target support levels.	Renewable heat incentive impact assessment
Two main mechanisms were introduced, a capacity market (CM) and Contracts for difference (CfD)	The CM is designed to ensure sufficient reliable capacity is available by providing payments to encourage investment in new capacity or for existing capacity to remain open. CfDs are private contracts that allow low carbon generators to be paid the difference between the 'strike price' – a price for electricity reflecting the cost of investing in a particular low carbon technology – and the 'reference price'– a measure of the average market price for electricity in the GB market. It gives greater certainty and stability of revenues to electricity generators by reducing their exposure to	BEIS -Electricity Market Reform: Contracts for Difference, updated 8th Feb 2017 DECC Electricity Market Reform: Capacity Market Consultation on Capacity Market supplementary design proposals and changes to the Rules. March 2015

	volatile wholesale prices, whilst protecting consumers from paying for higher support costs when electricity prices are high.	

Water Policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Removal of barriers to competition	The non-household sector is free to switch supplier from April 2017. The combined license is set to be unbundled (in 2019) so that it will be possible for a licensee to hold a wholesale authorisation without having to provide retail services (such as billing and customer services). For new entrants, access rights will be extended to the water companies' treatment and storage systems rather than just mains and pipes, allowing new entrants to input water into any part of the network.	UK Water Act 2014
Proposals to deregulate and simplify legislation, reduce burdens on business and stimulate growth	A draft water bill; a new strategic policy statement for Ofwat; catchment pilots working with the EA; the design of a new abstraction regime; Social tariff guidance.	Water for Life 2014. HMSO
Actions to enhance resilience to climate change.	covers: • Built environment, • Infrastructure, • Healthy and resilient communities, • Agriculture and forestry, • Natural environment, Business and local government.	The National Adaptation Programme: Making the country resilient to a changing climate. Defra 2013
Ofwat Framework	• Defines resilience, • sets key actions to enhance resilience, • proposes mechanisms to measure resilience	Towards resilience: how we will embed resilience in our work. Ofwat 2015

Recommendations to Defra for assessing future needs associated with the resilience of strategic water infrastructure	In line with Water for life 2014.	Water supply and resilience and infrastructure: Environment Agency advice to Defra. October 2015
Proposed use of the Outcome Delivery Incentive mechanism to encourage adaptation to climate change.	Establishes a market-based approach to incentivising resilience to climate change.	Enabling, incentivising and encouraging climate adaptation in the water sector. Ofwat 2016

Agricultural /land use Policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Sustainable Development goals	UK Government has committed itself to implementing the Sustainable Development Goals (17 concern food)	Adoption of Agenda 2030.
Regulate agricultural land sales	EU Member States have the right to restrict sales of farmland to preserve agricultural communities and promote sustainable agriculture. But in doing so they must comply with EU law, in particular rules on free movement of capital.	Guidance to help Member States protect agricultural land from threats such as excessive price speculation and ownership concentration.
To undertake land management practices, beyond minimal regulatory compliance, to protect and enhance the environment and wildlife	Countryside Stewardship, Environmental Stewardship and other schemes offer payments to farmers and other land managers in England.	European Agricultural Fund for Rural Development funding.
Local Enterprise Partnerships (LEPs)	Established as locally derived business-led partnerships between the private and public sector to drive local economic growth.	Review of Local Enterprise Partnership Governance and Transparency. DCLG Board. October 2017
EU LEADER programme	Supports the growth of the rural economy, for example through measures such as farm diversification, rural tourism, and cultural and heritage activities.	The Leader Approach. Fact Sheet 2006

5 Assessment of policy coherence

The following sections look at policy coherence for the SW case study. This policy assessment draws on the identification of the nexus dimensions that are important to the SW case study (water, energy, agriculture/food and land issues) and their socio-economic context within this region. It also uses the work done in sections 3 and 4 which mapped important stakeholders for the case study work (section 3) and key policy goals and instruments (section 4). This assessment has been carried out with reference to the research questions (sub-section 3.1.) as detailed below:

Main RQ: How does the governance of energy, water and agriculture affect sustainable food production, the provision of water and wastewater services and the move to a smart and flexible system for resource management?

1. How can local and global environmental protection objectives be addressed, including the reduction of flood risk, while meeting an increasing demand for low cost and high quality water/waste water services?

2. To what extent can renewable energy generation, energy efficiency and demand management reduce or otherwise offset the need for grid-imported energy in the provision of water/waste water services?

3. How can South West Water and the agricultural sectors work together to improve future farming practices in order to protect food security, biodiversity and water objectives, tackle GHG emissions and increase renewable energy outputs from local farms?

The policy coherence assessment for the case studies is structured bottom-up. The goal is to learn from practice, i.e. from stakeholders, what works and what does not work in the implementation of policies in the nexus (Munaretto and Witmer 2017). Thus, the assessment builds on the knowledge gained in the previous sections by integrating this with stakeholder knowledge.

5.1. In-depth interviews with stakeholders

Using the mapping work carried out in section 3 and interest shown by particular stakeholders in the workshop held in January 2018, twenty two in-depth interviews with selected stakeholders were carried out, together with a further 11 written responses to the questions posed which were collected at the workshop held in January 2018. It should be noted that these stakeholder interviews are not the official position of SWW or reflective of company policy/opinion.

These interviews explored which critical objectives and instruments generate conflicts and synergies in the nexus, and how conflicts, synergies and trade-offs are dealt with in practice, including how stakeholders handle conflicts, foster policy synergies and negotiate trade-offs. It is also worth noting that the UK's pending BREXIT occupies stakeholder thinking at this particular time and we have tried to factor this in. The interviews provide valuable insights into:

• interactions between policy objectives;

• interactions between policy instruments and objectives;

• vertical interactions between relevant policies;

• how stakeholders handle conflicts, successfully foster policy synergies and negotiate trade-offs in practice.

The interviews included stakeholders in each of the relevant nexus sectors (water, energy, food, agriculture and land) and one additional interview with the tourism sector. The interviews included all levels of the public sector, business, NGOs, research institutions and two associations (Table 10). Some of the organisations' concerns and interests were cross-sectoral (e.g. Environment Agency, South West Tourism Alliance) and this provided additional helpful insights about policy implementation on the ground.

Table 10 Type and number of Stakeholders Interviewed

Stakeholder	Sector	Type of organisation	Date interviewed
OFWAT	Water	Public	02/05/2018
Torbay Council	Water	Public	24/04/2018
UKWIR	Water	Public	04/05/2018
West Country Rivers Trust	Water	NGO	03/05/2018
OFGEM	Energy	Public	08/05/2018
Centrica	Energy	Business	23/04/2018
Exeter University	Energy	Research	03/05/2018
ReGen	Energy	NGO	24/04/2018
Cornwall Energy	Energy	Business	23/04/2018
Exeter Community Energy	Energy	NGO	27/04/2018
Energy Policy Group, Exeter University	Energy	Research	01/05/2018
DEFRA / Natural England	Agriculture / Land	Public	09/05/2018
Environment Agency	Agriculture / Land / Food	Public	15/05/2018
Wildlife Trust	Land / Agriculture	NGO	10/05/2018
Exeter University	Land / Agriculture	Research	29/05/2018
Tenant Farmers' Association	Agriculture / Land / Food	Association	24/04/2018
Clinton Devon Estates	Land / Agriculture	Business	23/05/2018
Linking Environment and Farming (LEAF)	Food / Agriculture / Land	NGO	01/05/2018
Exeter University	Food	Research	09/04/2018

University of Gloucester CCRI	Food / Land / Agriculture	Research	23/04/2018
Sustainable Food Systems Planning	Food	NGO	30/04/2018
South West Tourism Alliance	Tourism	Association	19/04/2018

Total = 22 interviews (+ 11 paper questionnaires) = 33

The UK South West case study was therefore able to engage stakeholders from a range of organisations from the four category types and sectors through the interviews and workshops. However, specific feedback from Workshop 2 (held in June 2018) indicated that future stakeholder analysis could be improved by recognising communities in the South West as stakeholders, particularly in the South West relating to energy objectives. Communities (as opposed to individual customers) represent both a practically and analytically difficult category / group to engage with and given the time constraints it was therefore not possible to include them in the current analysis for this case study. Moreover, support for community energy projects, which was previously a key component of energy policy in the UK, has now disappeared from the policies. However, given the current uncertainties in the policy landscape it may be important to recognise communities in future analyses, particularly given that the South West has a relatively large number of community-led/-owned renewable energy generation projects compared to other regions in the UK.

5.2. Interactions between Nexus Critical Objectives

The nexus critical objectives (NCOs) were identified using the analysis of key policy goals across the nexus sectors (section 4) and the stakeholder interviews (sub-section 5.1), bearing in mind that the assessment generates useful input for the models and the serious game.

A nexus critical objective is defined as 'the policy objective that according to the stakeholders and the policy analysis is highly relevant for the issues under investigation in the case study and has a potentially high number of interactions with other objectives in the nexus' (Munaretto and Witmer, 2017).

Eighteen NCOs were identified that were most critical for the nexus in the case study (Table 11): water (6); energy (4); agriculture and food (5); and land (3). The selection was based on those that had been identified in the inventory (section 4), those that had emerged strongly from the stakeholder interviews, and an awareness of what would contribute to the models and serious game. Table 11 lists the NCOs and provides a more detailed description for each NCO to clarify what is involved and the context for the scoring.

Table 11 Nexus Critical Objectives

Water		
Code	NCO	Detailed description

W1	Enhance the sustainability of water service delivery	• Implement grey/rainwater water recycling; • maintain or reduce leakage/ingress of water/wastewater networks; • maintain or reduce drinking water demand; • increase use of sustainable urban drainage; • implement wholesale trading of water resources .
W2	Protect and enhance the natural capital of aquatic environments	• implementation of paid eco systems services approach to improve surface water quality; • maintain or optimise abstraction (surface & ground water) at environmentally sustainable level; • maintain or enhance biodiversity of freshwater habitats; • maintain or enhance resourcing of pollution enforcement activities.
W3	Protect and enhance human health	• maintain or enhance drinking water quality; • maintain or enhance wastewater effluent quality.
W4	Enhance the resilience of water service delivery	• mitigate impact of climate change on drinking water and wastewater service delivery; • mitigate impact of population growth on drinking water and wastewater service delivery
W5	Reduce reliance on external energy supply	• increase utilization of self-supplied energy from: Hydro, CHP, PV & energy storage; • improve energy efficiency of treatment/distribution of water/wastewater.
W6	Address affordability of water services for consumers	• reduce unit cost to the consumer while maintaining quality of service; • better targeting of support for vulnerable communities e.g. poor urban and rural areas.
Energy		
Code	Heading	Detailed description
E1	Decarbonisation of energy supply	• increased use of low carbon energy.
E2	Increase energy security.	• increase energy efficiency; • enhance the resilience of energy supply; • create a smart and flexible electricity system; • reduce energy demand; • create more balanced renewable supply;

		• local trading of power and flexibility.
E3	Increase the use of renewable resources.	• financial support for renewables; • unblock barriers to delivery; • develop emerging technologies.
E4	Address affordability of energy services for consumers.	• reduce unit cost to the consumer while maintaining quality of service; • targeting of support for vulnerable communities e.g. poor urban and rural areas.
Agriculture and food		
Code	Heading	Detailed description
A/F 1	Maintain and improve the agri-environment	• maintain and enhance environmental and biodiversity measures on agricultural land (now and post-Brexit); • enhance agricultural standards for greater sustainability.
A/ F 2	Develop catchment sensitive farming	• reduce diffuse pollution from agriculture; • enhance agricultural management across the whole catchment.
A/F 3	Build farm business development	• support for agricultural diversification; • enhance support for local food producers.
A/F 4	Protect standards of food production	• ensure food is safe and does not damage human health.
A/F 5	Reduce food supply chain emissions and waste	• reduce environmental pollution and waste from food supply chain
Land		
L1	Mitigation of flood risk and flooding	• reduce surface water flood risk; • incorporation of flood mitigation measures in housing developments; • improve natural and sustainable drainage (infiltration).
L2	Improve environmental land	• better management of waste on land; • enhance biodiversity;

	management	• enhance natural capital and public benefits of land management; • ensure secure evidence base for implementation of land management measures.
L3	Improve soil structure and composition	• better enforcement of agrichemicals regulations; • reduce reliance on synthetic fertilisers or chemicals; • reduce soil compaction; • reduce soil run-off (loss of topsoil).

Once the NCOs had been identified and agreed within the team, a scoring matrix was constructed assessing the interactions between the objectives (Table 12). Assessing only direct interactions and across different spatial scales was quite complex. The scoring of interactions was based on relevant literature, the policy analysis that took place in section 4, information from stakeholders in the interviews, and on expert judgments.

The interactions were assessed using a framework that scores every NCO against each of the other 17 NCOs (a 'pairs of policy areas' approach). Negative scores identify conflicts between pairs of objectives; positive scores identify synergies between pairs of objectives. The score 0 indicates the absence of a significant interaction between pairs of objectives.

Table 12 Scoring matrix of coherence among NCOs in the Water (W). Energy (E), Agriculture and Food (A/F) and Land (L) sectors.

What happens to objective x → **(affected)**

If we make progress on objective y ↓**(affecting)**

	W1	W2	W3	W4	W5	W6	E1	E2	.E3	E4	A/F1	A/F2	A/F3	A/F4	A/F5	L1	L2	L3
W1		2	1	2	1	1	0	1/-1	1	1	3	3	0	1	2	2	2	2
W2	2		2	2	1	-1	1/-1	0	1	0	3	3	1	3	3	2	3	3
W3	2	3		2	0	-1	1/-1	1	0	0	3	3	1	3	3	2	3	2
W4	2	3	2		2	2	2	2	2	0	2	3	1	1	2	2	2	2
W5	2	0	-1	2		-1	1/-1	0	3	-1	1	1	0	1	1	1	0	0
W6	2	2	1/-1	-2	2		1/-1	1	1/-1	0	1	2	1	1	2	2	2	1
E1	0	0	0	0	1	0		1	2	1/-1	0	0	1	0	0	1	0	0
E2	1	1	0	1	2	1	2		1/-1	2	1	1	1	0	1	2	1	0
E3	0	1	0	2	2	0	1/-1	2		1/-1	1	1	1	0	0	0	0	0
E4	2	1	0	1	1	0	1/-1	2	1/-1		1/-1	0	1	0	-1	1	1	1
A/F1	1	2	2	2	1	0	1/-1	1	2	0		3	1/-1	1/-1	2	2	3	3
A/F2	1	1	0	1	0	0	0	1	0	0	2		2	1/-1	2	2	3	3
A/F3	1	1/-1	1	1	0	1	1/-1	1	1	0	1/-1	1		1/-1	1/-1	2	2	1/-1
A/F4	1	2	2	1	0	0	1/-1	1	1	0	3	2	2		1	2	2	2
A/F5	0	0	1	1	1	0	+1/-1	0	2	0	2	2	1	1/-1		2	2	2
L1	3	2	1	2	1	0	2	1	2	0	3	3	1	1	1		3	3
L2	1	2	2	2	1	0	1/-1	1	1	1	3	3	1/-1	1/-1	2	2		3
L3	0	1	1	1	0	0	0	0	0	0	3	2	1/-1	1/-1	1	2	3	

Key to scoring:

Cancelling	-3
Counteracting	-2
Constraining	-1

Neutral	0
Enabling	1
Reinforcing	2
Indivisible	3
Multiple	1/-1

In order to provide further clarity, the scoring matrix is accompanied by justification of the scoring of each cell value below (Table 13).

The scoring of the interactions of paired policy objectives above (Table 12) shows that many of the synergies evident are among objectives within the same nexus sector (e.g. synergies among water resource objectives), with in most cases a high level of complementarity amongst objectives within the same sector. Synergies are also evident across sectors, particularly between agriculture / food and water objectives, agriculture / food and land objectives and; water and land objectives. Such synergies are fully justifiable for the following reasons:

- the majority of agriculture / food objectives are strongly related to the water objectives,
- objectives concerning the sustainable delivery of water resources are closely linked to goals having to do with land and climate change mitigation / adaptation;
- goals that place emphasis on the sustainable development of agriculture are closely related to the sustainable environmental management of land.

Several climate change-related synergies are highlighted – these have been included within the specific sectoral objectives, particularly the water objectives (sustainability and resilience objectives) and land objectives (mitigation), rather than as a separate analytical category.

There were no very strong conflicts between the nexus critical objectives although some weaker conflicts were identified, mainly arising from efforts to improve affordability of water (and to a lesser extent energy) supply. This impacts on some capital investments in other service delivery operations. However, comments from stakeholders indicated that further conflicts arose at more practical levels, mainly during the policy implementation process. Many of the conflicts / trade-offs and multiple effects noted in the scoring are also conditional or potential ones, depending on how the policy is implemented or which aspect the policy implementation focuses on as follows:

- conflicts between decarbonisation and renewable energy generation objectives if decarbonisation concentrates on nuclear energy generation;

- multiple potential conflicts associated with the nuclear energy component of the decarbonisation objective – for the environment, cost implications, etc – depending on the proportion of nuclear vs. renewables implemented.
- potential cost trade-offs between different energy and water objectives and within energy objectives – where they require significant investment this may have an impact on affordability for customers and vice-versa;
- potential cost implications / trade-offs of reducing emissions impacting on affordability for customers and vice-versa; and
- multiple potential conflicts within agriculture objectives e.g. protecting or enhancing agricultural standards will have differential effects on large and small producers (who may not be able to meet the standards) and on costs depending on the nature of the standards; multiple effects of subsidies (farm business development objective) – based on which subsidies are implemented, how achievable the measures implemented are and on the enforcement mechanisms utilised.

Specific examples of synergies and conflicts are discussed further in the section on success stories and failures below (sub-section 5.5).

Table 13 Justification of policy interaction scoring

Interaction	Score	Justification
Water to water		
W2>W1	+2	Protecting and enhancing the natural capital of aquatic environments reinforces the sustainability of water service delivery as it improves water quality and resilience over the long term.
W3>W1	+1	Protecting and enhancing human health (e.g. water quality) creates the conditions for (enables) the sustainability of water service delivery.
W4>W1	+2	Enhancing the resilience of water service delivery reinforces sustainability of delivery through addressing longer term risks and vulnerability to shocks from climate change and population growth.
W5>W1	+1	Reducing reliance on an external energy supply contributes to (enables) sustainability of water service delivery through potentially reducing longer term energy-related delivery costs.
W6>W1	+1	Addressing affordability of services drives the longer term need for improved sustainability of water service delivery.
W1>W2	+2	Enhancing sustainability of service delivery reinforces the enhancement of aquatic environments.
W3>W2	+2	Protecting and enhancing human health reinforces the enhancement of aquatic environments through improving wastewater effluent quality.
W4>W2	+2	Enhancing resilience of service delivery reinforces enhancement of aquatic environment through addressing climate and population-related risks and vulnerabilities.
W5>W2	+1	Reducing reliance on external energy supply contributes to (enables) enhancement of the aquatic environment through greater long term sustainability of delivery and lower

		pollution associated with greenhouse gas (GHG) emissions.
W6>W2	-1	Addressing affordability of services conflicts with enhancement of aquatic environments due to the reduced availability of capital for investment in environmental protection or increased effluent treatment.
W1>W3	+2	Enhancing sustainability of service delivery reinforces the protection and enhancement of human health.
W2>W3	+3	Enhancing the natural capital of aquatic environments is inextricably linked to protecting and enhancing human health.
W4>W3	+2	Enhancing resilience of service delivery reinforces the protection and enhancement of human health.
W5>W3	0	There is no significant direct interaction between the two goals in this direction.
W6>W3	-1	Addressing affordability of services conflicts with the protection and enhancement of human health due to the reduced availability of capital for investment in, or operation of these measures.
W1>W4	+2	Enhancing sustainability of service delivery reinforces the resilience of service delivery (they are mutually reinforcing).
W2>W4	+3	Protecting and enhancing aquatic environments is inextricably linked to the resilience of service delivery.
W3>W4	+2	Protecting and enhancing human health reinforces the resilience of service delivery.
W5>W4	+2	Reducing reliance on external energy supply reinforces enhancement of the resilience of service delivery.
W6>W4	-2	Addressing affordability of services conflicts with enhancing the resilience of service delivery due to the reduced availability of capital for investment in, or operation of these measures.
W1>W5	+2	Enhancing sustainability of service delivery reinforces the reduction in reliance on external energy supply through more efficient water and energy use.
W2>W5	0	There is no significant direct interaction between the two goals in this direction.
W3>W5	-1	Protecting and enhancing human health conflicts with a reduction in reliance on external energy supply by increasing energy demand of treatment processes through less need for waste water treatment.
W4>W5	+2	Enhancing resilience of service delivery reinforces the reduction in reliance on external energy supply through reducing need for treatment over the longer term.
W6>W5	-1	Addressing affordability of services conflicts with the reduction in reliance on external energy supply due to the reduced availability of capital for investment in, or operation of service delivery.
W1>W6	+2	Enhancing sustainability of service delivery reinforces the affordability of water services.
W2>W6	+2	Protecting and enhancing aquatic environments reinforces the affordability of water services (otherwise treatment costs will rise).
W3>W6	+1/-1	Protecting and enhancing human health has multiple effects on the affordability of water services as it may lead to either lower or higher treatment costs depending on the extent / type of treatment required.
W4>W6	+2	Enhancing resilience of service delivery reinforces the affordability of water services through increasing longer term sustainability and decreasing risks and vulnerabilities to shocks.
W5>W6	+2	Reducing reliance on external energy supply reinforces the affordability of water

		services through lower energy costs for water treatment etc.
Energy to water		
E1>W1	0	There is no significant direct interaction between the two goals.
E2>W1	+1	Increasing energy security contributes to (enables) sustainability of water service delivery through increased security of energy supply for water service delivery.
E3>W1	+1/-1	Increasing use of renewable resources has multiple effects on the sustainability of water service delivery depending on its effects on the cost and security of energy supply for water service delivery.
E4>W1	+1	Addressing affordability of energy services could contribute to (enable) sustainability of water service delivery through reducing / maintaining energy costs where applicable.
E1>W2	+1/-1	Decarbonisation of energy supply has multiple effects on aquatic environments depending on the proportion of nuclear vs. renewables. Nuclear energy has significant potential harmful effects on aquatic environments whereas renewable sources have positive effects compared to fossil fuels.
E2>W2	0	There is no significant direct interaction between the two goals.
E3>W2	+1	Increasing use of renewable resources contributes to (enables) the protection and enhancement of aquatic environments through less pollution from fossil fuels entering these environments.
E4>W2	0	There is no significant direct interaction between the two goals.
E1>W3	+1/-1	Decarbonisation of energy supply has differential effects on human health depending on the proportion and relative effect of nuclear / renewables on water treatment costs.
E2>W3	+1	Increasing energy security contributes to (enables) enhancing human health through maintaining energy costs for water treatment.
E3>W3	0	There is no significant direct interaction between the two goals.
E4>W3	0	There is no significant direct interaction between the two goals.
E1>W4	+2	Decarbonisation of energy supply reinforces resilience of water service delivery through decreasing climate change effects on water system.
E2>W4	+2	Increasing energy security reinforces resilience of water service delivery through maintaining / reducing energy costs of delivery.
E3>W4	+2	Increasing use of renewable resources reinforces resilience of water service delivery through decreasing climate change effects on water system.
E4>W4	0	There is no significant direct interaction between the two goals.
E1>W5	+1/-1	Decarbonisation of energy supply has differing effects on the reliance on external energy supply depending on the proportion of nuclear vs. renewables – renewables if not managed / balanced well can lead to unpredictable supply.
E2>W5	0	There is no significant direct interaction between the two goals.
E3>W5	+3	Increasing use of renewable resources is inextricably linked to reduction in reliance on external energy supply through increasing renewable energy generation.
E4>W5	-1	Addressing affordability of energy services could constrain reduction in reliance on external energy supply if external energy supply is cheap as there is less incentive to reduce external energy use.
E1>W6	+1/-1	Decarbonisation of energy supply has differing effects on affordability of water services depending on the effects on pricing of energy and amount of external energy used for water service delivery.

E2>W6	+1	Increasing energy security reinforces affordability of water services through increasing energy efficiency and flexibility and providing a sustainable supply of energy.
E3>W6	+1/-1	Increasing use of renewable resources has differing effects on affordability of water services depending on the relative costs of renewables vs. other energy sources at a local level.
E4>W6	0	There is no significant direct interaction between the two goals
Agric/Food to water		
A/F1>W1	+3	Improving the agri-environment is inextricably linked to enhancing the sustainability of water service delivery through increasing standards and environmental sustainability impacting directly on water system.
A/F2>W1	+3	Development of catchment sensitive farming is inextricably linked to enhancing the sustainability of water service delivery.
A/F3>W1	0	There is no significant direct interaction between the two goals.
A/F4>W1	+1	Protecting standards of food production contributes to (enables) enhancing the sustainability of water service delivery through less need for water treatment services.
A/F5>W1	+2	Reducing food supply chain emissions / waste reinforces sustainability of water service delivery through less need for water treatment services.
A/F1>W2	+3	Improving the agri-environment is inextricably linked to enhancing aquatic environments through improving environmental outcomes impacting on aquatic environments.
A/F2>W2	+3	Development of catchment sensitive farming is inextricably linked to enhancing aquatic environments through improving environmental outcomes impacting on aquatic environments.
A/F3>W2	+1	Building farm development is likely to contribute to (enable) the enhancement of aquatic environments through less intensification of farming activities and use of fewer pesticides etc.
A/F4>W2	+3	Protecting standards of food production is inextricably linked to enhancing aquatic environments through minimising pollution, bad practice etc.
A/F5>W2	+3	Reducing food supply chain emissions / waste is inextricably linked to enhancing aquatic environments through reducing emissions and waste entering aquatic environments.
A/F1>W3	+3	Improving the agri-environment is inextricably linked to enhancing human health through less need for water treatment.
A/F2>W3	+3	Development of catchment sensitive farming is inextricably linked to enhancing human health through reducing the need for water treatment.
A/F3>W3	+1	Building farm development is likely to contribute to (enable) enhancing human health through less intensification and reducing the need for water treatment.
A/F4>W3	+3	Protecting standards of food production is inextricably linked to enhancing human health through minimising effects of pollution, bad practice etc. on health.
A/F5>W3	+3	Reducing food supply chain emissions / waste is inextricably linked to enhancing human health through reducing the need for water treatment.
A/F1>W4	+2	Improving the agri-environment reinforces the resilience of water service delivery through contributing to resilience to climate change and population increase.
A/F2>W4	+3	Development of catchment sensitive farming is inextricably linked to resilience of water service delivery through increasing resilience of the whole catchment to flooding

		etc.
A/F3>W4	+1	Building farm development is likely to contribute to (enable) enhancing the resilience of water service delivery through less intensive farming practices impacting positively on the water system.
A/F4>W4	+1	Protecting standards of food production contributes to (enables) increased resilience of water service delivery through positive impacts of less pollution / bad practice etc.
A/F5>W4	+2	Reducing food supply chain emissions / waste reinforces resilience of water service delivery through positive impacts of less pollution / bad practice etc.
A/F1>W5	+1	Improving the agri-environment contributes to (enables) the reduction of reliance on external energy supply due to less demand for treatment and associated external energy use.
A/F2>W5	+1	Development of catchment sensitive farming contributes to (enables) the reduction of reliance on external energy supply due to less demand for treatment and associated external energy use.
A/F3>W5	0	There is no significant direct interaction between the two goals.
A/F4>W5	+1	Protecting standards of food production contributes to (enables) the reduction of reliance on external energy supply due to less demand for treatment and associated external energy use.
A/F5>W5	+1	Reducing food supply chain emissions / waste contributes to (enables) the reduction of reliance on external energy supply due to less demand for treatment and associated external energy use.
A/F1>W6	+1	Improving the agri-environment contributes to (enables) affordability of water services due to less need for water treatment where applicable.
A/F2>W6	+2	Development of catchment sensitive farming reinforces affordability of water services due to less need for water treatment.
A/F3>W6	+1	Building farm development is likely to contribute to (enable) affordability of water services due to less intensive farming and less need for water treatment.
A/F4>W6	+1	Protecting standards of food production contributes to (enables) affordability of water services due to less need for water treatment.
A/F5>W6	+2	Reducing food supply chain emissions / waste contributes to (enables) affordability of water services due to less need for water treatment.
Land to water		
L1>W1	+2	Mitigation of flood risk and flooding reinforces sustainability of water service delivery through reducing flood-related costs and pollution.
L2>W1	+2	Improving environmental land management reinforces sustainability of water service delivery through infrastructure improvements and reducing costs associated with pollution, bad practice etc.
L3>W1	+2	Improving soil structure and composition reinforces sustainability of water service delivery through reducing costs associated with compaction and run-off etc.
L1>W2	+2	Mitigation of flood risk and flooding reinforces enhancement of aquatic environments through infrastructure improvements and reducing flood-related pollution.
L2>W2	+3	Improving environmental land management is inextricably linked to enhancement of aquatic environments through reducing pollution etc.
L3>W2	+3	Improving soil structure and composition is inextricably linked to enhancement of aquatic environments through reducing compaction and run-off of pollutants etc.

L1>W3	+2	Mitigation of flood risk and flooding reinforces human health through infrastructure improvements and reducing flood-related pollution impacting directly on water treatment.
L2>W3	+3	Improving environmental land management reinforces human health through reducing pollution of water sources and need for water treatment.
L3>W3	+2	Improving soil structure and composition reinforces human health through reducing run-off of pollutants into water sources.
L1>W4	+2	Mitigation of flood risk and flooding reinforces resilience of water service delivery through infrastructure improvements and reducing flood events.
L2>W4	+2	Improving environmental land management reinforces resilience of water service delivery through reducing pollution and need for water treatment.
L3>W4	+2	Improving soil structure and composition reinforces resilience of water service delivery through reducing run-off pollution and need for water treatment.
L1>W5	+1	Mitigation of flood risk and flooding contributes to (enables) the reduction of reliance on external energy supply through infrastructure improvements and reducing the need for flood-related interventions.
L2>W5	0	There is no significant direct interaction between the two goals.
L3>W5	0	There is no significant direct interaction between the two goals.
L1>W6	+2	Mitigation of flood risk and flooding reinforces affordability of water services due to infrastructure improvements and reducing the need for expensive flood-related interventions.
L2>W6	+2	Improving environmental land management reinforces affordability of water services due to less need for water treatment.
L3>W6	+1	Improving soil structure and composition contributes to (enables) affordability of water services due to reduced run-off and less need for water treatment.
Water to energy		
W1>E1	0	There is no significant direct interaction between the two goals.
W2>E1	0	There is no significant direct interaction between the two goals.
W3>E1	0	There is no significant direct interaction between the two goals.
W4>E1	0	There is no significant direct interaction between the two goals.
W5>E1	+1	Reducing reliance on external energy supply contributes to (enables) decarbonisation of energy supply through increased use of renewables.
W6>E1	0	There is no significant direct interaction between the two goals.
W1>E2	+1	Enhancing sustainability of water service delivery contributes to (enables) energy security through increased sustainability of water supply used in energy generation processes.
W2>E2	+1	Enhancing natural capital of aquatic environments contributes to (enables) ensuring a water supply for renewable energy generation (hydro) and other energy processes.
W3>E2	0	There is no significant direct interaction between the two goals.
W4>E2	+1	Enhancing resilience of water service delivery reinforces energy security due to increased resilience of supply of water for energy generation processes.
W5>E2	+2	Reducing reliance on external energy supply reinforces energy security through increased use of renewables and reducing energy demand.
W6>E2	+1	Enhancing sustainability of water service delivery contributes to (enables) energy security by reducing demand for external energy.

W1>E3	0	There is no significant direct interaction between the two goals.
W2>E3	+1	Enhancing natural capital of aquatic environments contributes to (enables) increasing renewables use through ensuring a water supply for renewable energy generation (hydro).
W3>E3	0	There is no significant direct interaction between the two goals.
W4>E3	+2	Enhancing resilience of water service delivery reinforces renewable energy use due to increased resilience of supply of water for energy generation processes.
W5>E3	+2	Reducing reliance on external energy supply reinforces use of renewable resources through its contribution to generating renewables.
W6>E3	0	There is no significant direct interaction between the two goals.
W1>E4	+2	Enhancing sustainability of water service delivery reinforces affordability of energy services through higher sustainability of supply for energy processes.
W2>E4	+1	Enhancing natural capital of aquatic environments contributes to (enables) affordability of energy services through securing / enhancing the supply of water used in energy generation.
W3>E4	0	There is no significant direct interaction between the two goals
W4>E4	+1	Enhancing resilience of water service delivery contributes to (enables) affordability of energy services through increasing resilience of the supply of water used in energy generation.
W5>E4	+1	Reducing reliance on external energy supply is likely to contribute to (enable) affordability of energy services through lower water costs for energy generation.
W6>E4	0	There is no significant direct interaction between the two goals
Energy to energy		
E2>E1	+1	Increasing energy security contributes to (enables) decarbonisation of energy supply where it involves increased renewable generation.
E3>E1	+2	Increased use of renewables reinforces decarbonisation of energy supply (non-nuclear).
E4>E1	+1/-1	Addressing affordability of energy services has differing effects on decarbonisation of energy supply depending on the relative prices of energy generated from renewable, nuclear and fossil fuel sources and on the investments required.
E1>E2	+2	Decarbonisation of energy supply reinforces energy security where it involves increased renewables and by providing more sustainable energy than fossil fuels over the longer term.
E3>E2	+2	Increased use of renewables reinforces energy security as this is a component of energy security.
E4>E2	+1/-1	Addressing affordability of energy services is likely to have differing effects on energy security according to the relative prices and investments in security / sustainability of energy supply required.
E1>E3	+1/-1	Decarbonisation of energy supply has differing effects on increasing use of renewables depending on whether it involves nuclear or renewable generation.
E2>E3	+2	Increasing energy security reinforces use of renewables as it contains this as one of its components.
E4>E3	+1/-1	Addressing affordability of energy services has differing effects on use of renewables depending on the relative prices of energy generated from renewable, nuclear and fossil fuel sources.

E1>E4	+1/-1	Decarbonisation of energy supply has differing effects on affordability of energy services depending on the relative prices of energy generated from renewable, nuclear and fossil fuel sources.
E2>E4	+2	Increasing energy security reinforces affordability of energy services through increased security of supply.
E3>E4	+1/-1	Increased use of renewables has differing effects on affordability of energy services depending on the relative prices of energy generated from renewable, nuclear and fossil fuel sources.
Agriculture / food to energy		
A/F1>E1	0	There is no significant direct interaction between the two goals
A/F2>E1	0	There is no significant direct interaction between the two goals
A/F3>E1	+1	Building farm development includes diversification and renewable energy generation so involves some contribution to (enabling of) decarbonisation of energy supply.
A/F4>E1	0	There is no significant direct interaction between the two goals
A/F5>E1	0	There is no significant direct interaction between the two goals
A/F1>E2	+1	Improving the agri-environment contributes to energy security through reducing the energy demand associated with clean-up of agri-environmental pollution.
A/F2>E2	+1	Developing catchment sensitive farming contributes to energy security through reducing the energy demand associated with clean-up of agri-environmental pollution.
A/F3>E2	+1	Building farm businesses contributes to energy security via diversification through some increased renewable generation and (potential) energy savings.
A/F4>E2	0	There is no significant direct interaction between the two goals
A/F5>E2	+1	Reducing food supply chain emissions and waste contributes to energy security through reducing demand associated with clean-up of emissions/waste.
A/F1>E3	+1	Improving the agri-environment contributes to use of renewable resources through increased resilience of supply / lower costs of renewable generation (e.g. hydro).
A/F2>E3	+1	Developing catchment sensitive farming contributes to use of renewable resources through increased resilience of supply / lower costs of renewable generation (e.g. hydro).
A/F3>E3	+1	Building farm businesses contributes to use of renewable resources through diversification resulting in some increased renewable generation.
A/F4>E3	0	There is no significant direct interaction between the two goals
A/F5>E3	0	There is no significant direct interaction between the two goals
A/F1>E4	+1/-1	Improving the agri-environment has differing effects on affordability of energy services as it can lead to higher or lower costs of energy linked to land prices and availability of land for and extent of local generation etc.
A/F2>E4	0	There is no significant direct interaction between the two goals
A/F3>E4	+1	Building farm businesses contributes to affordability of energy services through some local renewable energy generation due to diversification.
A/F4>E4	0	There is no significant direct interaction between the two goals
A/F5>E4	-1	Reducing food supply chain emissions / waste constraints affordability of energy services due to increased energy needed to meet new waste targets.
Land to energy		

L1>E1	+1	Mitigation of flood risk / flooding contributes to (enables) decarbonisation of energy supply due to infrastructure improvements and reduction in flooding allowing / enabling decarbonised energy generation.
L2>E1	0	There is no significant direct interaction between the two goals
L3>E1	0	There is no significant direct interaction between the two goals
L1>E2	+2	Mitigation of flood risk / flooding reinforces energy security due to complementary infrastructure improvements and reduction in flooding and associated energy costs.
L2>E2	+1	Improving land management contributes to energy security through reducing the energy demand associated with clean-up of environmental pollution.
L3>E2	0	There is no significant direct interaction between the two goals
L1>E3	0	There is no significant direct interaction between the two goals
L2>E3	0	There is no significant direct interaction between the two goals
L3>E3	0	There is no significant direct interaction between the two goals
L1>E4	+1	Mitigation of flood risk / flooding contributes to (enables) affordability of energy services through infrastructure improvements and reduction in flooding leading to energy demand / cost savings over the long term.
L2>E4	+1	Improving land management contributes to (enables) affordability of energy services through reduction in energy demand / cost savings associated with clean-up activities relating to pollution.
L3>E4	+1	Improving soil structure / composition contributes to (enables) affordability of energy services through reduction in energy demand / cost savings associated with clean-up activities if compacted / there is run-off.
Water to agriculture / land		
W1>A/F1	+1	Enhancing the sustainability of water service delivery contributes to improving the agri-environment through reducing waste water leakage and improved drainage.
W2>A/F1	+2	Enhancing aquatic environments reinforces the improvement of the agri-environment through enhancing biodiversity, increasing enforcement of pollution, etc.
W3>A/F1	+2	Enhancing human health reinforces the improvement of the agri-environment by improving waste water effluent quality.
W4>A/F1	+2	Enhancing the resilience of water service delivery reinforces the improvement of the agri-environment by improving resilience to climate change / population growth.
W5>A/F1	+1	Reducing reliance on external energy supply contributes to the improvement of the agri-environment by reducing fossil fuel emissions / waste.
W6>A/F1	0	There is no significant direct interaction between the two goals
W1>A/F2	+1	Enhancing the sustainability of water service delivery contributes to the development of catchment sensitive farming through sustainable water for irrigation etc where needed.
W2>A/F2	+1	Enhancing aquatic environments reinforces the development of catchment sensitive farming through increased biodiversity and greater enforcement of polluting activities.
W3>A/F2	0	There is no significant direct interaction between the two goals
W4>A/F2	+1	Enhancing the resilience of water service delivery reinforces the development of catchment sensitive farming through increased resilience to climate / population-related shocks and vulnerabilities.
W5>A/F2	0	There is no significant direct interaction between the two goals

W6>A/F2	0	There is no significant direct interaction between the two goals
W1>A/F3	+1	Enhancing the sustainability of water service delivery contributes to (enables) farm business development through sustainable water supplies for diverse farm activities.
W2>A/F3	+1/-1	Enhancing aquatic environments has differing / unpredictable effects on farm business development depending on the effects on diversification of business activities, effects on land prices, etc.
W3>A/F3	+1	Enhancing human health contributes to farm business development through increased water quality and waste water quality (for varied uses).
W4>A/F3	+1	Enhancing the resilience of water service delivery contributes to farm business development through increased resilience to climate / population-related shocks / vulnerabilities.
W5>A/F3	0	There is no significant direct interaction between the two goals
W6>A/F3	0	There is no significant direct interaction between the two goals
W1>A/F4	+1	Enhancing the sustainability of water service delivery contributes to (enables) protecting standards of food production through increasing sustainability of the water supply for cleaning activities.
W2>A/F4	+2	Enhancing aquatic environments reinforces the protection of standards of food production through reduced pollution.
W3>A/F4	+2	Enhancing human health contributes to the protection of standards of food production through ensuring adequate water quality / waste water quality (for cleaning etc).
W4>A/F4	+1	Enhancing the resilience of water service delivery contributes to the protection of standards of food production through increased resilience of production to climate / population-related shocks / vulnerabilities.
W5>A/F4	0	There is no significant direct interaction between the two goals
W6>A/F4	0	There is no significant direct interaction between the two goals
W1>A/F5	0	There is no significant direct interaction between the two goals
W2>A/F5	0	There is no significant direct interaction between the two goals
W3>A/F5	+1	Enhancing human health contributes to reducing food supply chain emissions / waste through enhancing waste water effluent quality.
W4>A/F5	+1	Enhancing the resilience of water service delivery contributes to reducing food supply chain emissions / waste through greater resilience to climate / population-related shocks / vulnerabilities.
W5>A/F5	+1	Reducing reliance on external energy supply contributes to reducing food supply chain emissions / waste by reducing fossil fuel emissions / waste.
W6>A/F5	0	There is no significant direct interaction between the two goals
Energy to agriculture / food		
E1>A/F1	+1/-1	Decarbonisation of energy supply has differing effects on improving the agri-environment depending on the proportion of nuclear vs. renewables and the risks etc (nuclear can have very harmful effects).
E2>A/F1	+1	Increasing energy security contributes to improving the agri-environment through increased renewables and reduced fossil fuel waste / emissions.
E3>A/F1	+2	Increasing the use of renewables reinforces positive agri-environment outcomes through reducing emissions / waste from fossil fuels.
E4>A/F1	0	There is no significant direct interaction between the two goals

E1>A/F2	0	There is no significant direct interaction between the two goals
E2>A/F2	+1	Increasing energy security contributes to developing catchment sensitive farming through increasing security of energy supply for farming activities.
E3>A/F2	0	There is no significant direct interaction between the two goals
E4>A/F2	0	There is no significant direct interaction between the two goals
E1>A/F3	+1/-1	Decarbonisation of energy supply has differing effects on building farm businesses depending on the proportion of nuclear vs. renewables and the associated effects.
E2>A/F3	+1	Increasing energy security contributes to building farm businesses through increasing security of energy supply for diverse activities.
E3>A/F3	+1	Increasing the use of renewables contributes to building farm businesses e.g. through local / on-farm energy supply and where are diversifying into renewable energy generation.
E4>A/F3	+1	Addressing affordability of energy services contributes to (enables) building farm businesses through an affordable energy supply for diverse activities.
E1>A/F4	+1/-1	Decarbonisation of energy supply has differing effects on protecting standards of food production depending on the proportion of nuclear vs. renewables (nuclear can produce pollution damaging to human health).
E2>A/F4	+1	Increasing energy security contributes to protecting standards of food production through increasing security of energy supply for processing etc.
E3>A/F4	+1	Increasing the use of renewables contributes to protecting standards of food production through reduction in fossil fuel-related emissions / waste.
E4>A/F4	+1	Addressing affordability of energy services contributes to (enables) the protection of standards of food production through an affordable supply of energy for processing etc.
E1>A/F5	+1/-1	Decarbonisation of energy supply has differing effects on food supply chain emissions / waste depending on the balance of nuclear / renewables (and fossil fuels).
E2>A/F5	0	There is no significant direct interaction between the two goals
E3>A/F5	+2	Increasing renewable resource use reinforces the reduction of food supply chain emissions / waste through decreasing fossil fuel emissions.
E4>A/F5	0	There is no significant direct interaction between the two goals
Agriculture / food to agric/food		
A/F2>A/F1	+3	Catchment sensitive farming and improving the agri-environment are inextricably linked.
A/F3>A/F1	+1/-1	Building farm businesses has differing effects on the agri-environment depending on the type of subsidies and activities implemented and their corresponding effects.
A/F4>A/F1	+1/-1	Protecting standards of food production has differing effects on the agri-environment depending on the type / level of standards, how well they are enforced and the size / type of farm business.
A/F5>A/F1	+2	Reducing food supply chain / waste reinforces improvement of the agri-environment through lower emissions / waste and pollution.
A/F1>A/F2	+2	Improving the agri-environment reinforces catchment sensitive farming.
A/F3>A/F2	+2	Building farm businesses is likely to reinforce catchment sensitive farming through reducing intensification and increasing diversification into other activities.
A/F4>A/F2	+1/-1	Protecting standards of food production has differing effects on catchment sensitive

		farming depending on the type / level of standards, how well they are enforced and the size / type of farm business.
A/F5>A/F2	+2	Reducing food supply chain / waste reinforces catchment sensitive farming through reducing pollution.
A/F1>A/F3	+1/-1	Improving the agri-environment has differing effects on farm business development depending on its effects on land prices / availability (e.g. prices may rise for better quality land preventing its use for renewable generation).
A/F2>A/F3	+1	Developing catchment sensitive farming contributes to building farm businesses through increased opportunities associated with higher biodiversity and water quality etc.
A/F4>A/F3	+1/-1	Protecting standards of food production has differing effects on farm business development e.g. depending on the type of standards and size / capacity of the business (food standards may be almost impossible to reach for small businesses).
A/F5>A/F3	+1/-1	Reducing food supply chain emissions / waste has differing effects on farm business development depending on size / capacity of business (as above).
A/F1>A/F4	+3	Improving the agri-environment is inextricably linked to protecting standards of food production (less pollution etc).
A/F2>A/F4	+2	Developing catchment sensitive farming reinforces the protection of standards of food production through less pollution etc.
A/F3>A/F4	+2	Building farm businesses is likely to reinforce the protection of standards of food production through reduced intensification / inputs and increased business capacity.
A/F5>A/F4	+1	Reducing food supply chain emissions / waste contributes to the protection of standards of food production (fewer pollutants etc).
A/F1>A/F5	+2	Improving the agri-environment reinforces the reduction of food supply chain emissions / waste through less pollution etc.
A/F2>A/F5	+2	Developing catchment sensitive farming reinforces the reduction of food supply chain emissions / waste through less pollution etc.
A/F3>A/F5	+1	Building farm businesses is likely to contribute to the reduction of food supply chain emissions / waste through less intensification and greater capacity to reduce waste etc.
A/F4>A/F5	+1/-1	Protecting standards of food production has differing effects on reducing food supply chain emissions / waste depending on the type / level of standards, how well they are enforced and the size / type of farm business.
Land to agric / food		
L1>A/F1	+2	Mitigation of flood risk / flooding reinforces improvement to the agri-environment through increased resilience to climate / population-related risks / events.
L2>A/F1	+3	Improving land management is inextricably linked to improving the agri-environment.
L3>A/F1	+3	Improving soil structure and composition is inextricably linked to improving the agri-environment.
L1>A/F2	+2	Mitigation of flood risk / flooding reinforces catchment sensitive farming.
L2>A/F2	+3	Improving land management is inextricably linked to catchment sensitive farming.
L3>A/F2	+3	Improving soil structure and composition is inextricably linked to catchment sensitive farming.
L1>A/F3	+2	Mitigation of flood risk / flooding reinforces development of farm businesses through building resilience to climate / population shocks and vulnerabilities.
L2>A/F3	+2	Improving land management reinforces development of farm businesses through

		increased biodiversity-related opportunities and lower waste management costs etc.
L3>A/F3	+1/-1	Improving soil structure and composition has differing effects on development of farm businesses depending on long term / short term view and cost-benefit differential (e.g. planting of maize).
L1>A/F4	+2	Mitigation of flood risk / flooding reinforces protection of food standards due to increased resilience to climate / population-related shocks / vulnerabilities.
L2>A/F4	+2	Improving land management reinforces protection of food standards through reducing pollution etc.
L3>A/F4	+2	Improving soil structure and composition reinforces the protection of food standards through reducing run-off pollution etc.
L1>A/F5	+2	Mitigation of flood risk / flooding reinforces reduction of food chain emissions / waste through reducing flood-related pollution events.
L2>A/F5	+2	Improving land management reinforces reduction of food chain emissions / waste through reducing pollution etc.
L3>A/F5	+2	Improving soil structure and composition reinforces the reduction of food chain emissions / waste through reducing run-off pollution etc.
Water to land		
W1>L1	+3	Enhancing sustainability of water service delivery is inextricably linked to mitigation of flood risk / flooding e.g. sustainable drainage improvements.
W2>L1	+2	Enhancing aquatic environments reinforces mitigation of flood risk / flooding e.g. through ecosystems approach, maintenance of habitats etc.
W3>L1	+1	Enhancing human health contributes to mitigation of flood risk / flooding e.g. through improving water / wastewater effluent quality (lower costs).
W4>L1	+2	Enhancing the resilience of water service delivery reinforces mitigation of flood risk / flooding through reducing vulnerability to climate / population-related shocks and vulnerabilities.
W5>L1	+1	Reducing reliance on external energy supply contributes to mitigation of flood risk / flooding e.g. through fewer GHG emissions from fossil fuels impacting positively on climate change.
W6>L1	0	There is no significant direct interaction between the two goals
W1>L2	+1	Enhancing sustainability of water service delivery contributes to improving land management by providing a sustainable water source.
W2>L2	+2	Enhancing aquatic environments reinforces the improvement of land management through increased biodiversity and pollution enforcement.
W3>L2	+2	Enhancing human health reinforces the improvement of land management through improving waste water effluent quality.
W4>L2	+2	Enhancing the resilience of water service delivery reinforces the improvement of land management through greater resilience to climate / population-related shocks / vulnerabilities.
W5>L2	+1	Reducing reliance on external energy supply contributes to the improvement of land management through less GHG emissions / waste.
W6>L2	0	There is no significant interaction
W1>L3	0	There is no significant direct interaction between the two goals
W2>L3	+1	Enhancing aquatic environments contributes to improving soil structure and composition through increased biodiversity and pollution control reducing

		contaminants.
W3>L3	+1	Enhancing human health contributes to the improvement of soil structure and composition through increased waste water effluent quality reducing pollution / contaminants.
W4>L3	+1	Enhancing the resilience of water service delivery contributes to the improvement of soil structure and composition through increased resilience of water treatment reducing pollutants / contaminants.
W5>L3	0	There is no significant direct interaction between the two goals
W6>L3	0	There is no significant direct interaction between the two goals
Energy to land		
E1>L1	+2	Decarbonisation of energy supply reinforces mitigation of flood risk / flooding due to climate effects (reducing GHG emissions from fossil fuels).
E2>L1	+1	Increasing energy security contributes to mitigation of flood risk / flooding due to climate effects (reducing GHG emissions from fossil fuels).
E3>L1	+2	Increasing use of renewables contributes to mitigation of flood risk / flooding due to climate effects (reducing GHG emissions from fossil fuels).
E4>L1	0	There is no significant direct interaction between the two goals
E1>L2	+1/-1	Decarbonisation of energy supply has differential effects on improving land management depending on the proportion of renewables / nuclear / fossil fuels and the relative levels of associated pollution.
E2>L2	+1	Increasing energy security contributes to improving land management through a secure energy supply and higher renewable energy use.
E3>L2	+1	Increasing use of renewables contributes to (enables) improving land management through higher renewable energy use (fewer GHG emissions / waste).
E4>L2	0	There is no significant interaction
E1>L3	0	There is no significant direct interaction between the two goals
E2>L3	0	There is no significant direct interaction between the two goals
E3>L3	0	There is no significant direct interaction between the two goals
E4>L3	0	There is no significant direct interaction between the two goals
Agriculture / food to land		
A/F1>L1	+3	Improving the agri-environment is inextricably linked to mitigation of flood risk / flooding due to synergistic environmental improvements.
A/F2>L1	+3	Developing catchment sensitive farming is inextricably linked to mitigation of flood risk / flooding (as above).
A/F3>L1	+1	Building farm businesses is likely to contribute to mitigation of flood risk / flooding through less intensive farming, diversification and good practice.
A/F4>L1	+1	Protecting standards of food production contributes to mitigation of flood risk / flooding through upholding standard agri-environmental practice.
A/F5>L1	+1	Reducing food supply chain emissions / waste contributes to mitigation of flood risk / flooding due to less pollution in the event of floods.
A/F1>L2	+3	Improving the agri-environment is inextricably linked to improving land management.
A/F2>L2	+3	Developing catchment sensitive farming is inextricably linked to improving land

		management.
A/F3>L2	+1/-1	Building farm businesses has differing effects on land management depending on the size / type of business and level of diversification etc.
A/F4>L2	+1/-1	Protecting standards of food production has differing effects on environmental land management depending on the type / level of standards, how well they are enforced and the size / type of farm business.
A/F5>L2	+2	Reducing food supply chain emissions / waste contributes to environmental land management
A/F1>L3	+3	Improving the agri-environment is inextricably linked to improving soil structure / composition.
A/F2>L3	+2	Developing catchment sensitive farming reinforces the improvement of soil structure / composition through fewer pollutants etc.
A/F3>L3	+1/-1	Building farm businesses has differing effects on the improvement of soil structure / composition depending on the size / type of business and level of diversification etc.
A/F4>L3	+1/-1	Protecting standards of food production has differing effects on the improvement of soil structure / composition depending on the type / level of standards, how well they are enforced and the size / type of farm business.
A/F5>L3	+1	Reducing food supply chain emissions / waste contributes to the improvement of soil structure / composition through less pollution.
Land to land		
L2>L1	+3	Improving land management is inextricably linked to mitigation of flood risk / flooding as both build greater resilience.
L3>L1	+3	Improving soil structure / composition is inextricably linked to mitigation of flood risk / flooding through reducing flash flooding due to compaction and pollution from run-off.
L1>L2	+2	Mitigation of flood risk / flooding reinforces improvements in land management by building greater resilience to climate / population shocks.
L3>L2	+3	Improving soil structure / composition is inextricably linked to improving land management.
L1>L3	+2	Mitigation of flood risk / flooding reinforces improvements in soil structure / composition through building resilience to climate and population-related shocks and vulnerabilities.
L2>L3	+3	Improving land management is inextricably linked to improving soil structure / composition.

5.3. Interactions between Nexus Critical Instruments (NCIs) and Nexus Critical Objectives (NCOs)

The nexus critical instruments (NCIs) were identified using the analysis of key policy instruments across the nexus sectors (section 4) and the stakeholder interviews (sub-section 5.1).

A nexus critical instrument is defined as 'the policy instrument that according to the stakeholders and the policy analysis is highly relevant for the issues under investigation in the case study and has a potentially high number of interactions with the nexus critical objectives'. (Munaretto and Witmer, 2017).

Fourteen NCIs were identified that aimed to attain one or more of the nexus critical objectives, were deemed highly relevant for the stakeholders interviewed, and were relevant to the design of the serious game. These are: water (4); energy (4); agriculture and food (3); and land (3). Table 14 lists the NCIs and provides more detail for clarity of definition and scoring.

Table 14Nexus Critical Instruments (NCIs)

Code	Policy Instrument (Heading)	Detailed description
Wa	Enhance sustainability of infrastructure	Increase sustainable urban drainage; reduce leakage; reduce demand
Wb	Paid ecosystem services approach	Implement payments for a range of ecosystem services relating to water service delivery
Wc	Maintain or enhance water / wastewater quality standards	Ensure standards of drinking water and waste water are sufficient to maintain or enhance human health
Wd	Programme of support for vulnerable communities	Invest in targeted support for vulnerable communities; increase efficiency of services
Code	Heading	
Ea	Support mechanisms for flexibility in energy system operation	Increase use of smart technologies and implement greater flexibility of supply
Eb	Support mechanisms to increase energy efficiency	Includes range of measures to make energy supply chain more efficient and reduce energy demand
Ec	Support mechanisms for low carbon energy production	Invest in low-carbon electricity generation and infrastructure to meet carbon and renewable energy targets
Ed	Programme of support for vulnerable communities	Use of data analytics and smart technology to identify vulnerable communities; subsidise bills of vulnerable customers

Code	Heading	
A/Fa	Enhance agricultural standards	Implement natural capital approach; reduce pollution from agriculture; implement sustainable soil management practices (reducing soil compaction and run-off); monitor and restrict / reduce chemical inputs; monitor and implement regulations on health and safety and hygiene; ensure environmental protection remains at least at current level post-Brexit
A/Fb	Enhance support for local food production	Includes subsidies, support for catchment sensitive farming and sustainable farming practices; knowledge exchange and training; support for diversification; infrastructure support including broadband; support for longer term tenancy agreements; post-Brexit transitional support
A/Fc	Reduce greenhouse gas (GHG) emissions	Includes reduction of GHG emissions across whole food supply chain
La	Improve natural and sustainable drainage (non-urban land)	Implement natural and sustainable drainage infrastructure
Lb	Invest in natural capital	Invest in range of measures including habitat creation; crop rotation; planting in fallow periods; planting of herb-rich leys; increased field margins; hedges; alternative sustainable farming practices; soil health;
Lc	Reduce waste disposal to landfill	Increase % of municipal waste recycled; divert organic municipal waste to composting; develop new separation techniques to increase recovery of waste; support energy generation from waste.

These policy instruments have been chosen after detailed analysis of the objectives and policy documents. They have been chosen because they are particularly important for the particular policy objectives identified for the South West case study and / or because they have a large number of interactions with the policy objectives.

Once the NCIs had been identified and agreed within the team, a scoring matrix was constructed assessing the interactions between the NCOs and NCIs (Table 15). Once again, an iterative approach was adopted using the expert judgement of researchers, information gained from the interviews and from scientific and grey literature. Scoring was based on the same method as employed for scoring the NCOs.

(Munaretto and Witmer 2017)

-3 (cancelling): Progress in one objective makes it impossible to reach another objective and possibly Scoring system for the assessment of policy coherence

leads to a deteriorating state of the second. A choice has to be

made between the two (trade-off).

-2 (counteracting): The pursuit of one objective counteracts another objective.

-1 (constraining): The pursuit of one objective sets a condition or a constraint on the

achievement of another objective.

0 (consistent): There is no significant interaction between two objectives.

+1 (enabling): The pursuit of one objective enables the achievement of another

objective.

+2 (reinforcing): One objective directly creates conditions that lead to the

achievement of another objective.

+3 (indivisible): One objective is inextricably linked to the achievement of another

objective.

NB. there were some occasions when the interactions could have very different outcomes according to the context. The assessment in these cases is represented by more than one value (e.g. –1/+1).

Table 15 Scoring Matrix: Interactions between Nexus Critical Instruments (NCIs) and Nexus Critical Objectives (NCOs)

	W1	W2	W3	W4	W5	W6	E1	E2	E3	E4	A/F1	A/F2	A/F3	A/F4	A/F5	L1	L2	L3	Tot. n. +	Tot. n. -	Tot. n. (-/+)
Wa	+3	+1	+2	+2	+1	+1	0	+1	0	0	+1	+1	+1	+1	+1	+3	+1	+1	21	0	21
Wb	+1	+1	+1	+1	0	+1	0	0	0	0	+1	+2	+2	+1	+2	+2	+2	+2	19	0	19
Wc	+1	+2	+2	+1	-1	-1	0	-1	0	0	+1	+1	+1/-1	+1	+1	+1	+2	+1	15	4	11
Wd	+1/-1	+1	+1	+1	+1	+3	0	0	0	+1	0	0	+1	+1	0	+1	0	0	12	1	11
Ea	+1	0	+1	+1	+1/-1	+1	+1	+3	+3	+1	0	0	+1	+1	+1	+1	0	0	17	1	16
Eb	+1	0	0	+1	+1	+1	+1	+3	+1	+2	0	0	+1	+1	+1	+1	0	0	15	0	15
Ec	+1/-1	+1/-1	+1/-1	+1/-1	+1	+1/-1	+3	+2	+1/-1	+1/-1	+1/-1	+1/-1	+2	+1/-1	+1	+2	+1	+1	23	10	13
Ed	+1	0	0	0	0	+1	0	0	0	+3	0	0	+1	0	0	+1	0	0	7	0	7
A/Fa	+1	+2	+2	+1	+1	+1	0	0	0	0	+3	+3	+1/-1	+3	+1	+2	+3	+3	27	1	26
A/Fb	+1	+2	+2	+1	+1	+1	+2	+1	+1	+1	+2	+2	+3	+1	+2	+2	+3	+2	30	0	30
A/Fc	0	+2	+1	+1	+1	+1	+1	+1	+1	0	+1	+1	+1/-1	+1	+3	+3	+1	0	20	1	19
La	+3	+2	+2	+2	+1	+1/-1	0	+1	0	0	+1	+1	+1	+1	+1	+3	+2	+2	24	1	23
Lb	+1	+2	+1	+1	+1	+1	0	+1	0	0	+2	+2	+2	+1	+2	+2	+2	+3	23	0	23
Lc	+1	+2	+2	+1	+1	+1	0	+1	+2	+1	+2	+2	+1	+1	+3	+1	+1	+1	24	0	24
Tot. n. +	17	18	18	15	11	15	8	14	9	10	15	16	19	15	19	25	18	16			
Tot. n. -	2	1	1	1	2	3	0	1	1	1	1	1	3	1	0	0	0	0			
Tot.	15	17	17	14	9	12	8	13	8	9	14	15	16	14	19	25	18	16			

n. - /+																					

Key to scoring:

Cancelling	-3
Counteracting	-2
Constraining	-1
Neutral	0
Enabling	+1
Reinforcing	+2
Indivisible	+3
Multiple	+1/-1

The justifications for the scoring above can be found below in Table 16.

Description of the overall assessment: most relevant/striking results

The policy instruments and objectives display a high number of interactions and a moderate to high level of synergy overall, with many of the instruments appearing to work in synergy with the policy objectives, especially within sectors but also to some extent across sectors. This is justified by the high level of complementarity and overlap between policy instruments and objectives chosen, based on the literature, analysis of policies and on opinions of stakeholders obtained from the workshops and interviews. However, as shown in the detailed justifications, many of these synergies correspond to potential or conditional effects only, depending on how the policy instruments are implemented. Specifically, the interactions show high degrees of conditionality and multiple effects depending on the following:

- the proportion of nuclear vs. renewable energy generation implemented as part of the decarbonisation objectives/instruments;
- the specific components of subsidies (support for local food production / farm business development) and how these are implemented and enforced – according to stakeholders these are currently having multiple effects;
- how natural capital policy instruments are implemented in practice – although natural capital is a key policy component the detail of the implementation and its effects are currently uncertain;
- the relative costs e.g. of increasing sustainability (water objectives/instruments), protecting /enhancing agricultural and water quality standards etc.

The conflicts identified mainly relate to the cost implications of enhancing water quality / wastewater standards which potentially impact on affordability to customers and on farm business development; and to the effects of support for low carbon energy generation where that concerns nuclear energy generation.

The scoring totals show that the agriculture (highest) and land (second highest) policy instruments had the highest overall interaction scores (they had the most synergistic effects on policy objectives) – with 'enhancing support for local food production' (A/Fb) having the highest score (30). The energy instruments had the lowest scores (least supported the policy objectives), with 'programme of support for vulnerable energy customers' (Ed) the least (7).

In the same way, the land (highest) and agricultural (second highest) policy objectives showed the highest overall interaction scores (best supported by the policy instruments), with mitigation of flood risk and flooding (L1) the highest scored (25), and energy having the lowest scores (least supported by policy instruments), with 'decarbonisation of energy supply' (E1); 'increasing use of energy resources' (E3) jointly the least (8).

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Table 16 Justification of interactions between NCIs and NCOs

The following table provides the justifications for the scores above describing the interaction between NCIs and NCOs, and explaining how either one or more instruments together interact with the objectives with the effect of either hampering or supporting the achievement of the nexus critical objectives.

The scoring of interactions is based on expert judgment of researchers and on relevant literature, and controversial scores and issues were discussed and validated with experts and stakeholders where possible (via interviews, workshops etc). The scoring is based on responses to the following question: *What happens to objective X when instrument Y is implemented?* (i.e. only one-way interactions were assessed in this section).

Interaction	Score	Justification
Interactions with Water objectives		
Wa>W1	+3	Enhancing the sustainability of infrastructure is an extremely important part of (and inextricably linked to) enhancing the sustainability of water service delivery.
Wb>W1	+1	Implementing a paid ecosystem approach is likely to contribute to (have an enabling effect on) the sustainability of water service delivery but the extent of the contribution will vary considerably depending on which ecosystem service(s) is involved and how effective the payment system is.
Wc>W1	+1	Maintaining or enhancing water / wastewater quality standards enables (it is a vital condition for) the sustainability of water service delivery.
Wd>W1	+1/-1	Addressing affordability of water services for consumers is likely to have multiple effects on the sustainability of water service delivery depending on the particular pricing system used and how this relates to the real cost of sustainable water service delivery.
Ea>W1	+1	Supporting mechanisms for flexibility in energy system operation contributes to (enables) the enhancement of sustainable water service delivery through providing a flexible and sustainable energy supply.

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Eb>W1	+1	Supporting mechanisms to increase energy efficiency contributes to (enables) the enhancement of sustainable water service delivery through providing a more efficient and sustainable energy supply.
Ec>W1	+1/-1	Supporting mechanisms for low carbon energy production has multiple effects on the sustainability of water service delivery depending on which type of energy production, the effects on energy pricing, and the level and type of support.
Ed>W1	+1	Implementing a programme of support for vulnerable communities (regarding their energy bills) contributes to (enables) the sustainability of water service delivery through increased affordability of water services.
A/Fa>W1	+1	Enhancing agricultural standards contributes to (enables) the enhancement of sustainable water service delivery through reducing costs of water (recycling) treatment and contributing to the baseline water quality.
A/Fb>W1	+1	Enhancing support for local food production contributes to (enables) the enhancement of sustainable water service delivery through reducing costs of water (recycling) treatment and contributing to the baseline water quality e.g. through subsidies for catchment sensitive farming.
A/Fc>W1	0	There is no significant direct interaction between the two.
La>W1	+3	Improving natural and sustainable drainage (on non-urban land) is inextricably linked to enhancing the sustainability of water service delivery.
Lb>W1	+1	Investing in natural capital contributes to (enables) the enhancement of sustainable water service delivery through reducing costs of water (recycling) treatment and contributing to the baseline water quality.
Lc>W1	+1	Reducing waste disposal to landfill is likely to contribute to (enables) the enhancement of sustainable water service delivery through reducing contamination from waste and thereby reducing costs of water (recycling) treatment and contributing to the baseline water quality.
Wa>W2	+1	Enhancing the sustainability of infrastructure contributes to (enables) the enhancement of the natural capital of aquatic environments through providing adequate and sustainable infrastructure for water treatment (e.g. minimising accidents and effects of too much leakage impacting on water levels and quality).
Wb>W2	+1	Implementing a paid ecosystem services approach is likely to contribute to (enable) the enhancement of the natural capital of aquatic environments through e.g. paying land managers to decrease chemical / pesticide / fertiliser run-off. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented are.
Wc>W2	+2	Enhancing water / wastewater quality standards reinforces the natural capital of aquatic environments through cleaner wastewater going (back) into watercourses.
Wd>W2	+1	Implementing a programme of support for vulnerable communities contributes to (enables) the enhancement of the natural capital of aquatic environments where it results in less abstraction resulting from increased efficiency of water use.
Ea>W2	0	There is no significant direct interaction between the two.
Eb>W2	0	There is no significant direct interaction between the two.
Ec>W2	+1/-1	Support mechanisms for low carbon energy production have differing effects on the natural capital of aquatic environments depending on the proportion of nuclear vs. renewables and the related impacts.

Ed>W2	0	There is no significant direct interaction between the two.
A/Fa>W2	+2	Enhancing agricultural standards is likely to reinforce the enhancement of the natural capital of aquatic environments through positive environmental effects resulting from better farming practices, providing the standards are appropriate, achievable and adequately enforced (they may not be achievable for small producers).
A/Fb>W2	+2	Enhancing support for local food production is likely to reinforce the enhancement of the natural capital of aquatic environments through positive environmental effects resulting from better farming practices e.g. catchment sensitive farming, but the effects will differ depending on the type of subsidy and level of enforcement etc (and this may have unpredictable / unforeseen effects).
A/Fc>W2	+2	Reducing greenhouse gas (GHG) emissions is likely to reinforce the enhancement of the natural capital of aquatic environments through less pollution from fossil fuels.
La>W2	+2	Improving natural and sustainable drainage (on non-urban land) reinforces the enhancement of the natural capital of aquatic environments e.g. through better water filtration, protection of water flows and recharging of aquifers etc.
Lb>W2	+2	Investing in natural capital is likely to have positive impacts (reinforcing) the enhancement of aquatic environments through habitat creation; increasing field margins etc.
Lc>W2	+2	Reducing waste disposal to landfill reinforces the enhancement of the natural capital of aquatic environments through less pollution.
Wa>W3	+2	Enhancing the sustainability of infrastructure contributes to (enables) the protection / enhancement of human health through providing adequate and sustainable infrastructure for water treatment.
Wb>W3	+1	Implementing a paid ecosystem services approach is likely to contribute to (enable) the protection / enhancement of human health through e.g. paying land managers to decrease chemical / pesticide / fertiliser run-off. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented are.
Wc>W3	+2	Enhancing water / wastewater quality standards reinforces the protection / enhancement of human health through cleaner water, providing the standards are appropriate, achievable and adequately enforced.
Wd>W3	+1	Implementing a programme of support for vulnerable communities contributes to (enables) the enhancement of human health through ensuring adequate water supply to these communities for cleaning activities etc.
Ea>W3	+1	Implementing support mechanisms for flexibility in energy system operation contributes to (enables) the protection / enhancement of human health through ensuring adequate energy supply for water treatment.
Eb>W3	0	There is no significant direct interaction between the two.
Ec>W3	+1/-1	Supporting mechanisms for low carbon energy production has differing impacts on protecting / enhancing human health depending on the proportion of nuclear vs. renewables and the related impacts.
Ed>W3	0	There is no significant direct interaction between the two.
A/Fa>W3	+2	Enhancing agricultural standards is likely to reinforce the protection / enhancement of human health through positive effects on water quality from better farming practices, providing the standards are appropriate, achievable and adequately enforced (they

		may not be achievable for small producers).
A/Fb>W3	+2	Enhancing support for local food production is likely to reinforce the protection / enhancement of human health through positive effects on water quality from better farming practices e.g. catchment sensitive farming, but the effects will differ depending on the type of subsidy and level of enforcement etc (and this may have unpredictable / unforeseen effects).
A/Fc>W3	+1	Reducing greenhouse gas (GHG) emissions contributes to the protection / enhancement of human health through less pollution of water from fossil fuels.
La>W3	+2	Improving natural and sustainable drainage (on non-urban land) reinforces the protection / enhancement of human health e.g. through better water filtration impacting positively on water quality.
Lb>W3	+1	Investing in natural capital is likely to contribute to the protection / enhancement of human health through positive effects of e.g. habitat creation; increasing field margins etc. on water quality depending on what is invested in and the effectiveness of enforcement mechanisms.
Lc>W3	+2	Reducing waste disposal to landfill reinforces the protection / enhancement of human health through less pollution of water courses.
Wa>W4	+2	Enhancing the sustainability of infrastructure reinforces efforts to enhance the resilience of water service delivery as sustainable urban drainage is likely to mitigate population- and climate change-related effects.
Wb>W4	+1	Implementing a paid ecosystem services approach is likely to contribute to (enable) the resilience of water service delivery e.g. paying land managers to decrease pollution from run-off. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented are.
Wc>W4	+1	Enhancing water / wastewater quality standards contributes to (enables) the resilience of water service delivery through cleaner water / wastewater, providing the standards are appropriate, achievable and adequately enforced.
Wd>W4	+1	Implementing a programme of support for vulnerable communities contributes to (enables) the resilience of water service delivery through improving efficiency of service delivery.
Ea>W4	+1	Implementing support mechanisms for flexibility in energy system operation contributes to (enables) the resilience of water service delivery through ensuring adequate energy supply for water services.
Eb>W4	+1	Supporting mechanisms to increase energy efficiency contributes to (enables) the resilience of water service delivery through ensuring adequate energy supply / reducing energy demand relating to water services.
Ec>W4	+1/-1	Supporting mechanisms for low carbon energy production has differing impacts on the resilience of water service delivery depending on the proportion of nuclear vs. renewables and the related impacts.
Ed>W4	0	There is no significant direct interaction between the two.
A/Fa>W4	+1	Enhancing agricultural standards is likely to contribute to the resilience of water service delivery through positive effects on water quality from better farming practices, providing the standards are appropriate, achievable and adequately enforced.
A/Fb>W4	+1	Enhancing support for local food production is likely to contribute to the resilience of water service delivery through positive effects on water quality from better farming practices e.g. catchment sensitive farming, but the effects will differ depending on

		the type of subsidy and level of enforcement etc.
A/Fc>W4	+1	Reducing greenhouse gas (GHG) emissions contributes to the resilience of water service delivery through less pollution of water from fossil fuels.
La>W4	+2	Improving natural and sustainable drainage (on non-urban land) reinforces the resilience of water service delivery e.g. through better water improved filtration mitigating climate- and population-related effects.
Lb>W4	+1	Investing in natural capital is likely to contribute to the resilience of water service delivery through positive effects of e.g. habitat creation; increasing field margins, but the extent depends on what is invested in and the adequacy of the enforcement mechanisms.
Lc>W4	+1	Reducing waste disposal to landfill contributes to (enables) the resilience of water service delivery through less pollution of water courses.
Wa>W5	+1	Enhancing the sustainability of infrastructure reinforces efforts to reduce reliance on external energy supply due to fewer energy costs.
Wb>W5	0	There is no significant direct interaction between the two.
Wc>W5	-1	Enhancing water / wastewater quality standards constrains efforts to reduce reliance on external energy supply through added costs of energy required to meet enhanced standards.
Wd>W5	+1	Implementing a programme of support for vulnerable communities contributes to efforts to reduce reliance on external energy supply through improving efficiency of service delivery.
Ea>W5	+1/-1	Implementing support mechanisms for flexibility in energy system operation is likely to have multiple effects on reliance on external energy supply through less external energy demand (more efficient supply) and / or it may provide a disincentive (constraint) where it leads to a cheaper and more efficient external energy supply.
Eb>W5	+1	Supporting mechanisms to increase energy efficiency contributes to (enables) efforts to reduce reliance on external energy supply through improving efficiency of service delivery.
Ec>W5	+1	Supporting mechanisms for low carbon energy production contributes to (enables) efforts to reduce reliance on external energy supply through expanding renewable energy generation.
Ed>W5	0	There is no significant direct interaction between the two.
A/Fa>W5	+1	Enhancing agricultural standards is likely to contribute to (enable) efforts to reduce reliance on external energy supply through less energy required for water treatment (cleaner water prior to treatment).
A/Fb>W5	+1	Enhancing support for local food production is likely to contribute to efforts to reduce reliance on external energy supply through positive effects on water quality from better farming practices e.g. catchment sensitive farming (leading to lower energy required for treatment) and expanding renewable energy generation, but the effects will differ depending on the type of subsidy and level of enforcement etc.
A/Fc>W5	+1	Reducing greenhouse gas (GHG) emissions contributes to efforts to reduce reliance on external energy supply through lower energy requirements for treatment (less pollution of water from fossil fuels).

La>W5	+1	Improving natural and sustainable drainage (on non-urban land) contributes to reducing reliance on external energy supply e.g. through improved filtration leading to less need for energy expenditure on treatment.
Lb>W5	+1	Investing in natural capital is likely to contribute to reducing reliance on external energy supply e.g. through improved filtration leading through positive effects of e.g. habitat creation resulting in cleaner water and fewer requirements for treatment.
Lc>W5	+1	Reducing waste disposal to landfill contributes to (enables) reducing reliance on external energy supply through fewer energy requirements for water treatment.
Wa>W6	+1	Enhancing the sustainability of infrastructure contributes to efforts to address affordability of water services for consumers as sustainable urban drainage is likely to lead to cost efficiencies (providing costs of infrastructure work are not passed on to consumers).
Wb>W6	+1	Implementing a paid ecosystem services approach is likely to contribute to (enable) efforts to address affordability of water services for consumers e.g. through decreasing water treatment costs due to pollution from run-off. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented are.
Wc>W6	-1	Enhancing water / wastewater quality standards is likely to constrain efforts to address affordability of water services through added treatment costs to meet enhanced standards.
Wd>W6	+3	Implementing a programme of support for vulnerable communities is inextricably linked to efforts to address affordability of water services.
Ea>W6	+1	Implementing support mechanisms for flexibility in energy system operation contributes to efforts to address affordability of water services through increased reliability of supply (and there may be some cost savings e.g. through local supply).
Eb>W6	+1	Supporting mechanisms to increase energy efficiency contributes to (enables) efforts to address affordability of water services through potential efficiency-related cost savings.
Ec>W6	+1/-1	Supporting mechanisms for low carbon energy production is likely to have multiple effects on efforts to address affordability of water services depending on the proportion of nuclear vs. renewables and the relative costs involved and the level of government subsidies.
Ed>W6	+1	Implementing a programme of support for vulnerable communities (energy) is likely to contribute to efforts to address affordability of water services.
A/Fa>W6	+1	Enhancing agricultural standards is likely to contribute to (enable) efforts to address affordability of water services through fewer costs required for water treatment (cleaner water prior to treatment).
A/Fb>W6	+1	Enhancing support for local food production is likely to contribute to efforts to address affordability of water services through positive effects on water quality from better farming practices e.g. catchment sensitive farming (leading to lower treatment costs), but the effects will differ depending on the type of mechanism / subsidy and level of enforcement etc.
A/Fc>W6	+1	Reducing greenhouse gas (GHG) emissions contributes to efforts to address affordability of water services through lower treatment requirements (less pollution of water from fossil fuels).
La>W6	+1/-1	Improving natural and sustainable drainage (on non-urban land) potentially has multiple effects on efforts to address

		affordability of water services depending on the relative cost of these measures compared with the related treatment costs and to what extent any extra costs are passed on to the consumer.
Lb>W6	+1	Investing in natural capital has the potential to contribute to efforts to address affordability of water services depending on the relative costs and providing any extra costs are not passed on to the consumer.
Lc>W6	+1	Reducing waste disposal to landfill contributes to (enables) efforts to address affordability of water services through cost savings on water treatment.
Interactions with energy objectives		
Wa>E1	0	There is no significant direct interaction between the two.
Wb>E1	0	There is no significant direct interaction between the two.
Wc>E1	0	There is no significant direct interaction between the two.
Wd>E1	0	There is no significant direct interaction between the two.
Ea>E1	+1	Implementing support mechanisms for flexibility in energy system operation contributes to decarbonisation of energy supply through increased support for stability and flexibility of supply necessary for renewable energy use.
Eb>E1	+1	Supporting mechanisms to increase energy efficiency potentially contributes to (enables) decarbonisation of energy supply through fewer energy demands.
Ec>E1	+3	Supporting mechanisms for low carbon energy production is inextricably linked to decarbonisation of energy supply.
Ed>E1	0	There is no significant direct interaction between the two.
A/Fa>E1	0	There is no significant direct interaction between the two.
A/Fb>E1	+2	Enhancing support for local food production is likely to reinforce decarbonisation of energy supply through support / subsidies for renewable energy generation.
A/Fc>E1	+1	Reducing greenhouse gas (GHG) emissions is likely to contribute to decarbonisation of energy supply as some of the measures are common to both.
La>E1	0	There is no significant direct interaction between the two.
Lb>E1	0	There is no significant direct interaction between the two.
Lc>E1	0	There is no significant direct interaction between the two.
Wa>E2	+1	Enhancing the sustainability of infrastructure can contribute to increasing energy security where infrastructure improvements and efficiencies lead to reduced energy demand e.g. for pumping of water.
Wb>E2	0	There is no significant direct interaction between the two.
Wc>E2	-1	Enhancing water / wastewater quality standards is likely to constrain efforts to increase energy security through added energy demands to meet enhanced standards.
Wd>E2	0	There is no significant direct interaction between the two.

Ea>E2	+3	Implementing support mechanisms for flexibility in energy system operation is inextricably linked to increasing energy security.
Eb>E2	+3	Supporting mechanisms to increase energy efficiency is inextricably linked to increasing energy security.
Ec>E2	+2	Supporting mechanisms for low carbon energy production potentially reinforces efforts to increase energy security where these include mechanisms supporting smart / flexible supply and / or renewables generation.
Ed>E2	0	There is no significant direct interaction between the two.
A/Fa>E2	0	There is no significant direct interaction between the two.
A/Fb>E2	+1	Enhancing support for local food production is likely to contribute to efforts to increase energy security where there is support / subsidies for local renewable energy generation.
A/Fc>E2	+1	Reducing greenhouse gas (GHG) emissions is likely to contribute to efforts to increase energy security where measures reduce demand or support renewable energy generation.
La>E2	+1	Improving natural and sustainable drainage (on non-urban land) contributes to efforts to increase energy security e.g. through improved filtration leading to less energy demand for treatment.
Lb>E2	+1	Investing in natural capital is likely to contribute to efforts to increase energy security e.g. through improved filtration leading through positive effects of e.g. habitat creation resulting in cleaner water and less energy demand for treatment.
Lc>E2	+1	Reducing waste disposal to landfill is likely to contribute to efforts to increase energy security through less energy demand for water treatment.
Wa>E3	0	There is no significant direct interaction between the two.
Wb>E3	0	There is no significant direct interaction between the two.
Wc>E3	0	There is no significant direct interaction between the two.
Wd>E3	0	There is no significant direct interaction between the two.
Ea>E3	+3	Implementing support mechanisms for flexibility in energy system operation is inextricably linked to increasing use of renewable resources through unblocking barriers to delivery.
Eb>E3	+1	Supporting mechanisms to increase energy efficiency contributes to efforts to increase use of renewable resources through assisting with unblocking barriers to delivery and potentially reducing energy demand.
Ec>E3	+1/-1	Supporting mechanisms for low carbon energy production has multiple effects on efforts to increase use of renewable resources depending on whether is supporting nuclear or renewables generation.
Ed>E3	0	There is no significant direct interaction between the two.
A/Fa>E3	0	There is no significant direct interaction between the two.
A/Fb>E3	+1	Enhancing support for local food production is likely to contribute to efforts to increase use of renewable resources where there is support / subsidies for local renewable energy generation.
A/Fc>E3	+1	Reducing greenhouse gas (GHG) emissions is likely to contribute to efforts to increase use of renewable resources where measures reduce demand or support renewable energy generation.
La>E3	0	There is no significant direct interaction between the two.

Lb>E3	0	There is no significant direct interaction between the two.
Lc>E3	+2	Reducing waste disposal to landfill is likely to reinforce efforts to increase use of renewable resources through supporting the recycling of waste and the production of renewable energy from waste.
Wa>E4	0	There is no significant direct interaction between the two.
Wb>E4	0	There is no significant direct interaction between the two.
Wc>E4	0	There is no significant direct interaction between the two.
Wd>E4	+1	Support for vulnerable communities (water bills) could potentially contribute to affordability for consumers (energy services) e.g. through information sharing (e.g. Healthy Homes programme) as there may be some crossover.
Ea>E4	+1	Implementing support mechanisms for flexibility in energy system operation could contribute to affordability for energy consumers where there is greater flexibility and more information available to customers about e.g. household use.
Eb>E4	+2	Supporting mechanisms to increase energy efficiency reinforces affordability for energy consumers through cost savings and potentially reducing energy demand.
Ec>E4	+1/-1	Supporting mechanisms for low carbon energy production has multiple effects on affordability for consumers depending on the relative costs and subsidies available and the proportion of nuclear vs. renewables generation.
Ed>E4	+3	Supporting vulnerable communities is inextricably linked to addressing affordability for consumers.
A/Fa>E4	0	There is no significant direct interaction between the two.
A/Fb>E4	+1	Enhancing support for local food production could contribute to addressing affordability for consumers e.g. where there is support / subsidies for local renewable energy generation and this can be done on-farm or in the locality.
A/Fc>E4	0	There is no significant direct interaction between the two.
La>E4	0	There is no significant direct interaction between the two.
Lb>E4	0	There is no significant direct interaction between the two.
Lc>E4	+1	Reducing waste disposal to landfill is likely to contribute to affordability for consumers where it supports the recycling of waste and the production of renewable energy from waste and this enables cheaper energy supply.
Interactions with Agriculture / Food objectives		
Wa>A/F1	+1	Enhancing the sustainability of infrastructure enables improvements to the agri-environment through ensuring a clean and sustainable water supply and cleaner water flows through agricultural land.
Wb> A/F1	+1	Implementing a paid ecosystem services approach (water systems) is likely to contribute to (enable) improvements to the agri-environment e.g. through decreasing pollution from run-off. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented are.

Wc> A/F1	+1	Enhancing water / wastewater quality standards contributes to (enables) improvements to the agri-environment e.g. through cleaner water supply and water flow through agricultural land (providing the standards are appropriate, achievable and adequately enforced).
Wd> A/F1	0	There is no significant direct interaction between the two.
Ea> A/F1	0	There is no significant direct interaction between the two.
Eb> A/F1	0	There is no significant direct interaction between the two.
Ec> A/F1	+1/-1	Supporting mechanisms for low carbon energy generation potentially has multiple effects on the agri-environment through e.g. reducing pollution from fossil fuels but nuclear energy may have detrimental effects longer term.
Ed> A/F1	0	There is no significant direct interaction between the two.
A/Fa> A/F1	+3	Maintaining / enhancing agricultural standards is inextricably linked to improving the agri-environment, providing standards are appropriate, achievable and adequately enforced (small producers may not be able to meet these standards).
A/Fb> A/F1	+2	Enhancing support for local food production is likely to reinforce the improvement of the agri-environment e.g. where there are beneficial effects from diversification, increased knowledge, catchment sensitive farming etc providing measures are adequately enforced.
A/Fc> A/F1	+1	Reducing greenhouse gas (GHG) emissions is likely to contribute to the improvement of the agri-environment where it results in reductions in pollution from fossil fuels.
La> A/F1	+1	Improving natural and sustainable drainage (on non-urban land) contributes to the improvement of the agri-environment through improved filtration (cleaner water flows), less flooding of productive agricultural land etc.
Lb> A/F1	+2	Investing in natural capital (e.g. habitat creation; crop rotation) is likely to reinforce the improvement of the agri-environment providing measures are appropriate, achievable and adequately enforced.
Lc> A/F1	+2	Reducing waste disposal to landfill reinforces improvements to the agri-environment through less waste-related pollution.
Wa>A/F2	+1	Enhancing the sustainability of infrastructure enables development of catchment sensitive farming through ensuring clean and sustainable water supply, flows and infrastructure downstream.
Wb>A/F2	+2	Implementing a paid ecosystem services approach (water systems) is likely to reinforce development of catchment sensitive farming e.g. through payments to farmers for reducing pollution from run-off. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented and enforcement are.
Wc>A/F2	+1	Enhancing water / wastewater quality standards contributes to (enables) development of catchment sensitive farming e.g. through cleaner wastewater and water flows through agricultural land (providing standards are appropriate, achievable and adequately enforced).
Wd>A/F2	0	There is no significant direct interaction between the two.
Ea>A/F2	0	There is no significant direct interaction between the two.
Eb>A/F2	0	There is no significant direct interaction between the two.
Ec>A/F2	+1/-1	Supporting mechanisms for low carbon energy generation potentially has multiple effects on catchment sensitive farming

		through e.g. reducing pollution from fossil fuels but nuclear energy may have detrimental effects longer term.
Ed>A/F2	0	There is no significant direct interaction between the two.
A/Fa>A/F2	+3	Enhancing agricultural standards is inextricably linked to development of catchment sensitive farming, providing standards are appropriate, achievable and adequately enforced (small producers may not be able to meet these standards).
A/Fb>A/F2	+2	Enhancing support for local food production is likely to reinforce development of catchment sensitive farming e.g. where there are beneficial effects from diversification, increased knowledge, good environmental practices etc providing measures are adequately enforced.
A/Fc>A/F2	+1	Reducing greenhouse gas (GHG) emissions is likely to contribute to development of catchment sensitive farming where it results in reductions in pollution from fossil fuels.
La>A/F2	+1	Improving natural and sustainable drainage (on non-urban land) is likely to contribute to development of catchment sensitive farming through improved filtration (cleaner water flows), less flooding of productive agricultural land etc.
Lb>A/F2	+2	Investing in natural capital (e.g. habitat creation; crop rotation) is likely to reinforce development of catchment sensitive farming providing measures are appropriate, achievable and adequately enforced.
Lc>A/F2	+2	Reducing waste disposal to landfill reinforces development of catchment sensitive farming through less waste-related pollution.
Wa>A/F3	+1	Enhancing sustainability of water infrastructure is an enabling factor for farm business development i.e. a clean sustainable water supply.
Wb>A/F3	+2	Implementing a paid ecosystem services approach (water systems) is likely to reinforce farm business development e.g. through payments to farmers for a range of services. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented and the enforcement are.
Wc>A/F3	+1/-1	Enhancing water / wastewater quality standards has potential multiple effects on farm business development e.g. through cleaner water, wastewater and water flows through agricultural land but it may be costly to meet the wastewater standards and it depends on whether the standards are appropriate, achievable and adequately enforced.
Wd>A/F3	+1	Support for vulnerable communities (water bills) is an enabling factor for farm business development where they receive help to pay bills and / or other related support.
Ea>A/F3	+1	Implementing support mechanisms for flexibility in energy system operation could contribute to farm business development where there is greater flexibility of energy use and more information available to businesses about their own energy use.
Eb>A/F3	+1	Supporting mechanisms to increase energy efficiency is likely to contribute to farm business development where they are able to cut costs of their own energy use.
Ec>A/F3	+2	Supporting mechanisms for low carbon energy generation is likely to reinforce farm business development where it involves supporting local renewable energy generation and farmers are able to take up these opportunities.
Ed>A/F3	+1	Support for vulnerable communities (energy bills) is an enabling factor for farm business development where they receive help to pay bills and / or other related support.
A/Fa>A/F3	+1/-1	Enhancing agricultural standards has multiple effects on farm business development – they may enhance it where standards are

		appropriate, achievable and adequately enforced but may increase costs especially for small producers (who may not be able to meet these standards).
A/Fb>A/F3	+3	Enhancing support for local food production is inextricably linked to farm business development through support for a range of farm business activities including supporting longer term tenancies, knowledge exchange, training etc.
A/Fc>A/F3	+1/-1	Reducing greenhouse gas (GHG) emissions is likely to have multiple effects on farm business development – positive effects from reduction in pollution but there may be increased costs to reduce emissions across the whole chain.
La>A/F3	+1	Improving natural and sustainable drainage (on non-urban land) is likely to contribute to farm business development through improved filtration (cleaner water flows), less flooding of productive agricultural land etc.
Lb>A/F3	+2	Investing in natural capital (e.g. habitat creation; crop rotation) is likely to reinforce farm business development through increased environmental status and opportunities to diversify into tourism etc, providing measures are appropriate, achievable and adequately enforced.
Lc>A/F3	+1	Reducing waste disposal to landfill is likely to contribute to farm business development through less waste-related pollution.
Wa>A/F4	+1	Enhancing sustainability of water infrastructure is an enabling factor for protecting standards of food production i.e. a clean sustainable water supply for cleaning purposes etc.
Wb>A/F4	+1	Implementing a paid ecosystem services approach (water systems) is likely to contribute to protecting standards of food production e.g. through payments to farmers for beneficial environmental practices such as reducing chemical inputs. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented and the enforcement are.
Wc>A/F4	+1	Enhancing water / wastewater quality standards is an enabling factor for protecting standards of food production through ensuring a clean and safe water supply.
Wd>A/F4	+1	Support for vulnerable communities (water bills) is an enabling factor for protecting standards of food production where they receive help to pay bills and / or other related support (this is likely to be very small numbers currently but may be more post-Brexit).
Ea>A/F4	+1	Implementing support mechanisms for flexibility in energy system operation is an enabling factor for protecting standards of food production as it provides a stable and flexible energy supply for farming activities.
Eb>A/F4	+1	Supporting mechanisms to increase energy efficiency is an enabling factor for protecting standards of food production (potentially fewer energy costs).
Ec>A/F4	+1/-1	Supporting mechanisms for low carbon energy generation has potential multiple effects on protecting standards of food production through reducing pollution from fossil fuels but would depend on the proportion of nuclear vs. renewables and the related effects.
Ed>A/F4	0	There is no significant direct interaction between the two.
A/Fa>A/F4	+3	Enhancing agricultural standards is inextricably linked to the protection of standards of food production where they are appropriate, achievable and adequately enforced (but small producers may not be able to meet these standards).

A/Fb>A/F4	+1	Enhancing support for local food production is likely to contribute to the protection of standards of food production through info and support for best practice etc.
A/Fc>A/F4	+1	Reducing greenhouse gas (GHG) emissions is likely to contribute to the protection of standards of food production through reduced pollution.
La>A/F4	+1	Improving natural and sustainable drainage (on non-urban land) is likely to contribute to the protection of standards of food production through improved filtration (cleaner water flows), less polluting flooding events etc.
Lb>A/F4	+1	Investing in natural capital (e.g. habitat creation; crop rotation) is likely to contribute to the protection of standards of food production (less pollution).
Lc>A/F4	+1	Reducing waste disposal to landfill is likely to contribute to the protection of standards of food production through less waste-related pollution entering food chain.
Wa>A/F5	+1	Enhancing sustainability of water infrastructure is an enabling factor for reducing food supply chain emissions and waste i.e. a clean sustainable water supply.
Wb>A/F5	+2	Implementing a paid ecosystem services approach (water systems) is likely to reinforce the reduction of food supply chain emissions and waste e.g. through payments to farmers for beneficial environmental practices such as reducing chemical inputs. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented and the enforcement are.
Wc>A/F5	+1	Enhancing water / wastewater quality standards is an enabling factor for reducing food supply chain emissions and waste through ensuring a clean and safe water supply.
Wd>A/F5	0	There is no significant direct interaction between the two.
Ea>A/F5	+1	Implementing support mechanisms for flexibility in energy system operation is an enabling factor for reducing food supply chain emissions and waste where it supports flexible / local / renewable energy generation.
Eb>A/F5	+1	Supporting mechanisms to increase energy efficiency is an enabling factor for reducing food supply chain emissions and waste (potentially reducing polluting forms of energy use / energy-related emissions).
Ec>A/F5	+1	Supporting mechanisms for low carbon energy generation is likely to reinforce reducing food supply chain emissions and waste through reducing pollution from fossil fuels (but depends on the proportion of nuclear vs. renewables and the related effects).
Ed>A/F5	0	There is no significant direct interaction between the two.
A/Fa>A/F5	+1	Enhancing agricultural standards potentially contributes to reducing food supply chain emissions and waste where standards cover this aspect and providing they are appropriate, achievable and adequately enforced (small producers may not be able to meet these standards).
A/Fb>A/F5	+2	Enhancing support for local food production is likely to reinforce the reduction of food supply chain emissions and waste through info and support for best practice etc.
A/Fc>A/F5	+3	Reducing greenhouse gas (GHG) emissions is inextricably linked to the reduction of food supply chain emissions and waste.
La>A/F5	+1	Improving natural and sustainable drainage (on non-urban land) is an enabling factor for the reduction of food supply chain

		emissions and waste through provision of a sustainable clean water supply.
Lb>A/F5	+2	Investing in natural capital (e.g. habitat creation; crop rotation) is likely to reinforce reduction of food supply chain emissions and waste (less pollution) with the extent of benefits depending on the particular measures (and enforcement) implemented.
Lc>A/F5	+3	Reducing waste disposal to landfill is inextricably linked to the reduction of food supply chain emissions and waste.
Interactions with Land objectives		
Wa>L1	+3	Enhancing sustainability of water infrastructure is inextricably linked to (and necessary for) mitigation of flood risk and flooding.
Wb>L1	+2	Implementing a paid ecosystem services approach (water systems) is likely to reinforce mitigation of flood risk / flooding e.g. through payments to farmers to reduce soil compaction etc. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented and the enforcement are.
Wc>L1	+1	Enhancing water / wastewater quality standards is an enabling factor for mitigation of flood risk / flooding through reducing pollution of wastewater that may be a factor in flooding events.
Wd>L1	+1	Support for vulnerable communities (water services) is an enabling factor for mitigation of flood risk / flooding where there is information gathering and sharing about and support for communities vulnerable to / affected by flooding events.
Ea>L1	+1	Implementing support mechanisms for flexibility in energy system operation is an enabling factor for mitigation of flood risk / flooding where it supports flexible / local / renewable energy generation (reducing emissions and related climate change effects).
Eb>L1	+1	Supporting mechanisms to increase energy efficiency is an enabling factor for mitigation of flood risk / flooding (potentially reducing energy use and energy-related emissions from fossil fuels reducing climate change effects).
Ec>L1	+2	Supporting mechanisms for low carbon energy generation is likely to reinforce mitigation of flood risk / flooding through reducing emissions and climate change effects from fossil fuels.
Ed>L1	+1	Support for vulnerable communities (energy services) is an enabling factor for mitigation of flood risk / flooding where there is information gathering and sharing about and support for communities vulnerable to / affected by flooding events.
A/Fa>L1	+2	Enhancing agricultural standards potentially reinforces mitigation of flood risk / flooding through sound environmental practices including reducing soil compaction providing the standards are appropriate, achievable and adequately enforced.
A/Fb>L1	+2	Enhancing support for local food production is likely to reinforce mitigation of flood risk / flooding through info and support for best practice, support for catchment sensitive farming etc.
A/Fc>L1	+3	Reducing greenhouse gas (GHG) emissions is inextricably linked to mitigation of flood risk / flooding as it leads to reductions in climate-related flooding risk.
La>L1	+3	Improving natural and sustainable drainage (on non-urban land) is inextricably linked to the mitigation of flood risk / flooding through improving filtration.
Lb>L1	+2	Investing in natural capital (e.g. habitat creation; soil health; crop rotation; sustainable farming practices) is likely to reinforce

		mitigation of flood risk / flooding with the extent of benefits depending on the particular measures (and enforcement) implemented.
Lc>L1	+1	Reducing waste disposal to landfill is an enabling factor for mitigation of flood risk / flooding through potential reductions in polluting flows in flood events.
Wa>L2	+1	Enhancing sustainability of water infrastructure is an enabling factor for improving environmental land management (clean water supply and water flows through agricultural land).
Wb>L2	+2	Implementing a paid ecosystem services approach (water systems) is likely to reinforce improving environmental land management e.g. through payments to farmers for sound environmental practices. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented and the enforcement are.
Wc>L2	+2	Enhancing water / wastewater quality standards potentially reinforces the improvement of environmental land management through reducing pollution of water / wastewater if standards are achievable and adequately enforced.
Wd>L2	0	There is no significant direct interaction between the two.
Ea>L2	0	There is no significant direct interaction between the two.
Eb>L2	0	There is no significant direct interaction between the two.
Ec>L2	+1	Supporting mechanisms for low carbon energy generation contributes to improvement of environmental land management through reducing emissions from fossil fuels.
Ed>L2	0	There is no significant direct interaction between the two.
A/Fa>L2	+3	Enhancing agricultural standards is inextricably linked to improvement of environmental land management through sound environmental practices (providing the standards are appropriate, achievable and adequately enforced; but they may prove difficult for small producers).
A/Fb>L2	+3	Enhancing support for local food production is inextricably linked to improvement of environmental land management through info and support for best practice, support for catchment sensitive farming and for longer term tenancy agreements, etc.
A/Fc>L2	+1	Reducing greenhouse gas (GHG) emissions contributes to improvement of environmental land management as it reduces climate-related flooding risk and associated pollution.
La>L2	+2	Improving natural and sustainable drainage (on non-urban land) reinforces improvement of environmental land management through improving filtration and drainage on agricultural land.
Lb>L2	+2	Investing in natural capital (e.g. habitat creation; soil health; crop rotation; sustainable farming practices) is likely to reinforce improvement of environmental land management with the extent of benefits depending on the particular measures (and enforcement) implemented.
Lc>L2	+1	Reducing waste disposal to landfill contributes to improvement of environmental land management through potential reductions in pollution flowing through agricultural land / into watercourses.
Wa>L3	+1	Enhancing sustainability of water infrastructure is an enabling factor for improving soil structure and composition – through improving filtration and drainage.

Wb>L3	+2	Implementing a paid ecosystem services approach (water systems) is likely to reinforce the improvement of soil structure and composition e.g. through payments to farmers to reduce soil compaction etc. The degree of benefits (synergies) will differ widely depending on what type of payment and how effective the changes implemented and the enforcement are.
Wc>L3	+1	Enhancing water / wastewater quality standards is an enabling factor for improvement of soil composition through reducing pollution into water courses (providing standards are achievable and adequately enforced).
Wd>L3	0	There is no significant direct interaction between the two.
Ea>L3	0	There is no significant direct interaction between the two.
Eb>L3	0	There is no significant direct interaction between the two.
Ec>L3	+1	Supporting mechanisms for low carbon energy generation potentially contributes to improvement of soil composition through reducing emissions from fossil fuels (providing there is no pollution from nuclear energy generation).
Ed>L3	0	There is no significant direct interaction between the two.
A/Fa>L3	+3	Enhancing agricultural standards is inextricably linked to improving soil structure and composition through requiring sound environmental practices (providing the standards are appropriate, achievable and adequately enforced).
A/Fb>L3	+2	Enhancing support for local food production is likely to reinforce the improvement of soil structure and composition through info and support for best practice, support for catchment sensitive farming and for longer term tenancy agreements, etc.
A/Fc>L3	0	There is no significant direct interaction between the two.
La>L3	+2	Improving natural and sustainable drainage (on non-urban land) reinforces improvement of soil structure and composition through improving filtration and drainage of soil.
Lb>L3	+3	Investing in natural capital (e.g. habitat creation; soil health; crop rotation; sustainable farming practices) is inextricably linked to reinforce improvement of soil structure and composition with the extent of benefits depending on the particular measures (and enforcement) implemented.
Lc>L3	+1	Reducing waste disposal to landfill contributes to the improvement of soil structure and composition through potential reductions in pollution and contamination of soil.

5.4. Assessment of vertical interactions of policies across scales

The spatial scale for the case study is the South West region. Thus the assessment looks at interactions between higher-level policies (EU/ national) and those at the regional scale. It aims to understand:

1.) to what extent higher level policies (objectives and instruments) are transposed and implemented at the regional level;

2.) to what extent lower-level policies (policies and instruments) are supported or hindered by higher level policies; and

3.) how these vertical interactions affect the achievement of the nexus critical objectives.

The assessment draws on the previous analysis, the expertise within the team, workshop contributions, and on the practical experience of the stakeholders interviewed. This has proved invaluable for understanding the complexity of the regional context for those working on the ground.

5.4.1. The extent to which national policies are transposed and implemented at regional level, and the extent to which regional policies are supported or hindered by national policies.

It should be noted that the Brexit process has led to rapid change of policy across all the nexus sectors at this time (10 July 2018) and will continue to do so. This is a key factor affecting how policies are transposed and implemented at the regional level and has made assessment even more complex.

Key vertical interactions are presented in the summary table below (Table 17). The results are discussed in more detail below the table with some examples of how these findings can impact on the NCOs selected for this case study (for full details of NCOs see Table 11).

Table 17 Summary table of Key Vertical Interactions

HIGHER>LOWER	
Higher level policies <u>successfully</u> implemented at lower scale	
• Water supply regulations: **The Water Supply (water quality) regulations 2016** govern public water supplies in England and Wales;	Drinking water quality meets regulatory standards in accordance with current EU guidelines. Quality in SWW region is consistently of a very high standard.

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• The Private Water Supplies (water quality) regulations (England) 2016 govern private water supplies.	
Water Act 2014	The Act sets out powers for the Secretary of State to publish the government's strategic priorities and objectives for Ofwat, the water regulator (2017). These focus on securing long-term resilience of water service delivery and infrastructure; protecting vulnerable customers who are struggling to pay their bills; and increasing market competition, including for environmental services. SWW meets its statutory and legal obligations and has implemented a range of initiatives to meet the measures as laid out in the Act, including a Compliance Code with the aim of ensuring there is no restriction, distortion or prevention of competition. Outlining a pathway to achieve Ofwat's strategic priorities is a major component of the business plans currently being developed by all water companies ahead of the 2019 Price Review process.
Energy Act 2013	National legislative framework for delivering secure, affordable and low carbon energy.
Climate Change Act 2008	UK's approach to tackling and responding to climate change. Legally binding carbon budgets set cap on GHG emissions. But there has been no progress in reducing agricultural GHG emissions over the past six years (the major industry in the region) despite the requirement of a 36% reduction in UK emissions from 2016 to 2030. Electricity emissions have reduced, but heat and transport remain stationary.
The Food Safety and Hygiene (England) Regulations 2013	Food safety regulations and inspections implemented by relevant statutory local authorities.
Flood and Water Management Act 2010	Implemented but lack of coordination across jurisdictional boundaries between local authorities.

Higher level policies **only partly** implemented at lower scale	
National Strategy for Water	SWW meets statutory and legal obligations determined by EU Directives in national policy or requirements set out by regulators like the Environment Agency and Drinking Water Inspectorate. But there is a lack of coordination between statutory bodies which leads to potential inconsistency of enforcement between regions.
Water Abstraction Plan 2017	The Environment Agency is making full use of its existing powers to amend abstraction licences to protect the environment. The work aims for 90% of surface water bodies and 77% of groundwater bodies to meet the required standards by 2021. Obligations under existing licensing are fully met by SWW: maintenance of dams including upgrading spillways; maintenance and upgrades of pumps and other assets (e.g. pipework); and generation of renewable energy using hydropower, solar panels and wind power. However consultation is underway between regulators and license holders as to how licenses can be updated to reflect new sustainable abstraction standards for 2021.
National UK Energy Strategy	Sets UK on smart and flexible path; • Set out in Clean Growth Strategy (2017); Industrial Strategy (2017) and Ofgem's Upgrading our Energy Systems (2017). There are issues of inertia in moving the energy system based on fossil fuels and nuclear to a more sustainable, flexible one. For this to happen, the governance system has to move from supporting fossil fuels to supporting a sustainable, smart and flexible energy system.
Agri-environment schemes	**Agri-environment schemes:** provide funding to farmers and land managers to farm in a way that supports biodiversity, enhances the landscape, and improves the quality of water,

	air and soil. These payments and grants include: **Basic Payment Scheme;** **Countryside Stewardship Schemes; and The Rural Development Programme for England (RDPE) 2014 -2020**: The payments received from agri-environment schemes are highly variable because they depend on the particular environmental assets on each farm and on which elements of the available schemes have been adopted by the farmer. Plus the level of payments for agri-environment schemes is less than for the basic payment scheme. Also, there has been a drop off in the region from farmers and land-owners signing up because of uncertainty post 2022 when current schemes will be replaced.
Farming-related regulation and enforcement	Regulations and enforcement are difficult to implement because of lack of coordination and resources across the statutory bodies and lack of adequate funding of enforcement mechanisms.
Rules for farmers and land managers to prevent water pollution (2018)	It is mandatory for all farmers in England to maintain good practice to protect water quality and prevent water pollution incidents. But agriculture is a significant source of water pollution and there is a lack of coordination across relevant bodies to monitor pollution from farms.
Higher level policies **poorly** implemented at lower scale	
None	
LOWER>HIGHER	
Lower level policies **fully** supported by higher level policies	
Flood Risk Management Plans	Implements Flood and Water Management Act 2010 to set out how Risk Management Authorities (RMAs) work together with communities to manage flood risk.
River Basin management (SW district)	Set out how organizations have made decision on how to act to improve the water environment in the SW river basin

	district; • supports UK government framework for 25 year environment plan (Defra 2017) • links with UK's implementation of Marine Strategy framework (Directive 2008/56/EC).
Local authority policy statements	Provide more specific and detailed view of central government policy.
Catchment Sensitive Farming (CSF)	CSF has been working in specific Priority Catchments where agriculture is having the most significant impact on rivers, lakes and estuaries in the SW River Basin.
Lower level policies **only partly** supported by higher level policies	
Planning: Local and neighbourhood plans	National Planning Policy Framework (2012 – currently under review) does not dictate how local and neighbourhood plans should be written or planning outcomes, but is a framework for producing distinctive local and neighbourhood plans and development orders which meet local needs.
Upstream Thinking partnerships	Upstream Thinking focuses on achieving improved raw water quality and water storage in the natural landscape to make the provision of drinking water more sustainable. SWW have recognized that it is cheaper and highly effective to help farmers deliver cleaner raw water (water in rivers and streams) than it is to pay for the expensive filtration equipment required to treat polluted water after it is abstracted from the river for drinking. Ofwat allow funding for this activity and the DWI actively encourage it.
Lower level policies hindered/disrupted by higher level policies	

Local Economic Partnerships (LEPs)	Funding variations centrally prescribed by government has affected role and can limit remit.
Local energy markets (LEMs)	Range of regulatory and policy barriers hinder development of smaller scale initiatives.

5.4.2. How vertical interactions hamper or support the achievement of the Nexus Critical Objectives (NCOs)

The stakeholder interviews and feedback from workshop 2 (held on 26 June 2018) revealed both general observations about policy implementation from national to regional levels and more specific issues that were pertinent to the NCOs which are discussed in more detail below. At the general level, there were stakeholders who felt that there was **'almost a lack of policy' at regional and local levels**. Another said that one of the biggest challenges at the local level is influencing national policy. **Policy interpretation was also noted as an issue**, including how conflicts are likely to arise due to inconsistencies in how regulations are interpreted and enforced by regulators at the regional level. Another stakeholder also talked about how '**negative policy interactions result from poor articulation in the first place'**. When it came to looking across the nexus, there was recognition of '**siloed' thinking** in policy making and **failure to recognize cross-sectoral issues.** One stakeholder said that they were not aware of 'any inter-sectoral relationships among public organisations', and another said there was a need for more people to see 'common sticking points'. One stakeholder commented on how many policies are single issue and don't take others into account, and another recognised **the need for a mix of policy instruments to facilitate more sustainable practices.**

Stakeholders expressed concerns about **enforcement of policy at the regional level.** For example, policy implementation can be impeded by how the economic regulator (Ofwat), the regulator (Environment Agency) and the water company (in this case SWW) work together. Regulation to improve water quality in the catchment enforced by the Environment Agency can be at odds with cost efficiencies, the remit of the economic regulator, Ofwat. One of the stakeholders suggested this can lead to a negative policy cycle with the water company in the middle, noting that It is easy to get into this negative space if there is limited dialogue. Another stakeholder commented that from the perspective of the environmental regulator, it is easier to regulate point discharge of wastewater rather than to regulate multiple sites of diffuse discharge from agriculture. This stakeholder felt that there is a disparity between how these activities are regulated because the aggregated effect of numerous discharges is often greater than that from wastewater. In addition, another stakeholder asked how the new water regulations are going to be enforced, and suggested that there would be confusion as different agencies were likely to interpret them in different ways.

At the core of the Energy Act (2013) is the need to ensure that, as older power plants are taken offline, the UK remains able to generate enough energy to meet its needs even if demand increases. Nationwide and in the South West there is **energy system transformation happening offshore – with increasing amounts of offshore wind - and at a local level.** There is an abundance of generation from both solar and wind in the region and this has the opportunity to lead to the development of new **localised energy networks (LEMs).** However (as discussed in sub-section 2.3), nuclear power poses issues to the UK in the transition to a smart, flexible and responsive system. Not only is it a very expensive source of low carbon power but having nuclear power on the system makes it harder rather than easier for system operation with a high proportion of renewables (Mitchell, 2016). New figures released by energy analytics firm EnAppSys show renewables have already overtaken nuclear for electricity generation. Wind, solar and biomass power stations supplied 28.1% of power across April, May and June, with nuclear at 22.5%, the third quarter in a row that renewables have outstripped nuclear[38].

The variable power renewables that the UK has in abundance (such as solar and wind) requires a system that complements rather than undermines variable power output. Stakeholders and others raised the issue of **how work on the new Hinkley power plant on the region's border will compete with local energy markets** (see also Bray et al 2018).

There was also feedback about how drastic cut backs to energy support mechanisms first introduced as part of electricity market reform (EMR), in particular the **Feed-in Tariffs scheme (FIT),** had affected implementation at the local level (the South West leads the way for onshore renewable energy capacity in England). These low-carbon support mechanisms had been successful in promoting the development of renewable energy generation in the region, but the policy shift has had a detrimental effect on renewable energy businesses and community energy initiatives. One outcome of this is that it has motivated community energy groups in Devon to return to their roots by doing more on energy efficiency, fuel poverty, and community engagement, using home visits, gardening, art, housing, and food to involve people in the energy debate.

Alongside this there has been recognition at national level that climate change regulation and targets (Climate Change Act 2008, Renewable Energy Directive (2009/28/EC)) has neglected emissions from heat and transport. In 2016, the government recognised that significant acceleration was required to ensure the UK can meet its legally binding targets under the Climate Change Act. The **Renewable Heat Incentive (RHI)** provides a financial incentive to promote the use of renewable heat and is a government scheme set up to encourage uptake of renewable heat technologies amongst householders, communities and businesses through financial incentives.

[38] https://www.theguardian.com/uk-news/2018/jul/10/nuclear-renewables-are-better-bet-ministers-told?CMP=share_btn_tw (accessed 10 July 2018)

The RHI subsidy has been widely taken up at the regional level but as stakeholders pointed out, there is also recognition that policy support for energy generation can affect conditions in the food system as bioenergy crops compete with the food and feed sector, and with issues associated with the appropriateness of land-use for growing such crops; this has impacted on wider environmental and sustainability systems in the region. One stakeholder felt that short-term policy inducements offered by financial incentives rather than a long-term view of the impacts were 'skewing the picture' and resulting in inevitable trade-offs. Two particular issues stand out:

- although there are good examples of maize being grown for animal feed, some farmers have **grown more maize** in order to claim the subsidy for bioenergy crops. This has good and bad nexus implications because it may generate energy but it requires water, land can be left bare and subject to soil erosion, and it may use land that could otherwise grow food and livestock feed;
- **anaerobic digestion (AD)** is being used to process green waste slurries, then in order to maximise incentives, waste heat is being used for other bio-mass burnings. Bio-mass technologies may or may not provide lower carbon sources of heat. They may also be producing heat to attract income rather than to fulfill a real need.

This has resulted in **trade-offs** as subsidies provided for feed-in tariffs for anaerobic digestion to promote renewable energy **do not take efficiency of energy use into account,** including long-term impacts of contracts, how this fits with agri-environmental schemes, and rent rises in the tenanted farm sector when they cannot compete for over-priced land.

As one stakeholder put it, the SW region is 'almost a bit of an island' because of its geography. The region is relatively distant from other counties and waste that is generated here, needs taking care of here. This **can be problematic in terms of meeting energy and waste targets** (the EU Waste Directive (2018/851) stipulates that by 2025 no biodegradable waste (including food waste) should be sent to landfill) **BUT this is also driving innovation,** including the use of AD (supported by the government's 'Anaerobic Digestion Strategy and Action Plan' 2011). However, there is evidence that AD plants are under-used despite their efficacy for recycling food waste. One stakeholder suggested that Local Authorities need to be incentivised to implement a separate food waste collection service because the costs of additional food collections and treatment are outweighed by savings made by sending food waste to AD rather than landfill (thus saving on landfill tax). There are examples of these schemes being implemented successfully eg. Teignbridge Council but this is not universal.

As another stakeholder noted, 'agriculture is all about conflicts and trade-offs' and several stakeholders (including workshop participants) mentioned how livestock are a major source of GHG emissions in this farming region. There has been no progress in reducing agricultural GHG emissions over the past six years, despite the requirement of a 36% reduction in UK emissions from 2016 to 2030.

It is also worth reiterating that the possible outcomes of Brexit were particularly significant for stakeholders in the agricultural sector and were causing high levels of uncertainty. Currently, public funding to farming is paid from the Common Agricultural Policy (CAP). But when the UK leaves the EU in

2019 (as currently stated) this element will be lost, as all decisions over farm funding in England will revert to the UK government. Stakeholders reported indecision in the agricultural sector as businesses do not know the parameters for making business decisions and there is uncertainty about profitability. Concerns were also expressed that small farms, that are already struggling, may not survive further consolidation of land ownership.

Other interactions that came up included the **challenges for innovation and entrepreneurism** because of the enforcement of food and safety regulations in local food businesses that were often too complicated, and issues associated with **planning.** How planning interacts with farm diversification is a significant area because planning restrictions can make alternative use of farm building unviable and, in the tenanted sector, successful planning applications has meant that tenant farmers lose buildings to residential use. In addition, there were also **conflicts between land use planning and renewable energy initiatives.**

5.5. Formal and informal rules and practices to handle conflicts, negotiate trade-offs and exploit synergies

This sub-section describes how problems and opportunities are managed in policy implementation practices. It identifies how formal and informal rules are used to handle conflicts, exploit synergies and negotiate trade-offs among stakeholders in practice, including the enabling and hindering factors (Table 18).

Table 18 Formal and informal rules and practices

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision-making, knowledge sharing etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of the NCOs
Formal	Direct (basic farm) payments provide funding to farmers and land managers to farm in a way that supports biodiversity, enhances the landscape, and improves the quality of water, air and soil	Mechanism of control	Enabled by funding and support systems provided by relevant agencies.	Helps improve water quality; builds farm businesses; improve soil structure and composition
Informal	Devon Wildlife Trust can act as intermediary between SWW and farmers	Knowledge sharing	Acts as intermediary between water company and farmers	Helps improve water quality; reduce pesticide pollution; improve the agri-environment

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision-making, knowledge sharing etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of the NCOs
Informal	Farming communities tend to rely on informal networks with neighbouring farms (in the pub etc.) and these are often more trusted than more formal networks (which farmers often don't have time to attend).	Informal networks/ knowledge sharing	Peer-to-peer networks more trusted than formal networks.	Helps maintain and improve the agri-environment; build farm businesses; increase the use of renewable resources.
Formal	Continuity in local political leadership	Governance/ coordination	Embedding sustainable practices requires long-term political commitment.	Helps build all aspects of NCOs
Formal	Cornwall and the Isles of Scilly have some of the best natural resources for renewable energy in Europe, including wind, solar, marine and geothermal. The distribution network, however, is operating close to capacity, meaning that despite the renewable resource potential, new renewable generation projects are becoming increasingly uneconomical, due to the need for costly high voltage network reinforcement. Not all of the issues affecting Cornwall and the Isle of Scilly's electricity grid will be able to be met through Smart Cornwall activity. Through the wider Green Cornwall programme, a Cornwall Grid Group has been set up with participant from Cornwall Council, Western Power Distribution, Ofgem and DECC.	Partnership	Shared objectives	Helps increase energy security; meet carbon budgets; increase the use of renewable resources
Informal	23 community energy groups	Coordination/	Community	Helps increase

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision-making, knowledge sharing etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of the NCOs
	across the county of Devon (the highest number in England). These groups run 62 community owned renewable projects, which have generated 17,431 MWh of clean green energy, saving 6,080 tonnes of CO2 emissions and helping 2,717 homes to save on energy bills and increase their energy efficiency. The 12.3 MW of capacity installed by community energy groups represents 1.3 per cent of the total renewable electricity installed in Devon. Community energy organisations in Devon have raised £14.1 million of investment, enabling them to create 33 FTE jobs.	Knowledge sharing	energy is well supported. Cuts in subsidies (Feed-in tariffs) has reduced activity and impact, but also motivated community energy groups in Devon to do more on energy efficiency, fuel poverty, and community engagement.	energy security; increase the use of renewable resources; address affordability of energy for customers.
Formal	Cooperation between the Wadebridge Community Energy Network (WREN) and SWW to install solar to power its water and sewage treatment plants in the area (e.g. Nanstallon)	Cooperation	Strong and committed partnership between energy CSO and water company.	Increase the use of renewable resources.
Formal	Local Economic Partnerships (LEPs) are voluntary partnerships between local authorities and local private sector businesses. They play a central role in determining local economic priorities and undertaking activities to drive economic growth and job creation, improve infrastructure and raise workforce skills within the local area. https://heartofswlep.co.uk/ https://www.cioslep.com/	Partnership	The rural economy is a key priority for many LEP areas.	Helps build all aspects of the nexus sectors

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision-making, knowledge sharing etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of the NCOs
Formal	A range of food and drink policies and strategies initiated at regional/ local levels, including Exeter Food Strategy, Cornwall Food and Drink; and Taste of the West	Partnerships/ knowledge sharing/ marketing and promotion	Provide effective promotion of regional food and knowledge about sustainable and healthy food systems. City food policies require continuity of support from local politicians.	Helps build farm businesses; protect standards of food production.
Formal	The Cornwall Local Energy Market (LEM) project is a three-year trial from 2017 to 2020 jointly funded through the European Regional Development Fund and Centrica. The project is led by Centrica in association with project partners Western Power Distribution, National Grid, the University of Exeter and Imperial College London. The trial will test the role of flexible demand, generation and storage via a new virtual marketplace. This will be supported by the installation of new low carbon technologies into over 150 homes and businesses.	Partnership/ knowledge sharing	Enabled by funding support and ability of partners to work together on shared objectives	Helps increase energy security and decarbonisation of energy supply.
Formal	Upstream Thinking plans (http://www.upstreamthinking.org/) and SWEEP - **www.sweep.ac.uk** - investment of funds at the top of the catchment that leads to lower costs downstream. One example: partnership of South West Water, the Devon Wildlife Trust, the Cornwall Wildlife Trust, the	Partnership working. Environmental interventions.	Enabled by govt. funding. Involves water company investment, but plans can compete rather than complement.	Helps protect and enhance aquatic environments; enhance the sustainability of water service delivery; and improve environmental

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision-making, knowledge sharing etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of the NCOs
	Westcountry Rivers Trust and the Exmoor National Park Authority, is building on work begun in 2008 to change land management practices to protect rivers. The programme is part of South West Water's long term business plan to reduce its environmental footprint and manage the impact of diffuse pollution on customers' bills. The Upstream Thinking Initiative has seen a wide array of innovative catchment management and other environmental interventions delivered, including: mires restoration, culm grassland restoration by Devon Wildlife Trust, pesticide advice and guidance by Cornwall Wildlife Trust			land management.
Informal	Beaver dams on the river Otter, Devon are slowing the flow and helping to reduce flooding. This means there are discussions going on about beaver dams as a natural water flow regulation mechanism; and there has been data collection by the University of Exeter now which supports this, and this data has been presented to Defra – research-led influence.	Knowledge sharing	It is important that dissemination is in a format that policy-makers can understand.	Helps with flood mitigation
Formal	Catchment Sensitive Farming (CSF) raises awareness of diffuse pollution from agriculture by giving free training and advice to farmers in selected areas in England, including the SW. The aim of the advice is to improve the	Raising awareness/ training and advice	Enabled through farmers applying for Countryside Stewardship fund to improve water quality and biodiversity and	Helps develop catchment sensitive farming; maintain and improve the agri-environment; protect and

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision-making, knowledge sharing etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of the NCOs
	environmental performance of farms. Advice is only available in high priority areas for water quality. These areas will contribute most to meeting Water Framework Directive objectives. CSF has been working in specific Priority Catchments where agriculture is having the most significant impact on rivers, lakes and estuaries. This includes the SW River Basin. The purpose of a river basin management plan is to provide a framework for protecting and enhancing the benefits provided by the water environment. To achieve this, and because water and land resources are closely linked, it also informs decisions on land-use planning.		to reduce flood risk. Only available in high priority areas for water quality.	enhance the natural of aquatic environments.
Formal	Exmoor Coastal Streams is one of 37 groups to receive funding from Defra in the latest national competitive round of Countryside Stewardship Facilitation Fund awards (Feb 2018). This includes partnership working by 15 farmer members covering 6938ha of north-west Exmoor. The group aims to focus on landscape scale management including habitats such as moorland, grassland and woodland with a key focus on priority habitats and species. Flood risk and water management also included, along with enhancement of the historic environment.	Partnership/ knowledge sharing	Enabled by funding. 'Working and learning together will help the land managers to improve the resilience of their businesses and will provide multiple environmental benefits'.	Helps improve environmental land management; mitigation of flood risk and flooding.

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision-making, knowledge sharing etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of the NCOs
Formal	WILD project (see: http://www.ccri.ac.uk/wild/) enhancing European Water Framework Directive (WFD) delivery through the integration of a number of different objectives. The partnership activity includes: individual parish plans for ditches and water courses, integrated development of Surface Water plans, delivery of Catchment Sensitive farming programmes developed by NGOs such as the Wildlife Trust and Cotswold Rivers Trust. WILD 2 – linking issues to do with water quality/farming practices and communities.	Partnership	Enabled by funding. Shared objectives	Enhances Water Framework delivery; develops catchment sensitive farming.
Informal	Informal agreements in tenanted sector avoid long legal processes eg. when landlord wants to take back land to install solar panels/AD etc. may offer free electricity, alternative land or farm house/ building renovation as compensation.	Informal agreements	Landlord and tenant farmers need to agree, but can also threaten small farm tenancies.	Helps increase use of renewable resources; build farm businesses.
Informal	Growers' Groups are coming together to share experience, how to interpret policy, and to share advice to help make informed decisions. This is about being informed and clear interpretation of what decisions mean for the business.	Knowledge sharing	Sharing knowledge and advice helps growers make informed decisions. There are examples of people making strong business plans only for	Helps build farm businesses; maintain and improve the agri-environment; protect standards of food production.

Type of arrangement (formal/informal)	Description of arrangement	Function of the arrangement (coordination, decision-making, knowledge sharing etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of the NCOs
			policy to change. Time awareness is crucial.	
Formal	A 'collaboration fund' of up to £10 million was announced in February 2018 as part of a series of measures to help farmers and small producers compete and thrive alongside larger businesses in the food supply chain. The fund will be designed in consultation with the farming industry and will work by bringing together those interested in co-operation. These groups will be supported by the funding to formally establish, develop or expand, so that farmers and growers can take advantage of new market opportunities to help their businesses to thrive.	Cooperation/ knowledge sharing	Enabled by funding. Collaboration between farmers can bring substantial economic benefits, enabling farmers to benefit from economies of scale, share knowledge and jointly market their produce.	Helps build farm businesses; maintain and improve the agri-environment; protect standards of food production.

5.6. Success stories and failures

Table 19 Success stories

Type of successful policy arrangement	Description	Factors of success, do's
Catchment Sensitive Farming and Upstream Thinking – Partnership and funded programme (farm business support)	Catchment Sensitive Farming (CSF) is an approach to farming in which subsidies / incentives and advice are given to farmers at the top of a river catchment to promote sustainable farming practices (e.g. decreased use of pesticides in	- Partnership working across more than one type of organisation (including public, business, NGOs and farmers) and across more than one sector (water, land and agriculture / food); - Adequate and ongoing

	sensitive areas; habitat restoration, etc) leading to improvements in water quality downstream. Upstream Thinking is a programme operating in Devon and Cornwall using a CSF approach, and includes restoration of peatland.	funding mechanisms in place ; - Supportive policy, political and organisational environment.
Sustainable Drainage Systems (SUDS) – Set of infrastructure interventions (sustainable infrastructure development)	Sustainable (or 'natural' / 'green') drainage systems refers to a range of drainage and infiltration systems (e.g. ditches, ponds, soakaways, wetlands, etc), often in urban areas, leading to better water flow outcomes, slowing flows down through the catchment and reducing pollution in the watercourses. They can therefore help prevent or mitigate against flooding to settlements downstream, creating positive synergistic effects for the land (and agricultural) sectors.	- Inclusion in planning process (not statutory for new developments); - Public and business support; - Advice from government (county council level); - Support from professional bodies (e.g. Institution of Civil Engineers); - Practical application suitable for consideration by developers.
Healthy Homes for Wellbeing Project – funded outreach project (programme of support for vulnerable customers)	The Healthy Homes for Wellbeing Project provides free energy advice and free home visits for eligible people across Devon. Advisers give practical energy advice and support to people in a vulnerable and / or fuel-poor situation at drop-in energy advice clinics and events across the region, and during home visits.	- Partnership between various organisations, mainly NGOs and business; - Cross-sectoral working including energy and water sectors plus health and benefits – able to cross-refer; - On-the-ground project directly providing targeted help for vulnerable customers; - Interest from NHS regarding cost cutting and health potential.

Table 20 Failures

Type of unsuccessful policy arrangement	Description	Factors of failure, don'ts
Maize and the Renewable Heat Incentive (RHI) – government subsidy / incentive (farm business support)	The RHI encourages the use of food waste in anaerobic digesters (AD) to produce renewable energy (gas for heat) as part of decarbonisation objectives. The implementation of this policy has had **unintended consequences for the land, agriculture and water sectors**. Where there is a lack of food waste to feed ADs, farmers are growing maize to supplement supplies of food waste and to receive these incentives (maize is also grown for animal feed).	- Lack of foresight and / or guidelines on suitable inputs for AD i.e. discouraging use of virgin agricultural crops in AD process; - Lack of adequate guidelines / regulation / enforcement of good farming practices for maize; - Poor farming practices therefore frequently used for maize (harvesting in winter or wet weather) on hilly ground / steep slopes leading to soil compaction, loss of topsoil, run-off and flash flooding; - Short-term thinking compounds poor farming practices **through short farm tenancies and / or use of contractors**; - Maize growing is taking land out of human food production leading to conflicts over land use.
Hinkley Point C - nuclear power generation (decarbonisation objective)	Hinkley Point C nuclear power station is a project to construct a 3,200 MWe nuclear power station comprising of two reactors in Somerset, England, expected to be commissioned in 2025. Because of the current age, state and capacity of the electricity grid infrastructure, its construction is likely to lead to insufficient capacity for new renewable energy generation. Overall this is **likely to make renewable energy generation – which is regionally important – much less viable in the South West**, through crowding out at regional level (community renewable energy generation is a regional priority for Devon and Cornwall).	- Controversial public / business project based on national priorities for decarbonisation; - Lack of consensus across different types of organisations including government regulators; - **Inherent or potential conflicts with other policy priorities and initiatives** e.g. renewable energy targets; push for / investment in smart and flexible technologies; environmental protection and enhancement; - Conflict with regional priorities i.e. renewable energy generation including small-

		scale community initiatives; - Potentially serious **negative environmental consequences for the water, land and agricultural sectors** through pollution and ongoing issues related to decontamination and disposal of waste.

5.6.1. Success stories (synergies)

5.6.1a Catchment sensitive farming / Upstream Thinking - Water and Agriculture / Food sectors

Catchment sensitive farming is an approach to farming in which subsidies / incentives and advice are given to farmers at the top of a river catchment to promote sustainable farming practices (e.g. decreased use of pesticides in sensitive areas; habitat restoration). These practices, where they are well implemented, can **lead to better water quality downstream, with lower treatment costs and better environmental outcomes for biodiversity, wildlife, aquatic environments**. This leads to **synergies for riverine and coastal environments and to the economy, for instance the water sports, tourism and hospitality industries**, which are all heavily reliant on good water quality / environmental status in order for them to attract visitors.

Specifically, the Catchment Sensitive Farming programme (CSF)[39] is a joint initiative between the Environment Agency and Natural England funded by DEFRA and the Rural Development Programme for England, implemented in a number of priority catchments across England. CSF has two principle aims: (1) to save farms money by introducing careful nutrient and pesticide planning, reduce soil loss and help farmers meet their statutory obligations such as Nitrate Vulnerable Zones, and (2) to deliver environmental benefits such as reducing water pollution, cleaner drinking water, safer bathing water, healthier fisheries, thriving wildlife and lower flood risk for the whole community.

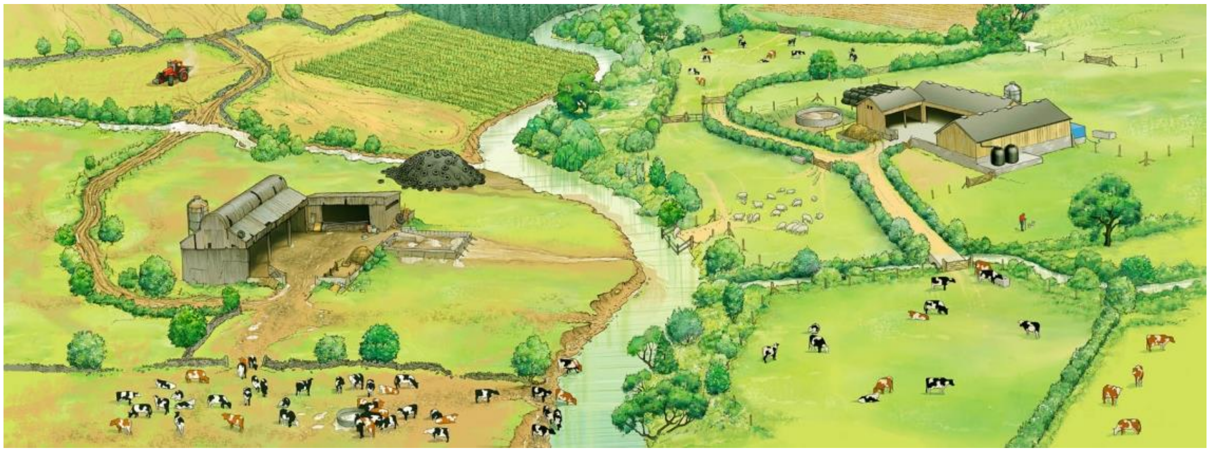
CSF provides practical solutions, targeted support and advice (including workshops, events and individual farm appraisals) which aims to enable farmers and land managers to take *voluntary* action to reduce diffuse water pollution from agriculture to protect water bodies and the environment. CSF support includes capital grants (up to 60% of the total funding) to deliver improvements in farm infrastructure.

The figure below (Figure 14) illustrates the benefits of the catchment based approach in simplified form – contrasting 'bad' farming practices (on the left) with 'good', i.e. using the catchment based approach (on the right). It illustrates the importance of good waste management practices, adequate infrastructure and the provision of (natural) barriers along the river to avoid contamination and pollution run-off (in this case

[39] https://www.catchmentbasedapproach.org/deliver/catchment-sensitive-farming

from both livestock and arable farming) flowing directly into the watercourse, with direct beneficial impacts on water quality.

Figure 14 Illustration of catchment sensitive farming



Source: Catchment Based Approach (CaBA)[40]

In the South West region, catchment sensitive farming is now in phase 4 of its implementation (2016-2021), with programme evaluation demonstrating the effectiveness of CSF's approach in reducing pollutant loads and improving water quality (Natural England 2016). In addition, the Upstream Thinking[41] partnership, involving South West Water, the Devon Wildlife Trust, the Cornwall Wildlife Trust, the Westcountry Rivers Trust and the Exmoor National Park Authority, is working to improve water quality in Devon and Cornwall's rivers by reducing pollution entering rivers. The latest £11million expanded programme (2015-2020) focuses on 11 catchments across Devon and Cornwall, which represent all the main abstraction areas in the region where water quality issues have been experienced. The programme provides advice and grants for farmers and the restoration of peatland in partnership with landowners, targeting 750 farms and 1,300ha of moorland and other semi-natural land under revised management. Grants are targeted at farms with land connected to rivers above water abstraction points.

5.6.1b. Sustainable drainage systems (SUDS) and natural flood management – Water, Land and Agricultural sectors

Sustainable (or 'natural' / 'green') drainage systems refers to a range of drainage and infiltration systems (e.g. ditches, ponds, soakaways, wetlands etc) that tend to lead to better water flow outcomes, slowing flows down through the catchment and reducing pollution in the watercourses. They can therefore **help prevent flooding to settlements downstream, creating positive synergistic effects for the land (and agricultural) sectors**. In natural environments, rain falls on permeable surfaces and soaks into the ground

[40] https://www.catchmentbasedapproach.org/deliver/catchment-sensitive-farming
[41] http://www.upstreamthinking.org/index.cfm?articleid=8689

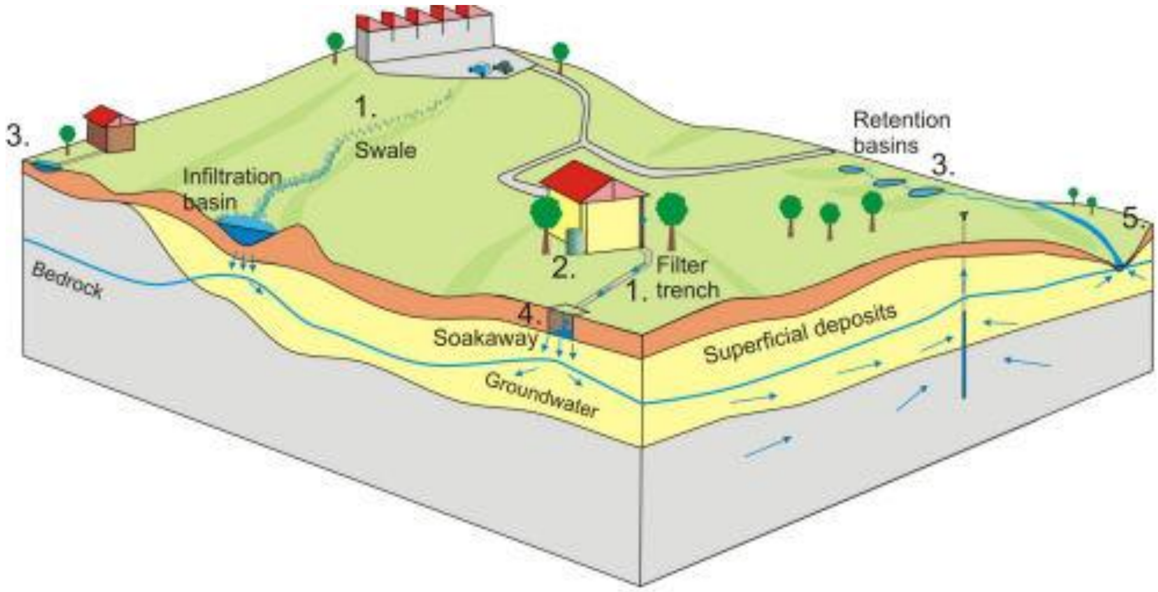
(infiltration). In urban areas where many surfaces are sealed by buildings and paving, natural infiltration is limited. Instead, drainage networks consisting of pipes and culverts, divert surface water to local watercourses. In some cases, this has resulted in downstream flooding and deterioration in river water quality caused when sewers are overwhelmed by surface water leading to a release of dirty water into rivers. Sustainable drainage systems aim to alleviate these problems by storing or re-using surface water at source, by decreasing flow rates to watercourses and by improving water quality[42].

Sustainable drainage systems use a sequence of techniques (Figure 15). As surface water flows through the system, the velocity of flow is controlled and pollutants are removed using the following:

- **source control** methods decrease the volume of water entering the drainage/river network by intercepting run-off water on roofs for subsequent re-use (e.g. for irrigation) or for storage and subsequent evapotranspiration (e.g. green roofs).
- **pre-treatment** steps, such as vegetated swales (ditches) or filter trenches, remove pollutants from surface water prior to discharge to watercourses or aquifers.
- **retention** systems delay the discharge of surface water to watercourses by providing storage in the form of ponds, retention basins and wetlands.
- **infiltration** systems such as infiltration trenches and soakaways mimic the natural recharging process, allowing water to soak into the ground[43].

Figure 15 Flow of water through sustainable drainage systems

[42] http://www.bgs.ac.uk/research/engineeringGeology/urbanGeoscience/suds/what.html
[43] http://www.bgs.ac.uk/research/engineeringGeology/urbanGeoscience/suds/what.html



Source: British Geological Survey44.

Figure showing flow of water through sustainable drainage systems into the subsurface. During a storm event, surface water flows through swales (ditches) and filter trenches that remove pollutants (1). The peak river discharge is delayed and reduced by: storage of water for re-use (2), storage in ponds (3), or infiltration of water to the ground through infiltration basins and soakaways (4). This process improves the quality of water in rivers and decreases peak river discharge (5).

SUDS are being implemented primarily in urban areas across Devon and Cornwall (e.g. Devon County Council (DCC) provided advice for 1430 planning consultations between April 2015 and April 2017). DCC have now issued guidance[45] (Jan 2017) on implementing SUDS for planning applicants. However, evidence from the Institution of Civil Engineers suggests that improvements in the regulatory framework could facilitate further and better quality implementation of these types of measures. Improvements recommended include greater consistency of approach; inclusion of SUDS in planning requirements for new developments, updating of standards, and clarification of funding mechanisms for SUDS[46].

Sustainable drainage systems are also needed in some rural and agricultural areas. In East Devon, and potentially throughout Britain in the longer term, there is also the potential to develop **natural flood attenuation and storage schemes** (retention systems) **associated with beaver ponds and wetlands**. The River Otter Beaver Trial is a five-year initiative which began in 2015. Licensed by Natural England and led by the Devon Wildlife Trust[47] with support from the landowner Clinton Devon Estates[48], Exeter University

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[44] http://www.bgs.ac.uk/research/engineeringGeology/urbanGeoscience/suds/what.html
[45] https://new.devon.gov.uk/floodriskmanagement/sustainable-drainage/
[46] https://www.ice.org.uk/news-and-insight/the-infrastructure-blog/february-2017/a-place-for-suds
[47] https://www.devonwildlifetrust.org/what-we-do/our-projects/river-otter-beaver-trial

and Derek Gow Associates, its aims are to understand the benefits and disbenefits of reintroducing this native species into the River Otter. There are already a large number of beavers living in Scottish river catchments, with over 400 beavers in the Tay catchment alone.

There are currently eight wild-living family groups within the River Otter catchment, with some of these beginning to develop new wetland systems associated with the building of dams. Research led by the Geography Department of Exeter University from captive trials suggests that **ponds and water pools created from beaver dams can improve the ecological health of rivers and improve water quality**[49]. Beavers do not tend to build dams on large rivers but do so instead on smaller streams to increase water levels so they can move around safely. There is a growing body of evidence to suggest that beaver ponds and wetlands can: moderate irregular water flow and maintain base levels in streams in times of drought; raise the water table locally creating wetland areas to the benefit of biodiversity; neutralise acidic run-off; act as sinks for pollutants and increase the self-purification of a watercourse; form sediment traps, reducing erosive run-off and particulate loads in downstream water. The dams are not necessarily permanent[50]. However, alongside the benefits there is a need over the longer term to put a suitable management strategy in place to mitigate against and mediate conflicts, as beaver activities can also create negative impacts (e.g. localised flooding) on farmland[51].

5.6.1c. Healthy Homes for Wellbeing project[52] – Energy sector (and health)

This small-scale project is a partnership between Exeter Community Energy, the Local Energy Advice Programme (LEAP)[53] run by AgilityEco[54], the Big Energy Saving Network, Western Power Distribution and Devon Community Foundation. It works actively to **create synergies between energy and health outcomes** and has led to **cross-referrals with water, energy, the benefits office (DSS), the fire service and health sectors** (NHS). It addresses fuel poverty, low income, vulnerability and energy efficiency in hard-to-heat homes leading to increased health and wellbeing outcomes (and lower associated NHS costs). The linkage between energy, housing and health has not yet become fully recognised through health funding mechanisms but, for example, significant numbers of respiratory problems can be linked to indoor environment-related issues such as dampness in the home; and simple measures to address energy efficiency can result in reduced hospital visits and / or duration of hospital visits.

The project provides free energy advice and free LEAP home visits for those who are eligible in Exeter, Mid Devon, East Devon, Teignbridge and Torbay. Advisers give practical energy advice and support to

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48 http://www.clintondevon.com/content/press-releases/landowner-welcomes-river-otter-beaver-reintroducti.ashx
49 https://www.exeter.ac.uk/news/featurednews/title_657691_en.html
50 https://www.scottishbeavers.org.uk/beaver-facts/beaver-trial-faqs/what-impact-will-the-beavers-have-on-water-quality-and-hydrology/
51 https://www.clintondevon.com/_assets/countryside_matters/spring%202016/managing%20beavers%20-%20clinton%20devon%20estates.pdf
52 https://www.ecoe.org.uk/healthy-homes-wellbeing/
53 https://www.projectleap.org.uk/
54 http://www.agilityeco.co.uk/

people in a vulnerable and / or fuel poor situation at drop-in energy advice clinics and events across the region, and during LEAP home visits. The service includes energy saving tips; installation of free energy saving measures (e.g. energy saving light bulbs, draught proofing); help with changing energy supplier or tariff and applying for discounts; referral for help with benefits and debt (including water debt); information about grants availability for insulation and heating; signing up for priority services register; and referral for Fire Safety Checks.

5.6.2. Conflicts and trade-offs (failures)

5.6.2a. Maize and the Renewable Heat Incentive (RHI) – Agriculture/Food and Water sectors

The Renewable Heat Incentive (RHI) was implemented in order to encourage the use of food waste in anaerobic digesters (AD) to produce renewable energy (gas for heat) as part of decarbonisation objectives. However, the implementation of this policy has had **unintended consequences for the land, agriculture and water sectors**. Where there is a lack of food waste to feed ADs, farmers are routinely growing sugar-rich crops to supplement supplies of food waste and to receive these incentives, and maize is frequently planted in this context (maize is also grown for animal feed).

Maize, unless carefully managed (e.g. only on flat ground and harvested in dry conditions), often leads to **compaction of the soil, loss of topsoil and run-off leading to flash floods**. This is a particular problem in Devon and Cornwall, because of the hilly nature of the topography and steep slopes including on agricultural land. Unsustainable farming practices are also exacerbated by short-term thinking as a result of **short farm tenancies and / or use of contractors**.In addition, it requires more inputs than other crops, and because it takes up significant portions of land, this causes conflicts with usage of land for the purposes of food production.

According to the Soil Association (2015), maize is the most rapidly growing crop in the UK – rising from just 8,000 hectares in England in 1973 to 183,000 hectares in 2014. Most maize is used as silage for animal feed, especially for dairy cattle, but increasingly maize is being grown as an energy crop for anaerobic digesters (AD). Maize produces high yields, both per hectare as a crop and per cubic meter of biogas, and because it is the most readily grown bulk product it has become the core feedstock for AD plants. The use of maize for silage is now known to have a significant negative effect on the nutritional content of both milk and meat (maize inhibits the uptake of protein).

Maize crops have severe negative impacts on soils and fresh water – firstly, they leave soil exposed during much of the growing season. Secondly, maize is usually harvested late in the year when soils are often wet. In heavy rain, water runs off the surface of compacted and damaged fields, polluting waterways with pesticides and nutrients, and causing floods. Estimates suggest that during the storms and heavy rainfall in the winter of 2013/14, every 10 hectare block of damaged land under maize stubble produced more than 375 million litres (equivalent to 15 Olympic swimming pools) of additional run-off. Research published in 2014 found that 75% of late-harvested maize sites showed high or severe levels of soil degradation. The overall financial cost of annual flooding in the UK is estimated to be somewhere in the region of £1.1 billion; a cost to the public to which maize is likely to make an increasing contribution. On the other hand, it is possible to grow maize to better practice standards that reduce the risks to soils and the environment. Some farmers are following good practice, but by no means all. The Soil Association (2015) recommends that the UK government introduce clear policy measures that encourage more farmers to meet best practice.

In December 2016 the government announced planned changes to the RHI, including reductions in subsidies for heating plants that use more agricultural crops to generate heat. Under the reformed scheme, new AD plants will only receive full subsidy support if they use more than 50% waste or crop residues as feedstocks, rather than virgin agricultural crops. Officials will determine the proportions of biogas from wastes and residues in sustainability audits for larger plants[55].

5.6.2b. Hinkley Point Nuclear Reactor – decarbonisation and nuclear energy generation – Energy sector

Source: New Scientist[56]

Hinkley Point C nuclear power station is a project to construct a 3,200 MWe nuclear power station comprising of two reactors in Somerset, England, approved in 2016 and expected to be commissioned in 2025. The plant, which has a projected lifetime of sixty years, has an estimated construction cost of between £19.6 billion and £20.3 billion[57]. It represents an expansion of the current generation on the site.

In terms of the Nexus, the construction of Hinkley Point C raises a number of important issues. Because of the current age, state, geography and capacity of the South West electricity grid infrastructure, its construction is likely to lead to insufficient capacity for the desired significant new renewable energy capacity (although in a few cases there may be a limited increase in grid infrastructure capacity for renewables generation as a result of Hinkley[58]). Already, solar farms are required to agree a contract which allows them to be shut down at times of grid shortage. Overall, this is **likely to make renewable**

[55] https://farming.co.uk/news/government-cuts-subsidies-for-crop-fed-ad
[56] https://www.newscientist.com/article/2105968-uk-approves-controversial-hinkley-c-nuclear-power-plant/
[57] https://www.bbc.co.uk/news/business-40479053 ; https://www.telegraph.co.uk/business/2017/07/03/hinkley-nuclear-costs-climb-almost-20bn-start-delayed/
[58] From stakeholder comment during Workshop 2.

energy generation – which is regionally important – much less viable in the South West, through crowding out at regional level. Although UK policy has veered away from supporting community-led/owned renewable energy initiatives in recent years, community renewable energy generation is still a regional priority for Devon and Cornwall. According to a report by Regen commissioned by DCC there are more community energy organisations in Devon (23) than in any other county in the UK. This represents 1.3% of the total renewable electricity installed in Devon. Community energy organisations in Devon have raised £14.1 million of investment, enabling them to create 33 FTE jobs[59].

The Hinkley Point C development therefore represents a conflict or trade-off among the different components of the decarbonisation objectives and regional / national supply priorities, given that further investment is required to provide a stable electricity supply from renewable energy generation. The electricity grid should be decarbonized by 2030 if the legally binding carbon budgets are **to be met (CCC, 2017)[60]. The majority of this decarbonisation will occur via more variable power renewable energy (wind and solar) and sources of flexibility connected to both distribution and transmission networks. Nuclear power plants of the size of Hinkley Point C undermine this need for flexibility – the vital complement to variable renewable energy. Therefore whilst Hinkley Point C provides some carbon reduction, it also undermines the bigger source of decarbonisation – renewables and flexibility - and is expensive.**

In addition, there are **potentially serious negative environmental consequences for the water, land and agricultural sectors** through pollution and ongoing issues related to decontamination and disposal of waste.

The Hinkley plans have also been subject to ongoing criticism reported in the press, including around high costs and safety. According to the National Audit Office (2017) the Department for Business, Energy and Industrial Strategy's deal for Hinkley Point C has locked consumers into a risky and expensive project with uncertain strategic and economic benefits. Concerns were also raised in March 2018 by the UK nuclear regulator with EDF Energy that management failings could affect safety at the Hinkley Point C power station if left unaddressed[61]. In January 2018 the plans for connecting Hinkley Point C to the grid were criticised for putting investment in the UK energy sector at risk[62]. As the recent National Infrastructure Commission (NIC)[63] report has said, the energy future is renewable and energy efficient and the Government should not build more than one nuclear power plant after Hinkley Point C – in effect the NIC has accepted what Government is currently doing with nuclear, but then said no more.

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[59] https://www.regensw.co.uk/devon-community-energy-impact-report-2018
[60] https://www.theccc.org.uk/publication/the-fifth-carbon-budget-the-next-step-towards-a-low-carbon-economy/ accessed 12 July 2018
[61] https://www.theguardian.com/uk-news/2018/mar/25/nuclear-watchdog-raises-hinkley-point-c-concerns
[62] https://www.theguardian.com/uk-news/2018/jan/23/national-grid-ofgem-hinkley-point-seabank

[63] https://www.nic.org.uk/wp-content/uploads/CCS001_CCS0618917350-001_NIC-NIA_Accessible.pdf#page=8 accessed 12 July 2018

5.7. Validation of the assessment

Workshop held on 26 June 2018 (see Appendix 1 for details)

The workshop was attended by 12 stakeholders who were spread across the sectors and types of organisations participating in the project. Eight members of the project team were also present. The workshop was structured to present the latest updates and information on the case study. There were sessions on:

- Presentation of SIM4Nexus models and the Serious Game
- Policy challenges and the Nexus: preliminary findings
- How the Serious Game can help with your decision-making
- How would you influence the development of the Serious Game? What is important to you? What handles would you pull?

The programme (see Appendix 1) also included time for questions and discussion on these areas.

Although the team had not completed all of the policy coherence assessment, initial outcomes were presented, including insights into enabling and hindering factors in some of the success stories and failures. Stakeholders discussed progress on the policy coherence work and this was followed by discussion in groups about what participants would like to see in the Serious Game and why.

Some of issues the stakeholders raised included:

- There needs to be more consideration of what the public think and their influence on policy making i.e. more emphasis on social aspects. Issues that came up included diet and impacts of less meat consumption, role of community stakeholders;
- There was a query about how to bridge the gap between the conceptual model and the development of the serious game;
- New heating incentives (RHI) featured as one of the stories and there was agreement that the amount of maize being grown has had a negative effect in some instances (although one of the participants noted that maize is also grown as animal feed). A stakeholder asked how the model will anticipate these types of unintended consequences;
- It was suggested that local planning policy needs to be more prominent in the conceptual model;
- Consideration of natural capital needs expanding within the game;
- User-requirements, user experience and outcomes of the game need clarifying.

The afternoon session explored these issues further when stakeholders were asked to do an activity (see Appendix 1). This asked stakeholders to imagine – in their own respective fields of activity - what kind of "Tech-tree" they could invest in to change future outcomes in the Serious Game. (Scans of these 'tech-trees' are presented in Appendix 1 – please view at 500%). These 'tech-trees' provide insight into the stakeholders and how they have been thinking about the Serious Game. This is still a work in progress as the intention is to build a ‘giant tech-tree’ but it is clear that these contributions open up ideas for some new domains for the ‘tech-tree’ and interesting technologies.

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7 Appendix 1

SIM4NEXUS Stakeholder Workshop AGENDA
Exeter University, 170 Harrison Building, North Park Road, EX4 4QF
26th June 2018

09:30-10:00	Registration and Coffee	
10:00-10:10	Initial welcome & housekeeping	SWW
10:10-10:40	Recap/intro to the SIM4NEXUS project and case study	SWW
10:40-11:00	Bringing Sim4Nexus to life - overview of the Sardinia case study	UNEXE
11:00-11:20	Presentation of SIM4Nexus models and the Serious Game	UNEXE
11:20-11:40	Coffee Break	
11:40-12:00	Policy challenges and the Nexus: preliminary findings	UNEXE
12:00-12:20	How the Serious Game can help with your decision-making	SWW

12:20-12:40	Questions and Discussion on the serious game, policy coherence and the conceptual model	All
12:40-13:30	Lunch	
13:30-14:00	How would you influence the development of the Serious Game? What is important to you? What handles would you pull?	UNEXE
14:00-14:30	Discussion in groups - What you would like to see in the Serious Game and Why?	All
14:30-14:50	Plenary - feedback and questions	All
14:50-15:00	Sum up and next steps	All
15:00	Coffee & close workshop	

Activity: How would you influence the development of the Serious Game?

As stakeholders, you are now being asked to imagine – in your respective field of activity - what kind of “Tech-tree” you can invest into so as to change future outcomes inside the Serious Game.

You have to imagine some sort of resource would either be needed to implement that technology (e.g money, political capital, energy, computing power) …

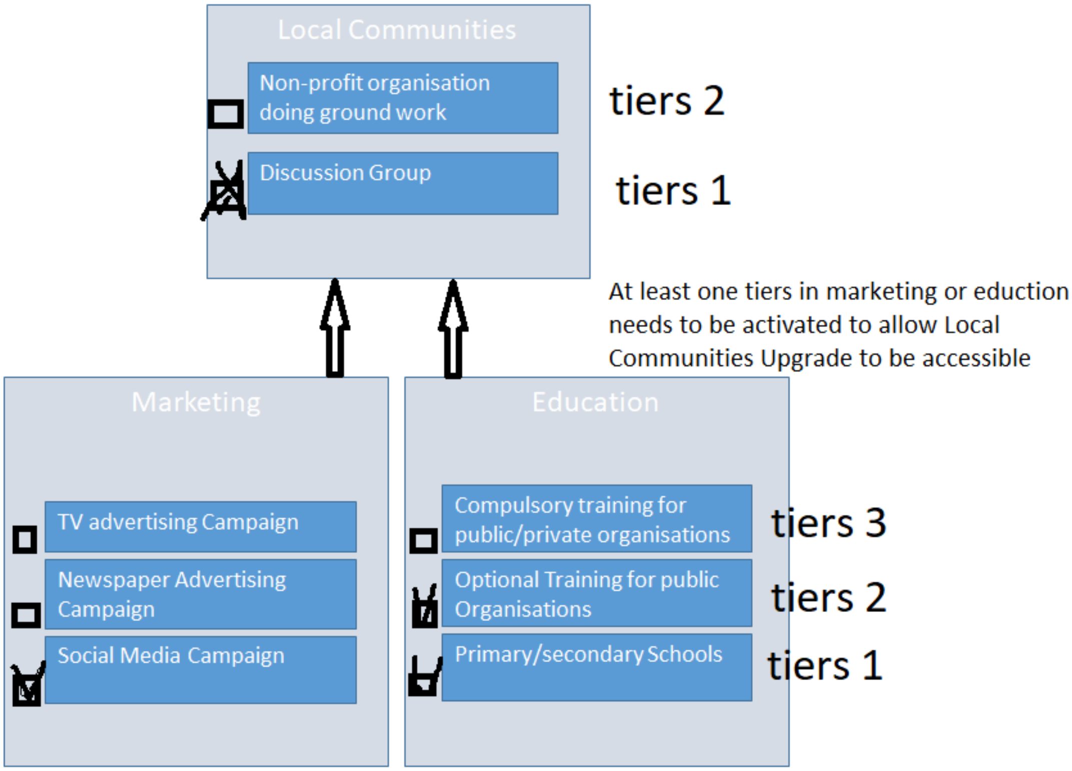
You have to imagine effects of that technology.

1- it can reinforce positive effects of some existing policies ?
2- it can decrease negative effects of some existing policies ?
3- it can have undesirable side effects such as increasing negative effects of some existing policies or increasing the consumption of resources ?
4- it can make some other future technologies available in the tech tree ?
5- it can either increase existing resources (e.g money, political capital, energy, computing power) or create a new one that was not available before ?
6- it can allow to choose new policies that were not available before that tech was activated ?

Starting example:

Let say you work in the field of engagement and sensitisation of the public to environmental issues. You think, that with a given budget, you could implement some concrete technologies that would improve the efficiency of policies and render the implementation of environmental work cheaper and more impactful.

The resulting "Tech-tree" could be:



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It does not have to be 100% realistic, but it has to be believable and must reflect to some extent a sensible view of how you see the tools available in the near future of your field.

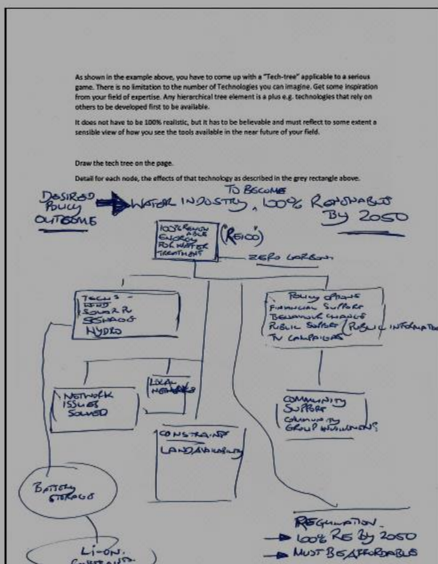
Draw the tech tree on the page.

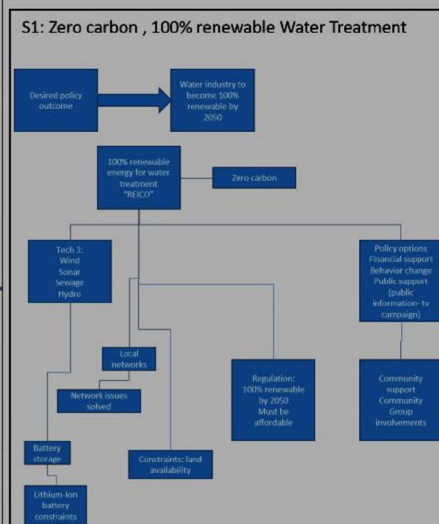
Detail for each node, the effects of that technology as described in the grey rectangle above.

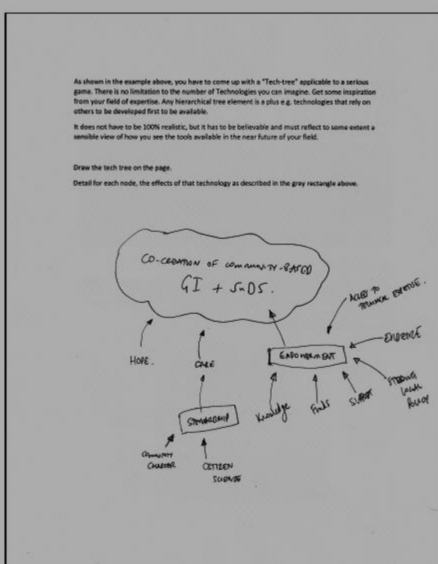
Scans of Workhop "Tech-Trees" from stakeholders

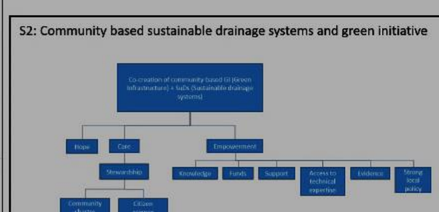
Still a work in progress as we are in the process of building a "giant" tech tree out for the suggested examples. Some things will be reused, and other will be discarded, and other that are not present so far will be added. So far , it seems to open ideas for new domain areas of the tech tree and interesting technologies.

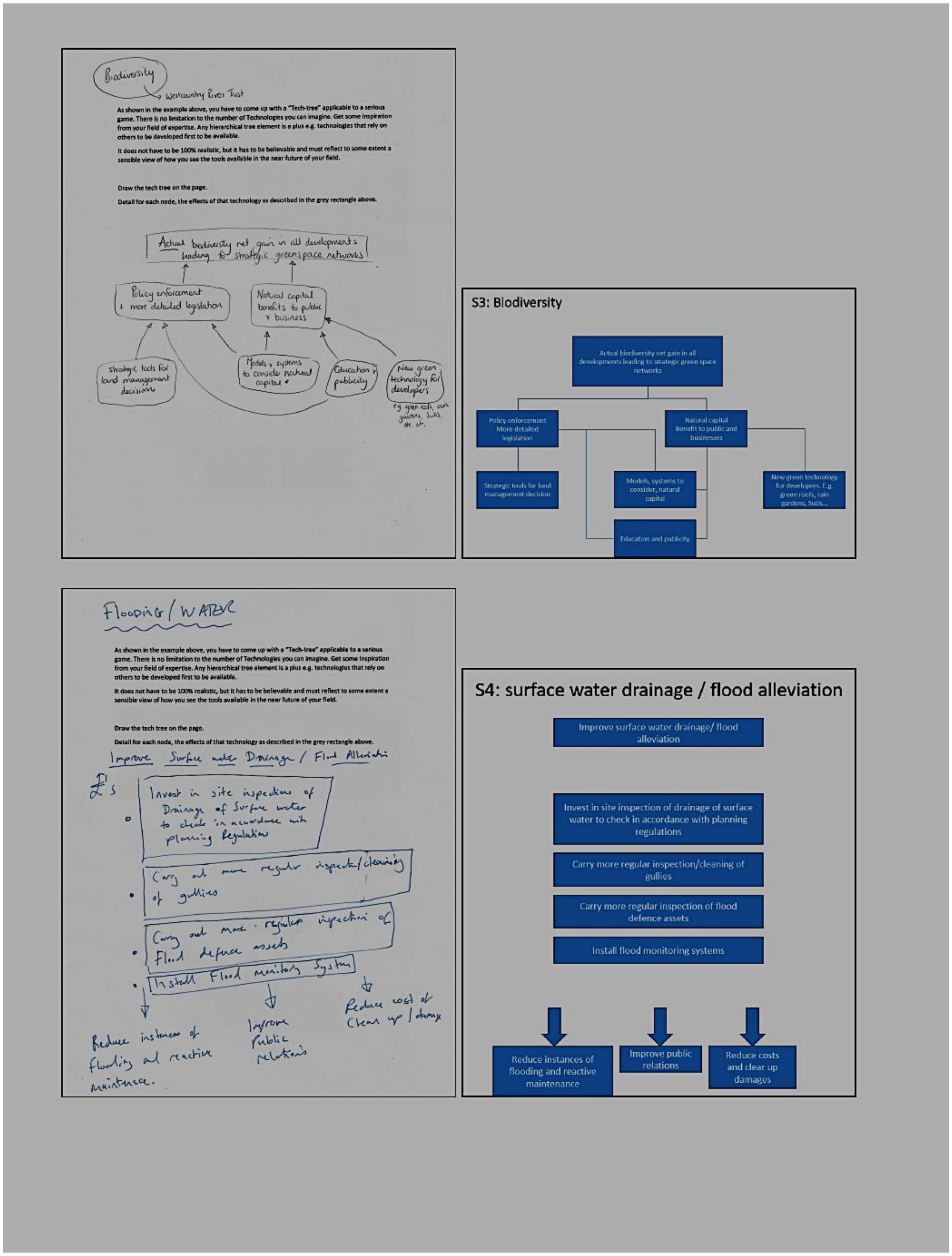
Link to Editable Power Point HERE (you need to ungroup graphs before editing)










Biodiversity
Westcountry Rivers Trust
As shown in the example above, you have to come up with a "Tech-tree" applicable to a serious game. There is no limitation to the number of Technologies you can imagine. Get some inspiration from your field of expertise. Any hierarchical tree element is a plus e.g. technologies that rely on others to be developed first to be available.
It does not have to be 100% realistic, but it has to be believable and must reflect to some extent a sensible view of how you see the tools available in the near future of your field.
Draw the tech tree on the page.
Detail for each node, the effects of that technology as described in the grey rectangle above.
Actual biodiversity net gain in all developments leading to strategic greenspace networks
Policy enforcement + more detailed legislation
Natural capital benefits to public + business
Strategic tools for land management decisions
Models + systems to consider natural capital
Education + publicity
New green technology for developers
S3: Biodiversity
Actual biodiversity net gain in all developments leading to strategic green space networks
Policy enforcement More detailed legislation
Natural capital Benefit to public and businesses
Strategic tools for land management decision
Models, systems to consider, natural capital
New green technology for developers. E.g. green roofs, rain gardens, SuDs...
Education and publicity
Flooding / WATER
As shown in the example above, you have to come up with a "Tech-tree" applicable to a serious game. There is no limitation to the number of Technologies you can imagine. Get some inspiration from your field of expertise. Any hierarchical tree element is a plus e.g. technologies that rely on others to be developed first to be available.
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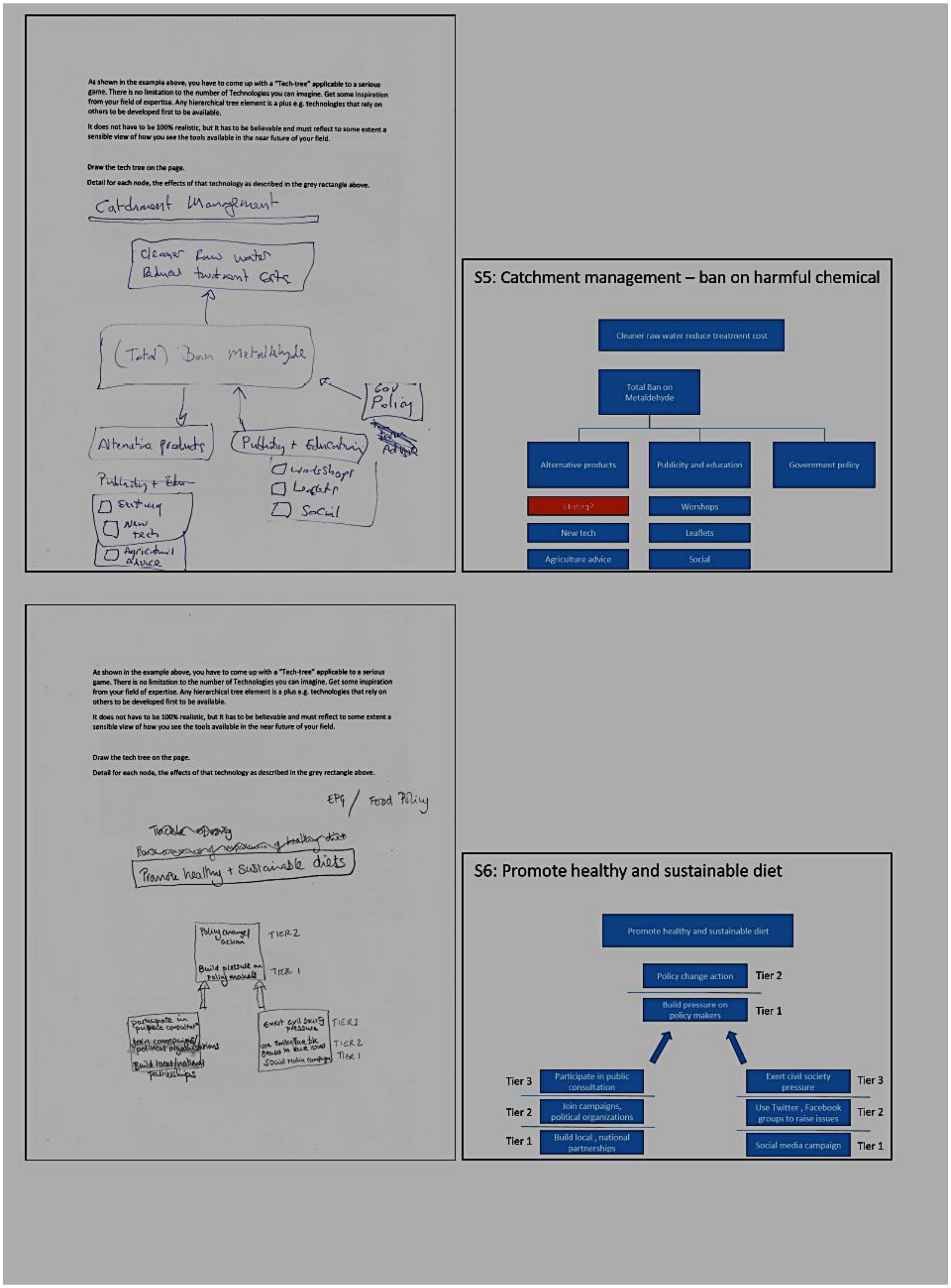
Draw the tech tree on the page.
Detail for each node, the effects of that technology as described in the grey rectangle above.
Improve Surface water Drainage / Flood Alleviation
£'s
Invest in site inspection of Drainage of Surface water to check in accordance with planning Regulations
Carry out more regular inspect/cleaning of gullies
Carry out more regular inspection of Flood defence assets
Install Flood monitoring System
Reduce instances of flooding and reactive maintenance.
Improve Public relations
Reduce cost of Clean up / damage
S4: surface water drainage / flood alleviation
Improve surface water drainage/ flood alleviation
Invest in site inspection of drainage of surface water to check in accordance with planning regulations
Carry more regular inspection/cleaning of gullies
Carry more regular inspection of flood defence assets
Install flood monitoring systems
Reduce instances of flooding and reactive maintenance
Improve public relations
Reduce costs and clear up damages



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Catchment Management
(Total) Ban Metaldehyde
Gov Policy
Alternative products
Publicity + Education
Workshops
Leaflets
Social
New tech
S5: Catchment management – ban on harmful chemical
Cleaner raw water reduce treatment cost
Total Ban on Metaldehyde
Alternative products
Publicity and education
Government policy
Existing?
Worshops
New tech
Leaflets
Agriculture advice
Social
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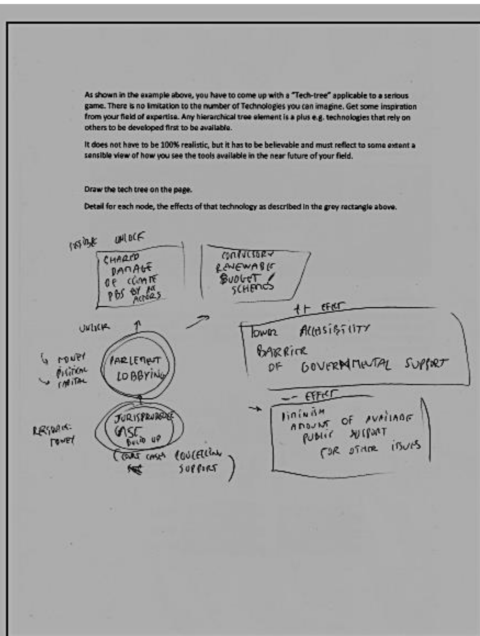
EPG / Food Policy
Promote healthy + sustainable diets
TIER 2
TIER 1
TIER 3
S6: Promote healthy and sustainable diet
Promote healthy and sustainable diet
Policy change action
Tier 2
Build pressure on policy makers
Tier 1
Tier 3
Participate in public consultation
Exert civil society pressure
Tier 3
Tier 2
Join campaigns, political organizations
Use Twitter, Facebook groups to raise issues
Tier 2
Tier 1
Build local, national partnerships
Social media campaign
Tier 1



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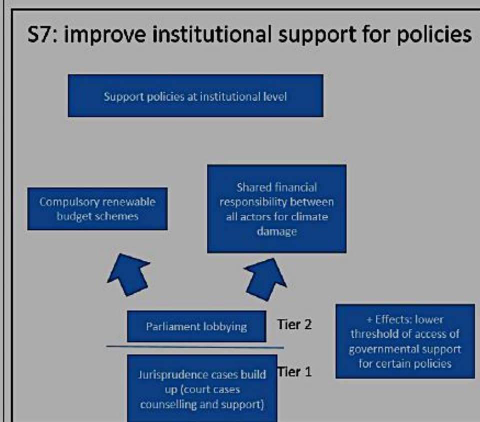
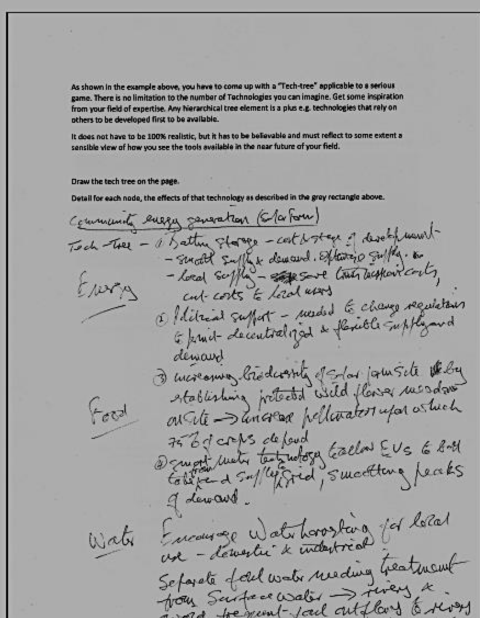


S7: improve institutional support for policies
Support policies at institutional level
Compulsory renewable budget schemes
Shared financial responsibility between all actors for climate damage
Parliament lobbying
Tier 2
+ Effects: lower threshold of access of governmental support for certain policies
Jurisprudence cases build up (court cases counselling and support)
Tier 1



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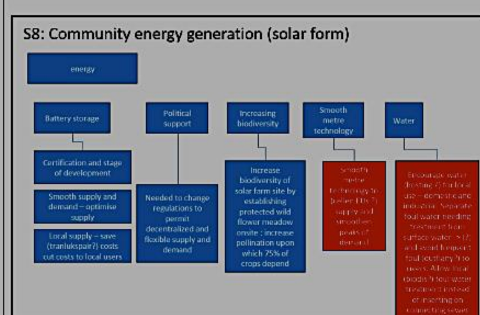
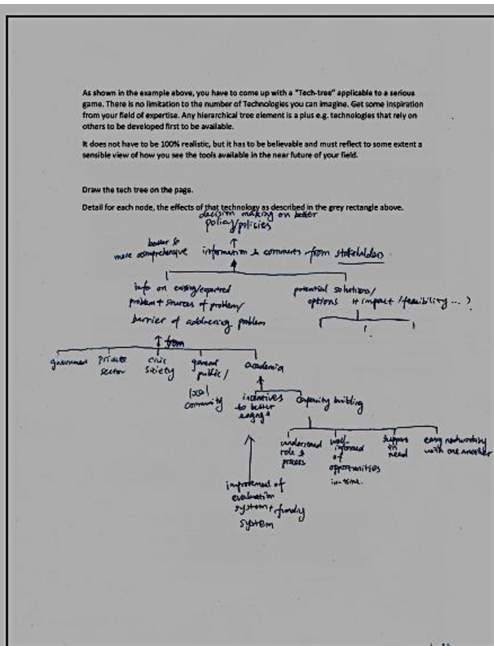


S8: Community energy generation (solar form)
energy
Battery storage
Political support
Increasing biodiversity
Smooth metre technology
Water
Certification and stage of development
Smooth supply and demand – optimise supply
Local supply – save (tranlukspair?) costs cut costs to local users
Needed to change regulations to permit decentralized and flexible supply and demand
Increase biodiversity of solar farm site by establishing protected wild flower meadow onsite : increase pollination upon which 75% of crops depend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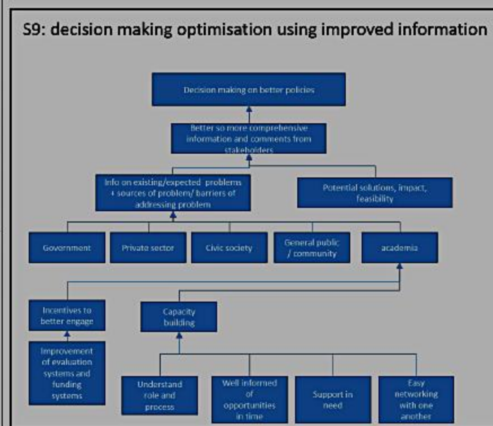
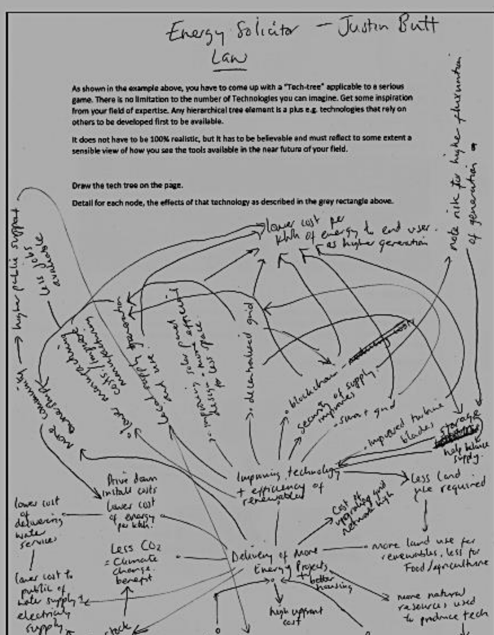
Draw the tech tree on the page.
Detail for each node, the effects of that technology as described in the grey rectangle above.
decision making on better policy/policies
better & more comprehensive information & comments from stakeholders
info on existing/expected problem + sources of problem/ barrier of addressing problem
potential solutions/ options + impact /feasibility ...)
from
government
private sector
civic society
general public/ local community
academia
incentives to better engage
capacity building
understand role & process
well-informed of opportunities in time.
support in need
easy networking with one another
improvement of evaluation system + funding system


S9: decision making optimisation using improved information
Decision making on better policies
Better so more comprehensive information and comments from stakeholders
Info on existing/expected problems + sources of problem/ barriers of addressing problem
Potential solutions, impact, feasibility
Government
Private sector
Civic society
General public / community
academia
Incentives to better engage
Capacity building
Improvement of evaluation systems and funding systems
Understand role and process
Well informed of opportunities in time
Support in need
Easy networking with one another


Energy Solicitor – Justin Butt
Law
As shown in the example above, you have to come up with a "Tech-tree" applicable to a serious game. There is no limitation to the number of Technologies you can imagine. Get some inspiration from your field of expertise. Any hierarchical tree element is a plus e.g. technologies that rely on others to be developed first to be available.
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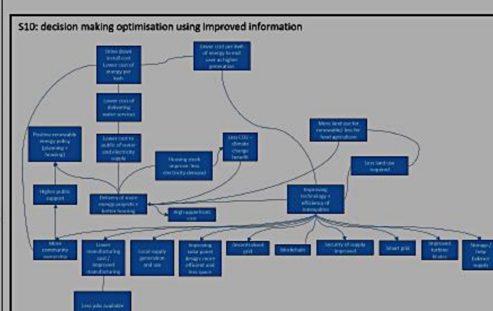
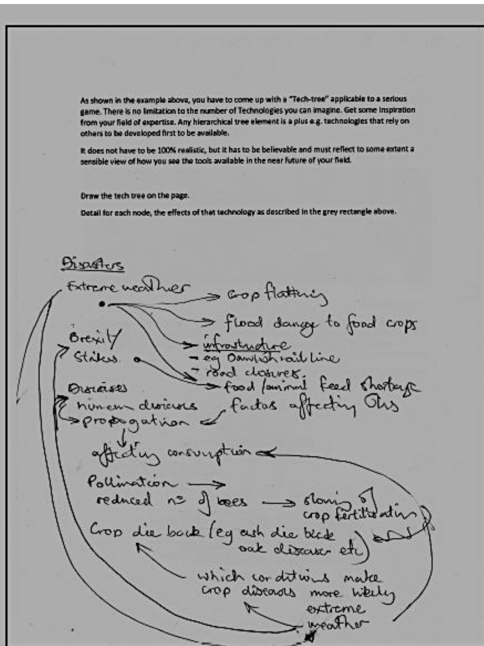
Draw the tech tree on the page.
Detail for each node, the effects of that technology as described in the grey rectangle above.
lower cost per kWh of energy to end user as higher generation
Improving technology + efficiency of renewables
Delivery of more energy projects + better housing
Drive down install costs lower cost of energy per kWh
lower cost of delivering water services
Less CO2 = climate change benefit
less land use required
more land use for renewables, less for food/agriculture
more natural resources used to produce tech
high upfront cost
blockchain
security of supply
smart grid
decentralised grid
improved turbine blades
higher public support
less jobs available


S10: decision making optimisation using improved information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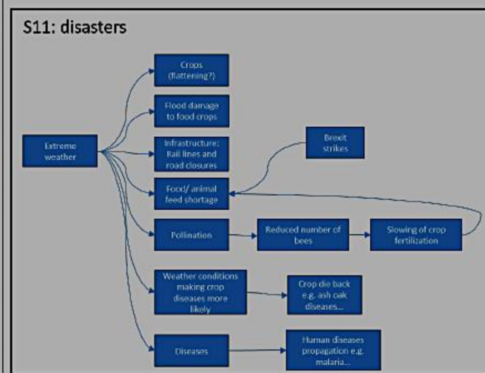
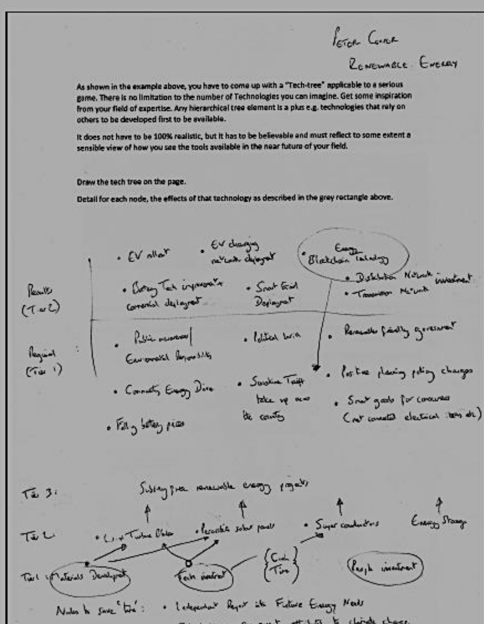
Disasters
Extreme weather
crop flattening
flood damage to food crops
infrastructure
eg Dawlish rail line
road closures
food/animal feed shortage
Brexit
Strikes
Diseases
human diseases
propagation
factors affecting this
affecting consumption
Pollination
reduced no of bees
slowing of crop fertilisation
Crop die back (eg ash die back oak disease etc)
which conditions make crop diseases more likely
extreme weather

S11: disasters
Extreme weather
Crops (flattening?)
Flood damage to food crops
Infrastructure: Rail lines and road closures
Food/ animal feed shortage
Brexit strikes
Pollination
Reduced number of bees
Slowing of crop fertilization
Weather conditions making crop diseases more likely
Crop die back e.g. ash oak diseases...
Diseases
Human diseases propagation e.g. malaria...

Renewable Energy
As shown in the example above, you have to come up with a "Tech-tree" applicable to a serious game. There is no limitation to the number of Technologies you can imagine. Get some inspiration from your field of expertise. Any hierarchical tree element is a plus e.g. technologies that rely on others to be developed first to be available.
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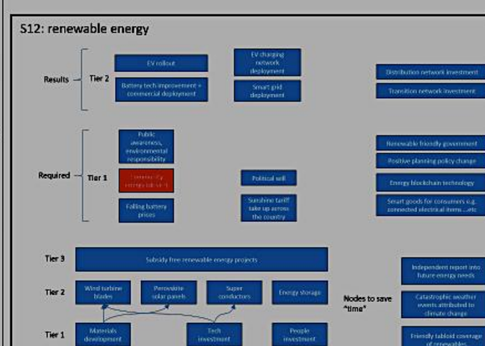
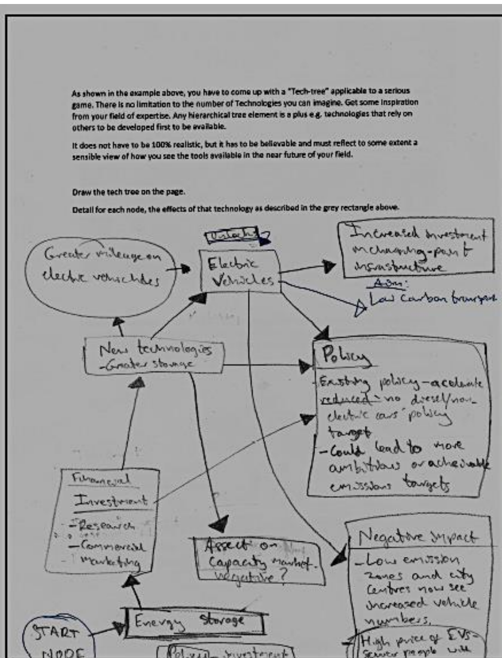
Draw the tech tree on the page.
Detail for each node, the effects of that technology as described in the grey rectangle above.
Results (Tier 2)
Required (Tier 1)
Tier 3
Tier 2
Tier 1
Energy Storage

S12: renewable energy
Results
Tier 2
EV rollout
Battery tech improvement + commercial deployment
EV charging network deployment
Smart grid deployment
Distribution network investment
Transition network investment
Required
Tier 1
Public awareness, environmental responsibility
Falling battery prices
Political will
Sunshine tariff take up across the country
Renewable friendly government
Positive planning policy change
Energy blockchain technology
Smart goods for consumers e.g. connected electrical items ...etc
Tier 3
Subsidy free renewable energy projects
Tier 2
Wind turbine blades
Perovskite solar panels
Super conductors
Energy storage
Tier 1
Materials development
Tech investment
People investment
Nodes to save "time"
Independent report into future energy needs
Catastrophic weather events attributed to climate change
Friendly tabloid coverage of renewables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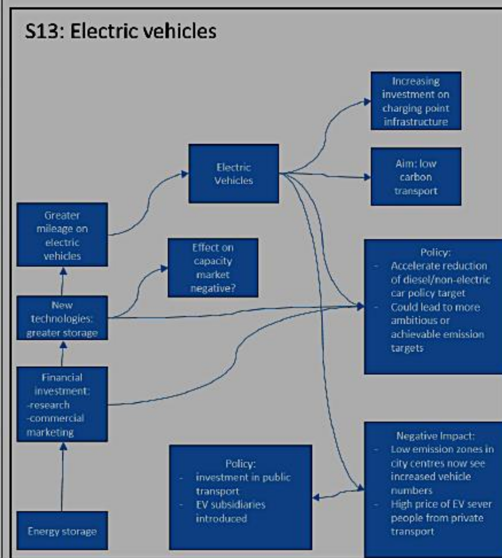
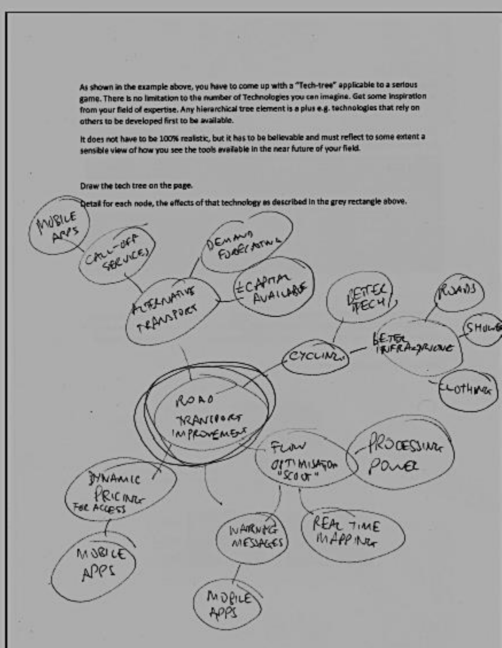
Draw the tech tree on the page.
Detail for each node, the effects of that technology as described in the grey rectangle above.
Greater mileage on electric vehicles
Electric Vehicles
Increased investment in charging-point infrastructure
Aim: Low carbon transport
New technologies -Greater storage
Policy
Financial Investment
-Research
-Commercial marketing
Negative impact
Energy storage
START NODE


S13: Electric vehicles
Increasing investment on charging point infrastructure
Aim: low carbon transport
Electric Vehicles
Greater mileage on electric vehicles
Effect on capacity market negative?
Policy:
- Accelerate reduction of diesel/non-electric car policy target
- Could lead to more ambitious or achievable emission targets
New technologies: greater storage
Financial investment:
-research
-commercial marketing
Negative Impact:
- Low emission zones in city centres now see increased vehicle numbers
- High price of EV sever people from private transport
Policy:
- investment in public transport
- EV subsidiaries introduced
Energy storage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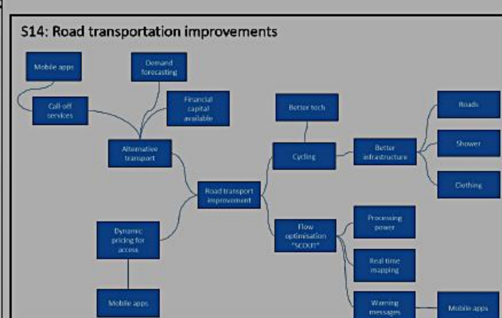
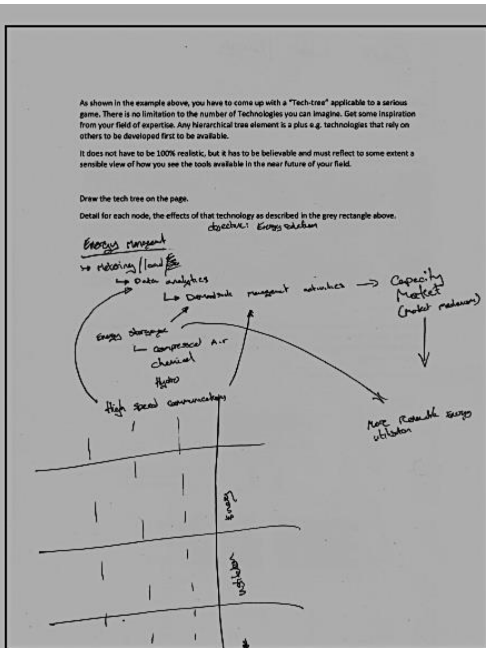
MOBILE APPS
CALL-OFF SERVICES
DEMAND FORECASTING
ALTERNATIVE TRANSPORT
£CAPITAL AVAILABLE
BETTER TECH
ROADS
SHOWER
CYCLING
BETTER INFRASTRUCTURE
CLOTHING
ROAD TRANSPORT IMPROVEMENTS
FLOW OPTIMISATION "SCOOT"
PROCESSING POWER
DYNAMIC PRICING FOR ACCESS
WARNING MESSAGES
REAL TIME MAPPING
MOBILE APPS
MOBILE APPS


S14: Road transportation improvements
Mobile apps
Demand forecasting
Call-off services
Financial capital available
Better tech
Roads
Alternative transport
Cycling
Better infrastructure
Shower
Clothing
Road transport improvement
Dynamic pricing for access
Flow optimisation "SCOUT"
Processing power
Real time mapping
Mobile apps
Warning messages
Mobile apps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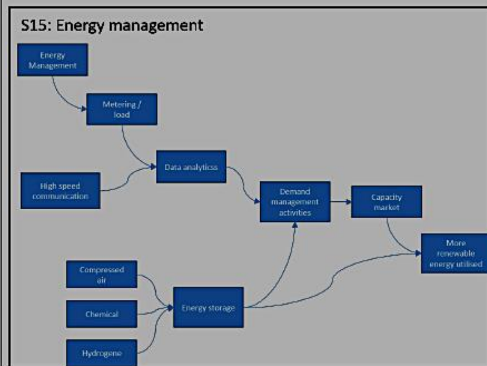

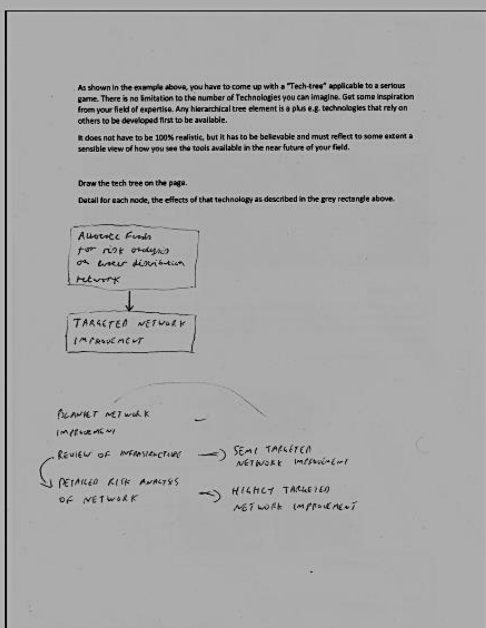
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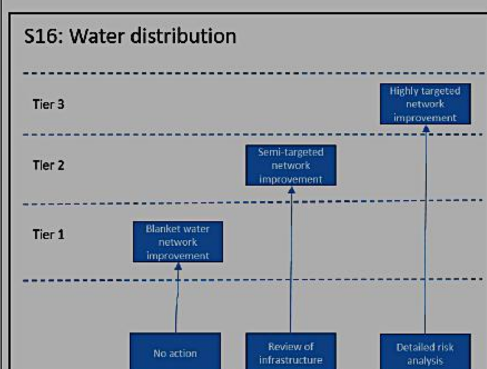


Germany-Czech Republic-Slovakia transboundary case study
Policy analysis
(Czech part)

AUTHORS: Petra Hesslerová, Jan Pokorný, Lenka Kröpfelová, Marek Baxa

29 – May – 2018

Document version: [WP2-T.2.2, final]

Executive summary

The main objective of this report is mapping of the nexus related policy in transboundary region of Germany, Czech Republic and Slovakia. This report is mapping the nexus related policy in the Czech Republic. Focus issues introduce the inherited problems resulting from both past landscape adaptations and current land management. All three states experienced a common period of collectivization, causing increased field block areas and large scale drainage; the ramified hydrological web of the agricultural landscape disappeared. Therefore, the main issue is drought mitigation which is related to landscape structure adaptations, changing agriculture practices and soil quality improvement. The policy review is aimed mainly at the agriculture, water and landscape management issues, soil protection, climate change mitigation, renewable energy. In this context we have reviewed number of laws, strategies, government decisions, decrees, orders, action plans, etc. Socio-economic aspect completes the report about social issues which have significantly influenced the landscape quality and indicates the current impacts of Common agriculture policy on Nexus related issues, as well as the joint topic of renewable resources. Stakeholders list complete the report on the subjects that may be potentially involved / interested in Nexus concept, or may contribute with their expertize, knowledge, demands.

Glossary/Acronyms

AECM	Agri-environmental and climate measures
APFC	Agriculture procedures favourable to climate
a.s.	Joint-stock company
CAP	Common Agriculture Policy
CLC	Complex land consolidation
CZ	Czech Republic
ČÚZK	State Administration of Land Surveying and Cadastre
EFA	Ecological Focus Area
ERÚ	Energy Regulatory Office
ES	Ecosystem services
EU	European Union
EU ETS	European Union Emission Trading System
FAO	Food and Agriculture Organization of the United Nation
GAEC	Good Agriculture and Environmental Conditions
GDR	German Democratic Republic
GHGs	Greenhouse gasses
HD	Historical landscape structure data
JZD	Cooperative farm
LC	Land consolidation
LPIS	Land Parcel Identification System
MW	megawatt
NPFA	Non-production functions of agriculture
PG	Permanent grassland
SAPS	Single area payment scheme
SBE	Soil blocks evidence
s.e.	State enterprise
$W.m^{-2}$	$Watt.meter^{-2}$

Table of contents

BLOCK 1

Mapping out the policy space

1 Identification of the focus issues and related policy sectors for the case study

The nexus context for the transboundary study was set up as a relationship of land-water-climate-energy, with crucial representation of agriculture activities that put a pressure on all four components. The problems which are common to all three case studies states result from common history. For all three states there are typical changes in the structure of the agricultural landscape, i.e. the creation of large soil/field blocks and the removal of small landscape features, as well as complicated ownership relations.

The general problem of the Czech Republic is the consolidation and drainage of large agricultural areas that began in the context of political and economic changes in the 1950s. These changes reflected as changes of landscape structure and its functions, ownership change, and landscape management. The transition from small-scale to large-scale production is mainly related to the simplification of the landscape structure, the merging of small fields into huge land blocks (the largest in Europe), the loss of landscape elements such as groves, balks, paths, i.e. all the elements preventing the smooth cultivation of land by heavy mechanization. These processes are also related to extensive drainage of agricultural land (by technological drainage systems in soil, drying wetlands, etc.), which culminated in the 1970s. For illustration, let us give a few numbers. At present, in the Czech Republic (78 866 km^2), there is 1,084,800 ha officially registered as drained (+ ca. 450,000 ha unregistered). Between 1948 and 1989, 270 000 ha of meadows and pastures, 145 000 hectares (800,000 km) of balks, 120 000 km of paths were ploughed; 35,000 ha of groves and 30,000 km of grass and shrubs belts were removed (Vašků 2011).

These changes have had the following negative events that directly affect water retention capacity of the landscape and local climate (Pokorný et al. 2010). The consolidation and drainage of large agricultural areas leads to the following negative events:

Organic compounds are reduced in soil. The degradation of organic matter (mineralization) in the soil is accelerated by alternating drying and saturation with water and is accompanied by acidification of the soil. Acidification is accompanied by the loss of nutrients and basic cations and the release of aluminum and heavy metals into the soil solution. The irreversible losses of substances from the catchment area determine the stability of the system. Soil acidification, reducing its fertility on the one hand and high nutrient content and eutrophication of water on the other hand are related phenomena of poor farming in the landscape.

The loss of the ability to retain water (water capacity of the soil) due to the loss of organic matter and changes in the soil structure lead to rapid soil drying. Soil loses water sorption, cohesion, and is more easily eroded. In the sunny weather, it overheats, thus leads to changing the local climate and accelerating its decomposition (oxidation) (Ripl 1995, 2003). The top soil horizon often disappears. In periods without precipitation, deforestated agricultural landscape is the same heat island as urban areas (Hesslerová and Pokorný 2010). Large drained agricultural areas become donor zones - water in the form of water vapour is diverted to places with higher evapotranspiration, which are cooler and where precipitation occurs (Makarieva et al. 2006; Makarieva and Gorshkov 2007). FAO reports in its statistics that 40% of agricultural land is suffering from water scarcity, 60,000 km2/year of agricultural land is subject to desertification and several fold area of land loses fertility.

Agricultural landscape fundamentally influences the hydrological cycle and the climate. Agricultural crops do not tolerate long-term flooding of roots with water and can therefore not be grown on soils regularly flooded.

On hot summer days, it overheats, most of the sun's radiation is transformed into sensible heat, due to lack of water, instead of latent heat, resulting in surface temperature increase and gradual drying of the landscape. The difference in latent and sensible heat distribution in a landscape with a mosaic of fields, forests, meadows, ponds, and drainage areas with intensive agriculture, reach of hundreds of W.m^{-2} (Huryna et al. 2014; Hesslerová et al. 2013). In the first case, the latent heat of the vapour is 60-80 % of net radiation, with sensible heat of 20-30 %. The decrease in evapotranspiration of 1 km^2 due to drainage (for an equivalent 100 mg.m^{-2}.s^{-1} water vapour) represents 250 MW of solar energy released from this area into the atmosphere in the form of warm air. In the Czech Republic, in August 2015 and 2016, almost 18,000 km^2 of wheat and rape were harvested. The sensible heat from these harvested and drained areas was 4,500,000 MW / day. To produce that amount of heat, it would require 4,500 nuclear power plants, each with a capacity of 1,000 MW. However, the real value of the sensible heat may be higher. The result is the creation of a large area of high air pressure over the overheated landscape, which subsequently prevents, in the conditions of Central Europe, the penetration of humid air from the Atlantic. The overheated landscape is drying up and becomes a water vapour donor for cold areas. It is necessary to point out that the hot air (sensible heat) released from overheated dry surfaces takes water from adjacent trees, small forests/woods and wetlands. Water bodies, woods, wetlands are dried out by warm air of low relative humidity, this dry air comes from dry areas. Furthermore, dry warm surfaces radiate long wave radiation which warms exposed adjacent objects. Briefly saying: dry land stress rest of wetlands and vegetation and accelerates drying of landscape, decline of organisms and biodiversity.

The agricultural landscape is experiencing deterioration in soil quality (erosion, sealing, nutrient losses, acidification), water scarcity and drying. Despite the EU's efforts to introduce various agro-environmental measures and measures to mitigate climate change. In these cases it is necessary to look at the main cause of the failure of these efforts.
In the past thirty years, there was not significant landscape structure change in the case study states, which would improve the retention and accumulation of water, the reduction of nutrient losses and decreasing surface temperature of the landscape. Principal condition for such an improvement is restoration of permanent vegetation. EU policy and subsidies were originally set to maximize agricultural output, from which the subsidy system was also developed. The Czech Republic became part of the CAP at a time when the EU gradually implemented the so-called Fischler's Reform. The reform, in accordance with Council Regulation (EC) No 1782/2003, governed the system of direct payments and introduced a single payment scheme (SPS), introducing a conditionality for direct payments under the set of legislative standards (cross-compliance system), reducing intervention prices in a number of important sectors, and envisaged a stronger strengthening of the so-called second pillar of the CAP, namely to support rural development. The Czech Republic, together with most other states that joined the EU in May 2004, was applying a simplified single area payment scheme (SAPS) instead of the SPS. In addition, in accordance with the EU Act of Accession, a transitional period for the payment of direct aid to the countries acceding to the EU in 2004 set a phasing-in period until 2013, according to the Accession Treaty, the level of direct payments provided by of the EU budget in the "new" and "older" Member States. In addition, EU-10 countries were allowed to call from their own resources using so-called national top-up payments. Gradually, the cross-compliance system has been introduced since January 1, 2009, as well as Good Agricultural and Environmental Status (GAEC) standards. The fulfillment of these requirements has gradually begun to make provision for the full amount of direct payments and some other subsidies (e.g. under the Rural Development Program). The entry of the Czech Republic into the EU and the previous preparatory period meant significant changes in legislation and subsidies in particular. The Government of the Czech Republic, in connection with the accession to the EU, approved several strategic documents related to agriculture and related areas. This was the concept of the Czech Republic's agrarian policy for the period 2004-2013 (from 2004), the water management policy of the Ministry of Agriculture up to 2010 or the Czech food industry concept for 2004-2013 (2006). On the basis of EU legislation, the National Forest Program of 2003 was also updated (by 2013).
In order to mediate financial support not only from national sources, but also from the EU, the State Agricultural Intervention Fund (SZIF) was established as a paying agency in 2007. In December 2009 the Ministry of Agriculture of the Czech Republic set up a Group on Strategic Issues in Agriculture, which in June 2010 drew up a Vision of Czech Agriculture after 2010. In November 2010 the Commission announced the future of the CAP after 2020, which outlined the objectives of the future reform. The Ministry of Agriculture of the Czech Republic immediately expressed its support for the reform based on more balanced and targeted support but **rejected** the proposals concerning the setting of limits for the level of direct payments, which would have primarily affected by large farms.
As a result of CAP implementation, there was a further decrease of small landscape features in the Czech Republic in order to maximize cultivated areas and maximize subsidies. In recent years, there is also an impact on the structure and management of the landscape resulting from policy on renewable energy sources, especially biofuel production. This problem arises from the Czech government's commitment to cover energy resources from 13.5% from renewable sources. The Czech Republic does not have the potential to use water or wind energy, so one of the main solutions is rape and maize production for biofuels. Losses of organic matter from soil of fields repeatedly used for cultivation of corn, rape and wheat are several times higher than amount of carbon harvested in form of plant biomass (Novotný et al. 2017).

For all above mentioned reasons, the transboundary study focuses on sectors relevant to agriculture policy, water and landscape management, renewable resources, climate change and its mitigation strategy documents.

Key research questions are:

- How can we encourage/achieve the complex and extensive changes of landscape structure, in national scale, in terms of increasing its water retention ability and decreasing surface temperature?
- Try to answer what effect could be achieved by greening in the drained fields and by landscape restoration based on seepage grass strips, wetlands and ponds for water retention which also stimulate sequestration of carbon and reduce water and nutrient losses.
- How can landscape restoration (wetlands, forests) be embedded into policy for climate change mitigation?
- How to increase an understanding of basic principles of NEXUS: incoming solar energy – water/absence of water – plants (biomass, food) – local climate. Because it is landscape management (land cover) what determine climate, water availability, food production.

2 Mapping out the socio-economic context

Former Czechoslovakia (Czech Republic and Slovak Republic) and Eastern Germany (GDR) passed common history in the second half of 20th century being a part of so called east bloc. Nationalization/expropriation of larger farms and collectivization of agriculture resulted in diminishing of individual farmers, increase of fields and systematic drainage of agriculture land. The agricultural land fund has been largely influenced by the construction of water management facilities (drainage systems). In the Czech Republic, about 25% of agricultural land is drained by systematic drainage. Precise numbers, however, are not available due to insufficient records of these systems. The drainage systems were built in the Czech Republic in several successive stages, most intensely between 1935-1940 and 1965-1985. Extensive drainage works were also carried out in unsuitable areas, i.e. mountain and sub-mountain areas with more complex morphological, climatic, soil and hydrogeological conditions. This, together with the subsequent intensive agricultural activities, has resulted in a significant destabilization of agroecosystems; simplification their structural heterogeneity, biodiversity has decreased, soil and hydrological conditions have changed in the substantial areas of basins. Surface area of individual field blocs increased of two orders of magnitude from 2 ha up to several hundred ha. In the Czech Republic 1 500 000 ha of agriculture land was drained, 800 000 km of hedgerows were ploughed, 12 000 km of small streams were straightened, deepened and mostly put into pipes. Tiny hydrological web of agriculture landscape disappeared (Vašků 2011).

The problem in the Czech Republic is the preservation of this unfavourable state of the past. There are no tools for change. Agriculture is an activity which determines amount and quality of water discharged from fields (agriculture landscape) and which determine distribution of solar energy on large areas of fields, briefly: agriculture affect significantly local climate and amount and quality of water. Recently agriculture negatively affects the local climate and the hydrological cycle. Agriculture is the most important entity that is directly responsible for the water retention in the landscape and its quality. This fact is not yet realized the society either by farmers themselves or any other bodies responsible for mitigating drought in the landscape, preventing floods, water retention, mitigating climate change. Effects of agriculture practice on local climate have been documented and can be demonstrated by monitoring of temperatures, air humidity, water discharge and quality (Hesslerová et al. 2012; Procházka et al. 2009; Ripl and Eiseltová 2009; Ripl and Hildmann 2000).

Farming is now governed by EU standards - the CAP (Common Agriculture Policy). Adherence to these standards, however, does not lead to a change in landscape structure and improvement of its functions in terms of water and nutrient retention; on the contrary supports conservation, and often deterioration of the current state (Novotný et al. 2017). Agriculture subsidies do not address complex issues and do not motivate to change. Apart from the fact that the Czech Republic has the largest soil blocks in Europe, land ownership also plays a crucial role. Extensive collectivization, i.e. the process whereby private farmers were deprived of private ownership of land and included in collective economies (JZD and state estates), intensively ran from 1949 to 1953 and 1955 to 1958. After 1989, restitution process has returned the property, but relations to the land have been broken; most of the original owners (families) had a chance to get the property back. They were not able to commence farming, they hired/leased their heritage land to bigger companies which manage land and take EU/state subsidies. Landscape i.e. large drained fields did not change. Only a small part of the original owners returned to agriculture. As a result, 80 % of agricultural subjects farm on leased land that they have no relationship to. This is not the motivation for proper soil care and landscape improvement. Moreover, there is a large fragmentation of ownership relationships, resulting from the restitution of agricultural land after 1990, when land seized in the 1950s gradually returned to either the original owners but rather their descendants. Small owners sell stepwise their land to big owners. Now, big part of arable land is used for production of energetic biomass i.e. rape for bio fuel and maize for biogas, such production is subsidized by the Czech government.

For all CAP measures (under pillars 1 and 2), it is a connecting element of preserving biodiversity and good management of farmland. There is no definition of the responsibility of the farmer as a subject of the process of proper landscape management, co-responsibility for the creation of water regime, water quality and local climate. The principles of good agricultural practice and standards of good agricultural and

environmental condition of the soil will not solve the hydrological problems nor can they. At present, it is impossible to achieve a state of improvement without using a comprehensive land-use and its structure change that would increase retention and accumulation of water in the landscape, improve its quality, reduce flood risk, drought, improve local climate, reduce erosion and nutrient and nutrient uptake. It is necessary to cooperate not only with subsidizing agricultural policy but also with water planning and climate strategies (e.g. catchment plans, water law ...),
The effectiveness of greening measures, which the EU is likely to promise, is not yet being evaluated, since 2016 was the first year that this measure came into force. Grassing without proper location and other follow-up measures will not solve hydrology and climate problems in the landscape. In practice, the farmer often manages large soil blocks to meet the greening quota, allocating only a larger area for cultivating crops, no matter where grassing has justification and the function of retaining or cleaning water. Since land is often leased, there is no incentive to apply for subsidies that would change the landscape structure and incorporate new and necessary landscape features to improve its water regime. Compensation payments only target those that are already exists.

CAP subsidies should, i.e. at the expense of other payments, include such measures, which will impose an obligation to implement complex solution for the entire catchment area, with the possibility of compensations for the land and the possibility of reimbursement for their maintenance. The first attempt to achieve this is the activity of the Povodí Vltavy, s.e. (Vltava River Basin management institution, state enterprise), which aimed to include these titles (according to Kvitek 2016):
1. Implementation of comprehensive and complex measures (type A - according to catchment area management plans) on the agricultural land
2. Maintenance and management of technical and nature measures for the retention, accumulation and improvement of water quality on agricultural land
3. Support for the purchase of land for the implementation of these measures
4. Reimbursement of economic damage from loss of production from the areas designated for the implementation of these measures
Povodí Vltavy, s.e. have already received the contract, where will design the concrete measures (changes of landscape structure, implementation of natural and technical features for water retention, etc.) on the farmland (approximately 3300 cases). However, will need to receive a support to get this measures into practice in the Czech Republic, by changing agriculture policy, legislation, question of land owners, funding etc. Sim4nexus project may be a tool how to achieve this goal or at least try to start solves this challenging issue.

Table 1. Land use in the Czech Republic (ČÚZK, 2008)

Land use	Area % (Total area of CZ 78 866 km2)
Urban areas	1,7 (130 933 ha)
Forests	33,8 (2 653 033 ha)
Water	2,1 (162 500 ha)
Farmland	53,5 (4 244 081 ha)
Other	9 (695 965 ha)

Table 2. Structure of farmland (ČÚZK, 2008)

Arable land	3 025 597 (ha) (71,3 % of farmland)
Hop-gardens	10 762 (ha) (0,25 %)
Vineyards	19 131 (ha) (0,45 %)
Gardens	162 642 (ha) (3,8 %)
Orchards	46 231 (ha) (1,1 %)

Permanent grassland	9798 (ha) (23,1 %)

2.1. Energy issue

Another problem related to increased soil erosion, reduced soil water retention capacity and its degradation in terms of nutrient losses, changes in local climate, is the cultivation of energy crops - rape and maize. This problem is driven by an ambitious commitment to use 20% of renewable energy by 2020 (the overall EU target). The National Renewable Energy Action Plan of the Czech Republic was developed on the basis of Directive 2009/28/ EC. The article 4 of this Directive mandates the Member States of the European Union to draw up and adopt a National Renewable Energy Action Plan (Renewable Energy Action Plan). Pursuant to the Directive, the national target for the Czech Republic of renewable energy in 2020 was set on 13,5 % (in 2005 this was 6.1%).

In the Czech Republic, the main source of energy is coal (46,12%) and nuclear power plants (35,87%), hydropower (4,6%), wind and solar (3,12%), biomass (1,85 %), biogas (2.44%), others (6%) (ERÚ Source, 2012). To achieve the quota of 13%, rape seed has to contribute to the production of biofuels and biogas. In 2016, rape was cultivated on 10% of agricultural land (400 000 ha, i.e. 5% of the Czech Republic's area), maize (241 500 ha) to 6% (i.e. 3% of the Czech Republic's area). Farmers are motivated by the high purchase prices of these commodities, no matter what burden these crops have for the landscape. In addition, there is no crop rotation. In the Czech Republic, more or less only four crops rotate - maize, rapeseed, barley, wheat, which make up 82% of the areas used in agriculture. To restore nutrients load in the soil, these species would need to be ten to fifteen.

Cultivation of these dry soils crops also affects the climate. Agriculture land is covered by growing plant biomass only several months a year. Harvested fields of grain and rape are overheated since July, surface temperature reach over 40 ° C, fast ascending warm air from these areas takes away moisture and dry up large areas. In August, there is 18,000 km2 harvested area in the Czech Republic, from which hot air is released with thermal energy (sensible heat) of 7000 - 9000 GW (the power of the Czech nuclear power plant Temelín is 2 GW). The warm air dries, creating a high pressure that prevents the supply of humid air. The dry surface layer of the soil and its sealing prevent the penetration of precipitation into soil profile; the ground water is not refilled, there is fast runoff, floods appear. In terms of biotic pump theory, present agriculture practice changed the landscape into water donor.

The conception of rape and maize cultivation is therefore not only against the principles of the Common Agricultural Policy, but also against the concepts and strategies for drought, floods and climate change mitigation.

Table 3. Electricity production from renewable resources in CZ (ERÚ, 2016)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Celkem OZE [MWh]	**3 393 509**	**3 738 459**	**4 668 514**	**5 886 915**	**7 247 504**	**8 055 026**	**9 243 382**	**9 169 709**	**9 422 950**	**9 395 450**
Malé vodní elektrárny do 10 MW	1 001 845	966 884	1 082 683	1 238 819	1 017 878	1 026 254	1 236 978	1 011 674	1 001 797	1 053 100
Vodní elektrárny nad 10 MW	1 077 493	1 057 451	1 346 937	1 550 655	945 276	1 102 912	1 497 762	897 549	793 010	947 388
Větrné elektrárny	125 098	244 661	288 067	335 493	397 003	415 817	480 519	476 544	572 612	496 957
Fotovoltaika	1 754	12 937	88 807	615 702	2 182 018	2 148 624	2 032 654	2 122 869	2 263 846	2 131 455
Bioplyn	182 699	213 632	414 235	598 755	932 576	1 472 142	2 241 300	2 566 699	2 614 188	2 600 546
Biomasa	993 360	1 231 210	1 436 848	1 511 911	1 682 563	1 802 591	1 670 327	2 007 039	2 090 855	2 067 443
BRKO	11 260	11 684	10 937	35 580	90 190	86 686	83 842	87 335	86 642	98 561

zdroj dat: předchozí roční zprávy, výkaz ERÚ-1, OTE, a.s. (od roku 2013)

Tuzemská brutto spotřeba [MWh]	72 045 200	72 049 267	68 600 000	70 961 700	70 516 541	70 453 278	70 177 356	69 622 096	71 014 254	72 418 279
Podíl OZE [%]*)	**4,71%**	**5,19%**	**6,81%**	**8,30%**	**10,28%**	**11,43%**	**13,17%**	**13,17%**	**13,27%**	**12,97%**

**) prostý podíl výroby brutto z OZE a celkové tuzemské brutto spotřeby*

zdroj dat: předchozí roční zprávy, výkaz ERÚ-1, ERÚ-2, ERÚ-3, OTE, a.s.

Note: Renewable resource energy production (Mwh); Small hydroelelectrics stations (up to 10 MW); Hydroelelectrics stations (more than 10 MW); Wind power stations; Photovoltaics; Biogass; Biomass; Biologicaly degradable waste; Bruttto electricity consumption in CZ (Mwh); Share of renewable resources (%)

3 Mapping of stakeholders

Stakeholders' engagement is important in almost any case where policy strategies and decisions are created, approved and adopted. Stakeholders can play both passive and active roles in the policy process. This chapter focuses on stakeholders' analysis for the Czech part of transboundary case study. Representatives of several public and private organizations have been addressed in order to offer their knowledge, experience and expertise with respect to the nexus-related policies. The issue of water retention in the landscape and drought mitigation connects many subjects, however their interest and power may differ significantly, as well as their ability/readiness to adopt significant policy changes and adaptations that can really contribute to the complex problem solving. The main constrains dwell in poor cooperation between ministries; despite the objectives (water retention, soil quality improvement, climate change mitigation, etc.) are often joint interests. The unwillingness to make fundamental changes to help solve the problem often involves fears of taking responsibility. All these facts make the process of establishing active cooperation with the crucial stakeholders very difficult.

3.1. Stakeholders analysis

ENKI actively cooperates with Ministry of Environment, Ministry of Agriculture on the conception "Preparation of measures to mitigate the negative impacts of drought and water scarcity".
Ministry of Environment
- Department of general nature and landscape protection (Jan Pokorný cooperates with):
  - Unit of landscape and forest protection
  - Unit of soil protection
  - Unit of programmes on landscape restoration and management and water in landscape
- Department of water protection (ENKI collaborates with)
  - Unit of water protection
  - Unit of flood protection
  - Unit of international cooperation and planning in water area
- Department of energy and climate protection
  - Unit of emissions trading
  - Unit of energy and climate protection

Ministry of Agriculture (departments for which we do expertise)
- Water management section
  - Water management policy and flood protection measures department
  - Water in the landscape and elimination of flood damages department
- Forest management section
  - State administration of forests, Game management and fisheries department
- EU funds, research, development and education section
  - Environmental subsidies for rural development programme

Other potential stakeholders involve:
Municipalities make suggestions and approve landscape development plans (infrastructure like new roads, new residential areas, industrial zones, exemption from forest and agriculture land). Landscape planning is worked out by regional offices and approved by the Ministry of Environment. Municipalities are involved in the process planning and use of natural sources like underground water, mining of ore, coal etc. Municipalities partly own infrastructure for potable water and wastewater treatment plants.
Larger municipalities (town administration) approve construction activities (new houses, buildings, factories), tree cutting through department of building – construction and department of environment.
Bureau/authority of landscape consolidation plans and decides on consolidation of plots of agriculture land with respect to their accessibility by individual owners, with respect to hydrology, floods and erosion

protection and interests of nature protection. Unfortunately, large agriculture fields are inadequately modified. Bureaus of landscape consolidation are in each region city with branches in district towns.
Chamber of agriculture unifies farmers, owners of agriculture land. Chamber of agriculture negotiates with the Ministry of agriculture (and others) on behalf of its members. Also provides regularly information on legislative processes, incentives and subsidies, prices of commodities etc., to individual members by email and on web – several times a week. Chamber of agriculture has offices in regional and district towns.
CHMI Czech Hydro-meteorological Institute is a state – owned institute operating a network of meteorological stations in the Czech Republic, it keeps database of meteorological data, evaluates data, provides weather forecast, delegates representative to IPCC.
Other potential stakeholders briefly:
Research organisations: Academy of Sciences of the Czech Republic independent institutes outside of universities, established in 1950s according to model of Soviet Union separating research from university teaching. In some post-communist countries academy of sciences were join with universities after the political change in1989.
Universities, Resort Research Organisations, Private and NGO non-profit research organisations.
ČEZ and E-on producers, distributors and providers of electric power, owners and operators of **photovoltaic** power plants and hydropower plants
Forest owners (34 % of land cover in Czech Republic): state (60%), municipalities 18%, other private owners 22%. (SVOL = association of owner, we work with)
Private farmers managing their own land
Fishponds management institutes. Long term contract based cooperation with biggest one (Rybářství Třeboň, Rybářství Kardašova Řečice/20 000ha) and with the Association.
In the course of the project, we will continue to try to address other above mentioned stakeholders, who can actively contribute through their experience, expertise and knowledge. The real cooperation may be established with:
Ministry of Environment – interest in drought mitigation strategies
Ministry of Agriculture – interest in drought mitigation strategies
Regional Office of South Bohemia region
Technology Platform on Sustainable Water Resources
Povodí Vltavy, State public enterprise - cooperation in the field of spatial water retention in landscape

Ministry of Environment		
Stakeholder´s role	Strong power in policy decision and legislation; responsible for strategies and acts (climate, water)	Public stakeholder responsible for environmental policy
Stakeholder´s interests	Water	The universal objective of the national water management policy is to create conditions for sustainable management of the finite water resources in the Czech Republic. This implies that all forms of water resource use should be in compliance with water and aquatic ecosystem protection requirements while applying measures to reduce the harmful effects of water. The key principles of the water management policy are derived from the EU Water Framework Directive, other water management directives and the renewed EU Sustainable Development Strategy. The Water Protection Department of the Ministry of the Environment is the central water management authority in particular with respect to the following issues: conservation of quantity and quality of surface water and groundwater flood prevention, water planning at the national and international levels, including programmes of measures, international co-operation in water protection,

		economic, financial and administrative instruments in water protection, drafting of legislation and standards in water protection.
	Climate	Adopts strategic documents on climate change adaptation and mitigation. The main interests are to: reduce greenhouse gas emissions by 20 % by year 2020 in comparison with 1990 levels within the so-called Climate-Energy Package (2008) reduce the greenhouse gas emissions by at least 40 % by year 2030 in comparison with 1990 levels within the so called 2030 Climate and Energy Framework (2014). Is responsible for Climate Protection Policy of the Czech Republic, Strategy on Adaptation to Climate Change in the Czech Republic, National Action Plan on Adaptation to Climate Change
	Energy	Participates on state energy policy. This strategic document formulates priorities and strategic objectives in the energy part that are necessary for investors, citizens and state authorities in order to ensure the stability of investments in energy and related sectors in the long term. The strategic priorities of the energy sector include balanced energy mix, savings and efficiency, infrastructure and international cooperation, research, development and innovation and energy security.
	Land	General nature and landscape protection
Policy and Instruments	-State environmental policy -Environmental impact assessment -Integrated pollution prevention and control - voluntary instruments - environmental education and consultations - research	The principal purpose of environmental policy is to provide a framework and guidelines for decision-making and activities at the international, national, regional and local levels aimed at further improvements in the environmental quality as a whole and in the quality of environmental components. Environmental policy focuses on enforcement of sustainable development principles, continuing integration of the environmental perspective into sectoral policies, and increasing the economic efficiency and social acceptability of environmental protection programmes, projects and activities.

Ministry of Agriculture		
Stakeholder´s role	Very strong and crucial power in policy decision and legislation; responsible for strategies and acts (water, food and agriculture, land, partly for climate and energy- renewable resources)	The Ministry of Agriculture is a central authority of state administration for agriculture excepting preservation of agricultural land fund, for water management excepting preservation of natural water accumulation, preservation of water sources and preservation of water quality, and for food industry.
Stakeholder´s interests	Water	The priorities are flood protection and support for the development of water supply and sewerage networks. Management of watercourses via state-owned enterprises managing the Vltava, Elbe, Morava, Oder a Ohře river basins. Provide support for pond cleaning and the construction of water supply and sewerage systems. Drought mitigation strategy Water legislation Water information system
	Climate	Mitigation strategy – bounding of greenhouse gasses into soil organic matter, biomass Adaptation strategy in agriculture
	Energy	Biofuels production

	Land	Land structure, landscape features Soil protection, mitigation of erosion Soil strategy documents, information system
	Food and agriculture	Food safety Plant, animal, organic production, sustainable use of pesticides, ecological farming Biofuels production
Policy and Instruments	state agriculture policy subsidies controls and monitoring education and consultations research	

Povodí Vltavy, state public enterprise		
Stakeholder´s role	Formal power – implementation of relevant policies, advisory activities	Administrates important and significant minor watercourses, manages and maintains state-owned waterworks with the entitlement to manage. The main goal is to improve a versatile use of surface water and groundwater within the whole hydrological Vltava River Basin
Stakeholder´s interests	Water	Improve surface, groundwater quality, minimize pollution, erosion, flood protection, revitalization of water courses
	Climate	Mitigate climate change
	Energy	Minimize support of biofuels in order to improve water quality
	Land	Landscape structure changes in order to increase water retention in landscape, minimize erosion, improve water quality – minimize spatial pollution; Maintenance and management of technical and nature measures for the retention, accumulation and improvement of water quality on agricultural land. Link up river basins management plans with land consolidation
	Food and agriculture	CAP changes in order to decrease spatial pollution and increase water retention in landscape. To apply good agriculture and environmental conditions and cross-compliance demands in practice
Policy and Instruments	- execution of rights and obligations - management and maintenance of state-owned waterworks - water management in waterworks - providing of expert opinions - ensuring flood protection - river basin administrator and owner of water works - providing professional advice to water-right authorities at decision-making process - developing river basin management plans - surveying and evaluation of surface water and groundwater status, monitoring of surface water	

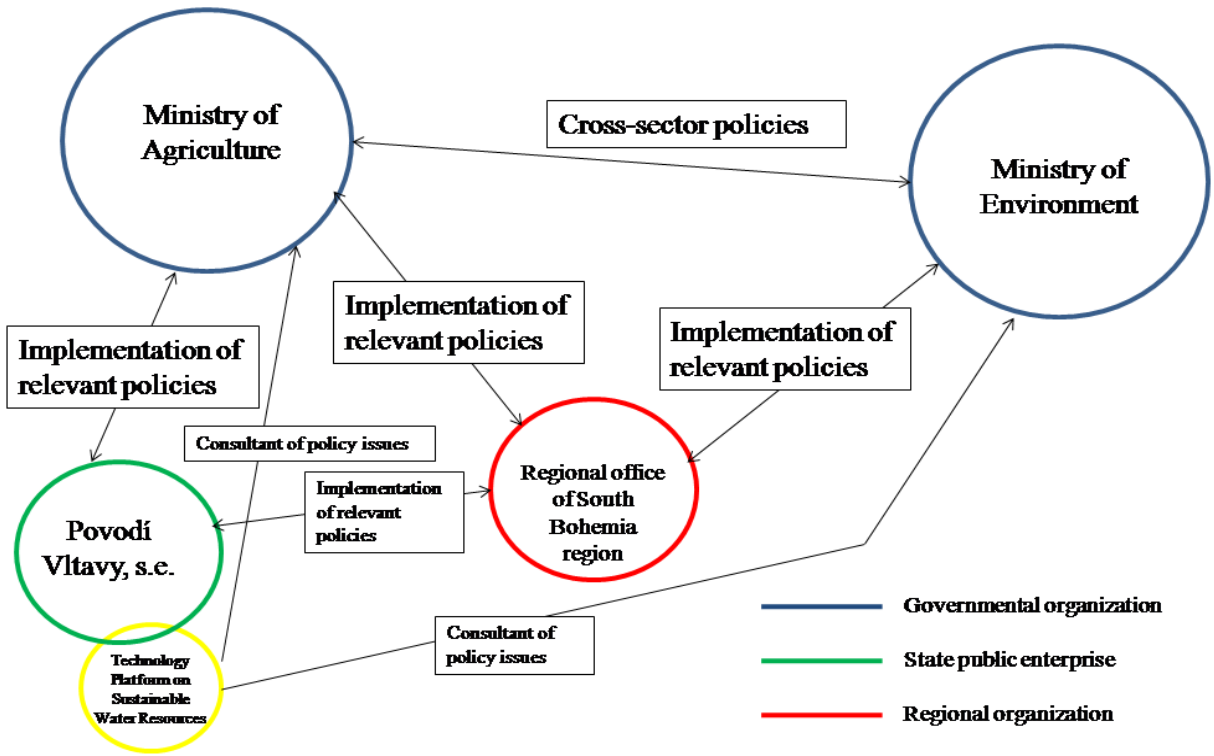
	quality - Development of conditions for a reasonable, considerate and environmentally sustainable use of surface water and groundwater and water courses. - Providing water management and hydrological information	

Technology Platform on Sustainable Water Resources		
Stakeholder´s role	Informal power for decisions, advisory and consulting activities	Informal association of legal entities. The mission is to be a complementary player and also a cementing agent among the other already existing or newly emerging Czech subjects involved in the landscape water management, including state organisations as well as non-governmental and not-for-profit organisations. The missing link in this chain was a body capable of ensuring interdisciplinary system approach to decision-making in the field of water protection and management, sustainable use.
Stakeholder´s interests	Water	Water cycle, water management, hydrological modelling, revitalization, water supply, drought, floods mitigation
	Climate	Climate change (in general) and its impact on water resources
	Energy	Use of water energy
	Land	Soil erosion and water quality, water in soil
	Food / Agriculture	Agriculture impact on water resources, hydrological cycle, water consumption
Policy and Instruments	- conduction of conceptual and applied analyses in the field of water resources Research, training, education, dissemination	

Regional Office of South Bohemia region		
Stakeholder´s role	Decision making process and implementation in regional level	The Regional Authority fulfils the tasks in a separate competence imposed by its council and assists the activities of committees. The Council may impose tasks on a regional authority only in the scope of its powers conferred by law. The regional authority shall exercise delegated powers, except for matters that are legally conferred on the council or a special body.
Stakeholder´s interests	Water	Conception of flood protection, water and sewerage systems
	Climate	General awareness of climate change
	Energy	Energy conception
	Land	Land consolidation, landscape planning
	Food / Agriculture	Agro-environmental measures for farmers
Policy and Instruments	- implementation of acts, strategies, and other policy documents - strategic conception drafts for South Bohemia region and their implementation	

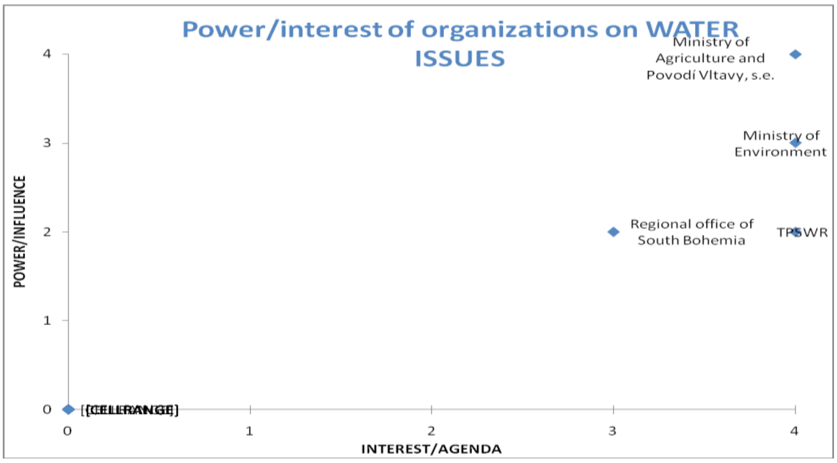
3.2. Stakeholders´ map

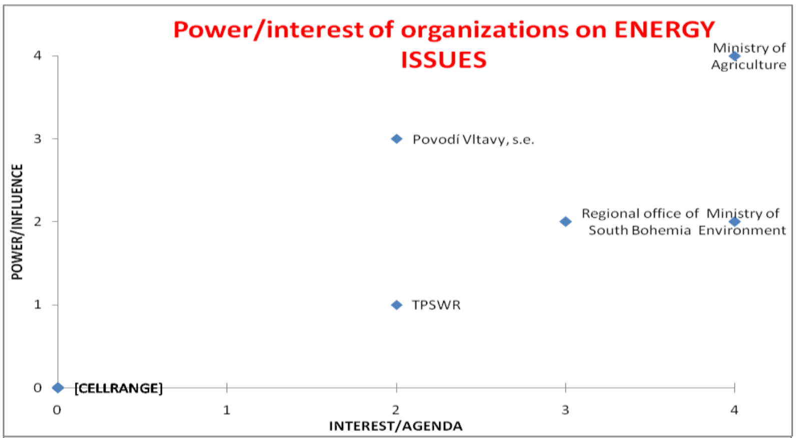
Stakeholders’ map briefly describes the role and responsibility of relevant stakeholder as well as the relationship among them. In a stakeholder map the size of the circle shows the importance of stakeholder, the colour of the circle represents different groups (government, regional, state enterprise, NGO). The relationship between the groups is indicated by the distance and overlap of the circles (the closer the circles the closer the relationship between the groups; overlap means that the stakeholder is a member of another group). Arrows indicate the main direction of the relationship; the textbox specifies the nature of the relationship.

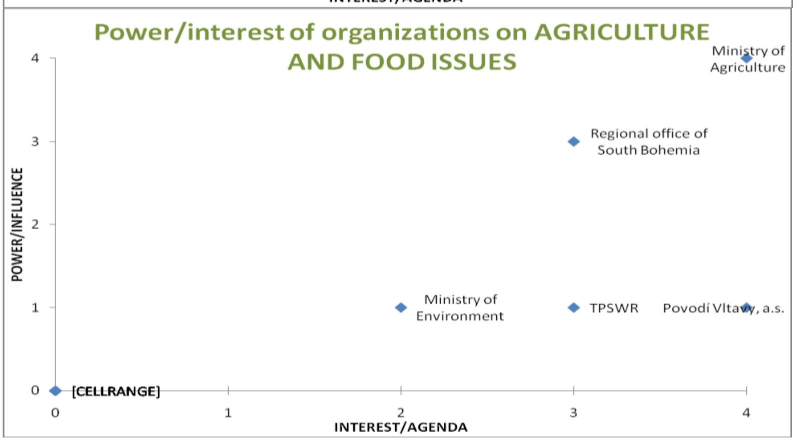


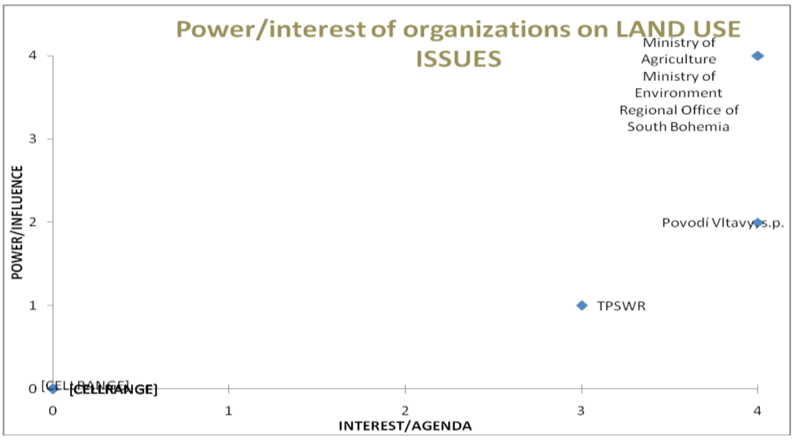
3.3. Stakeholders´ power / interest grids

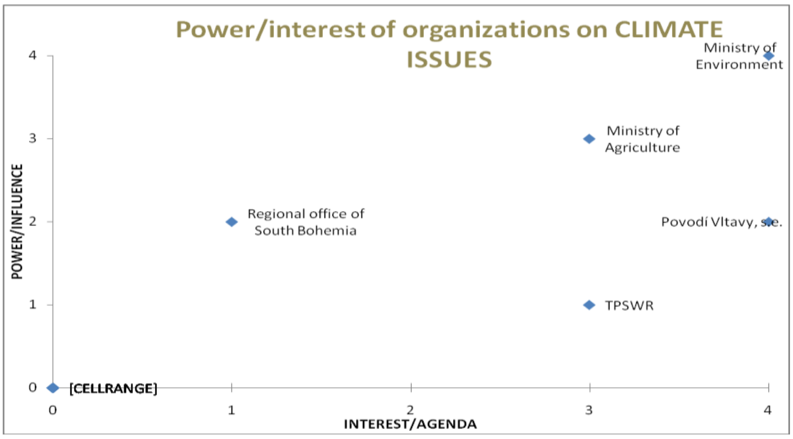
The stakeholders´power/interest grid has been automatically generated from the stakeholder’s register, after filling all relevant data; represents the power/interest in all nexus sectors of the most important stakeholders´. Stakeholders’ influence and interests have been rated in a scale from 1 (weak influence / weak interest) to 4 (very strong influence / very strong interest).


Power/interest of organizations on WATER ISSUES
Ministry of Agriculture and Povodí Vltavy, s.e.
Ministry of Environment
Regional office of South Bohemia
TPSWR
[CELLRANGE]
POWER/INFLUENCE
INTEREST/AGENDA


Power/interest of organizations on ENERGY ISSUES
Ministry of Agriculture
Povodí Vltavy, s.e.
Regional office of South Bohemia
Ministry of Environment
TPSWR
[CELLRANGE]
POWER/INFLUENCE
INTEREST/AGENDA


Power/interest of organizations on AGRICULTURE AND FOOD ISSUES
Ministry of Agriculture
Regional office of South Bohemia
Ministry of Environment
TPSWR
Povodí Vltavy, a.s.
[CELLRANGE]
POWER/INFLUENCE
INTEREST/AGENDA


Power/interest of organizations on LAND USE ISSUES
Ministry of Agriculture
Ministry of Environment
Regional Office of South Bohemia
Povodí Vltavy s.p.
TPSWR
[CELLRANGE]
POWER/INFLUENCE
INTEREST/AGENDA



Each stakeholder is usually involved in his specific activities. The common interests for all stakeholders are water and land use issues. The key players in policy design process are both ministries, which also interest in all nexus related issues. Ministry of Agriculture is a key player in the field of agriculture and food, as well as in water management and land use; partly in energy (through renewable energy resources). Ministry of Environment is responsible mainly for climate issues. Regional office of South Bohemia has a relatively strong mandate in agriculture and land use issues; less is involved in water, energy and climate issues. Povodí Vltavy, s.e. is engaged in water policy issues, partly in energy (through renewable energy resources), land use issues. High attention is payed to agriculture. TPSWR is a weak subject in terms of power, in all issues; however, with high interest rate in water, climate, land use, agriculture, slightly low interest in energy issues.

Generally, policies on landscape management - from the point of view of water management, landscape protection, soil, climate, etc., are isolated by sector. There is no common inter-ministerial concept dealing with issues across different subjects. The issue is solved individually, sometimes contradictory. In order to push for changes that would lead to complex changes in the landscape, from the point of view of surface water retention, cooperation is needed.

4 Mapping of policy goals and instruments

This chapter focuses on the identification of policy goals and policy means included in the policy documents (laws, directives, ministerial decisions, national strategic plans, etc.) that were collected during the policy inventory phase.

The policy areas investigated in the context of the present case study concern:

- The agriculture sector
- Water laws
- River basins management plans
- Renewable resources
- Climate change strategies
- Drought and floods protection
- Land management
- Soil protection

The results of the policy content analysis (policy goals and policy instruments) are described in the Table 4. Selection of important policy documents touching the issue of water retention in the landscape and mitigation of drought and climate change is briefly described in Tables 5 – 9, which is the list of documents with short explanation how these documents touch the water objective across all nexus related sectors. It appears in legislation and strategic documents on agriculture, environmental protection, water management, climate protection, mitigation and adaptation to climate change.

Table 4. Short description of the policy documents

Policy area	Type of the document	Title of the document	Short description of the document content	Life span of the policy
Agriculture	act	No.252/1997 Coll. on agriculture	Security of food safety, nutrition of the population and non-food resources 2. support of non-production functions of agriculture - protection of soil, water, air, maintenance of cultural landscape; 3. creating conditions for CAP and rural development; 4. improving the quality of life of villages	1997...
Agriculture	government order	no. 307/2014 Coll. On determination the evidence details of land use according to users relations	specification of different types of agriculture land, landscape features	2014...
Agriculture	government order	No.75/2015 on conditions for the implementation of agri-environmental measures	conditions of agri-environmental and climate measures implementation	2015; methodology is rewieved every year

Agriculture	government order	no. 48/2017 Coll. On the establishment of requirements under the acts and standards of good agricultural and environmental condition for the areas of cross compliance rules and the consequences of their breach for the provision of certain agricultural subsidies	cross compliance, GAEC, direct payments	2017...
Agriculture	government order	No.50/2015 and its Amendment No.61/2016 on laying down certain conditions for granting direct payments to farmers	direct payments, agri-environmental-climatic regulations, types of crops	2016...
Agriculture	guidance	The principles of good agricultural practice in land management - GAEC	information compilation on The principles of good agricultural practice in land management	NA
Agriculture	guidance	Cross compliance 2017 - guidance for farmers	These are requirements of 13 articles of the EU Regulation and Directives, as defined in Annex II to Regulation (EU) No 1306/2014, and included in three areas: Environment, Climate Change and Good Agricultural and Environmental Conditions and 2 others	2017...every year update
Agriculture	Act	No. 256/2000 Coll. on State agriculture intervention fund	financing of agriculture activities, describes the activities of the Fund	2000...
Agriculture	government order	no. 49/2017Coll. On Amending certain Government Orders in connection with the adoption of a Government Order laying down requirements under the acts and standards of good agricultural and environmental condition for areas of cross compliance rules and the consequences of their violations for the provision of certain agricultural subsidies	Amending certain Government Orders in connection with the adoption of a Government Order laying down requirements under the acts and standards of good agricultural and environmental condition for the areas of cross compliance rules and the consequences of their violations for the provision of certain agricultural subsidies	2017...
Agriculture	government	no. 47/2017 Coll.	Changes in agri-environmental measures	2017...

	order			
Agriculture	methodology	The methodology for direct payments		
Agriculture	strategy	Strategy of the Ministry of Agriculture, with a view to 2030	The strategic mission of czech agriculture is to contribute to the permanent provision of food security at national and European level and to contribute to the energetic and the food sufficiency of the Czech Republic. Another challenge is to increase its efficiency and competitiveness and to substantially improve relations with natural resources, landscape development, rural development and recreational potential, taking into account ongoing climate change.	Till 2030
Land/Soil	directive	Soil protection framework directive, amending the directive 2004/35/ES		in prep
Land	government decree	no. 13/2014 Coll. On the procedure for the implementation of land consolidation and the requirements of land consolidation proposal	the details of land consolidation proposals, the rules and requirements governing the procedures for land consolidation	2014...
Land	Act	no. 139/2002 Coll. On landscape consolidation and land offices	Regulation of land consolidation procedures and the competence of the State Land Office. Landscape consolidation provides conditions for improving the quality of life in rural areas, including diversification of economic activities and improving agricultural competitiveness, improving the environment, protecting and regeneration the soil fund, improving forestry and water management, especially in the field of minimizing the adverse effects of floods and drought and increase the ecological stability of the landscape. The land reform results serve for the renewal of the cadastral project and as a basis for spatial planning.	2002...
Land	Act	Act of the Czech National Council no. 334/1992 Coll., on agriculture soil protection	define agriculture land fund, its changes, protection, taking out the agriculture land from the agriculture land fund	1992...
Land/Soil	government decree	no. 13/1994 Coll.,which amends some details on the protection of the agricultural land fund	Possibility of changes of agriculture land fund, how to realize it in landscape and spatial planning	1994...
Land	conception	State environmental policy	It defines a plan for implementing effective environmental protection in the Czech Republic by 2020. The main objective is to ensure a healthy and quality environment, to contribute to the	2012-2020

			efficient use of all resources and to minimize the negative impacts of human activity on the environment, including cross-border impacts. The SEP focuses on the following thematic areas: Protection and sustainable use of resources, climate protection and improvement of air quality, protection of nature and landscape, safe environment.	
Climate	government decision	No.861/2015,The Adaptation Strategy of the Czech Republic on climate changes	The assessment of the likely impacts of climate change includes proposals for specific adaptation measures, legislative and partial economic analysis,etc. It identifies the risks and foreseeable impacts of climate change in areas such as forestry, agriculture, water management, urban landscape, biodiversity and ecosystem services, health, industry, transport, tourism, unexpected event, defines general principles of adaptation measures, indicates priorities, highlights intersectoral links The strategy analyzes the current state of the legislation in the given context and proposes the necessary legislative changes. The strategy also presents a framework assessment of the financial complexity of the implementation of the proposed adaptation measures, an analysis of the impact on the business environment and the quantification of costs in the case Inactivity, then an overview of existing and prospective economic instruments and the possibilities of their use.	2015...The Adaptation Strategy of the Czech Republic is ready for 2015-2020 with a view to 2030 and will be implemented by the National Action Plan for Adaptation to Climate Change. Continuous implementation of the Czech Republic's Adaptation Strategy will be evaluated in 2019 and every 4 years.
Climate	government decision	no. 207/2017 Coll., Policy of climate protection in the Czech Republic	decrease greenhouse gasses emissions	2017; updates 2020, 2030
Climate	communication	6th national communication of the Czech Republic	summary on climate change adaptation and measures in different resorts (water, agriculture, climate, energy, urban planning), education, research and development	2013...
Climate	government decision	no. .34/2017, National adaptation plan	A list of adaptation measures and tasks relevant to climate change adaptation and mitigation, including responsibility for implementation, deadlines, identification of relevant sources of funding, and estimation of implementation costs. The action plan also includes setting up a system for evaluating individual measures and a set of indicators.	2017 – 2023
Water	government decision	No. 1083/2015, Coll. National plans of Labe, Odra, Dunaj catchments	Approving the river basin plans.	2015...

Water	plan	National plan of Labe catchment	Approving the river basin plan. Set objectives and measures to protect and improve the status of surface and groundwater and aquatic ecosystems, to reduce the adverse effects of floods and droughts, to manage surface and groundwater and sustainable use of these waters to provide water services and to improve water conditions and protect ecological Stability of the landscape. River Basin Plans are the basis for the performance of public administration, especially for spatial planning and water management.	2015 – 2023
Water	conception	Preparation of measures to mitigate the negative impacts of drought and water scarcity	- to protect and improve the status of surface and groundwater and aquatic ecosystems,- to reduce the adverse effects of floods and drought,- the management of surface and groundwater and the sustainable use of these waters for providing water services and - to improve water conditions and to protect the ecological stability of the landscape. Also contain summaries of programs of measures to achieve these objectives and set out a strategy for their funding.	2015 – 2021
Water	conception	Concept of the solution of flood protection in the Czech Republic using both technical and nature measures	Presents an overview of basic genetic types of measures, the purpose of which is, in particular, to prevent the emergence of a crisis caused by drought and water scarcity, including the introduction of specific activities. It also includes proposals for legislative modifications, as efficient retention and accumulation of water in the area will affect its use and territorial plans.	2015...
Water	conception	Water Policy Conception of the Ministry of Agriculture by 2015	It defines the general objectives and principles of the state water policy, namely: To create conditions for sustainable management of the limited water resources of the Czech Republic, which will allow the harmonization of requirements for all forms of water use with the requirements of water and aquatic ecosystems protection, effects of water.	2011 – 2015
Water	Act	no. 254/2001 Coll. On water	It sets out ways how to implement preventive flood control measures after 2013, including optimization procedures for individual measures. The system of flood protection measures also includes landscape measures as well as the new requirements of European legislation. 1) to protect surface and groundwater, to establish conditions for the economical use of water resources and to preserve and improve the quality of surface and groundwater, to create conditions for reducing the adverse effects of floods and droughts and to ensure the safety of water structures in accordance	2001...

			with European Community law. Contribute to ensuring the supply of drinking water, protection of aquatic ecosystems. 2) regulates legal relations to surface and groundwater, the relations of natural and legal persons to the use of surface and groundwater, as well as relations with land and buildings directly related to the occurrence of such waters, in order to ensure the sustainable use of these water, the safety of water reservoirs and the protection against flood and drought effects.	
Water	conception	State Nature Conservation Program	The program briefly analyzes the state of the natural and landscape environment, formulates the long-term goals and measures necessary to achieve them. It deals with the issue of landscape protection in general and further, in more detail interests in individual types of ecosystems, protected areas and species conservation. In terms of water retention: 1. restore the natural hydro-ecological functions of the landscape and strengthen the landscape ability to withstand and adapt to the expected climate change, 2. Ensure sustainable use of water in relation to achievement of good ecological status of waters under Directive 60/2000 / EC 3. preserve and enhance the biodiversity of aquatic and wetland ecosystem	2009...
Energy	action plan	National action plan of the Czech Republic for the renewable resources energy	sets national target for the share of energy from renewable sources by 2020 in electricity, heating and cooling and transport. 13,5 % energy from renewable resources	2010 – 2020, 2 year assessment
Energy	Act	no.180/2005 Coll. On support of electricity production from renewable resources	supporting the production of electricity from renewable energy sources and from mining gas from closed mines and the performance of state administration and law and the obligations of natural and legal persons associated with it.	2005...
Energy	Act	No. 383/2012 Coll. on the conditions for trading in greenhouse gas emission allowances.	It specifies the facilities to which the system is applied, and the rights and responsibilities of individual operators. Operators monitor their emissions, report them annually and set aside allowances. All combustion plants with a rated thermal input exceeding 20 MW are included in the system.	2012...
Energy	Action plan	Biomass action plan	The aim of this paper is to define the measures and principles that will lead to the effective and efficient utilization of the biomass energy potential and thus to fulfill the commitments of the Czech Republic for the production of energy from renewable sources by 2020. The share of energy in gross domestic	2012 – 2020

			consumption should reach 13, 5% and the share of renewable energy in transport 10%.	

Table 5. The objectives touching the water issue in terms of food/agriculture

Overarching objectives	Specific objectives	Reference documents
Support of non-production functions of agriculture - protection of soil, water, air, maintenance of cultural landscape	evidence of the features of ecological importance (e.g. wetlands)	Act No.252/1997 Coll. on agriculture
Land use specification	definition of all features with ecological importance	Government order no. 307/2014 Coll. On determination the evidence details of land use according to user relations
	Define wetlands as protected agriculture feature and feature for water retention in the landscape	
	Establish soil blocks evidence: drainage systems, adjacency to water reservoirs, if suitable for greening because of concentrated drainage	
Improve agriculture land quality	Set up conditions of agri-environmental and climate measures implementation	Government order No.75/2015 on conditions for the implementation of agro-environmental measures
	support of greening areas along water courses	
	good agriculture ecological conditions specification (GAEC)	
	control of buffer zones and vegetated strips along water courses	Government order no. 48/2017 Coll. On the establishment of requirements under the acts and standards of good agricultural and environmental condition for the areas of cross compliance rules and the consequences of their breach for the provision of certain agricultural subsidies
	control of harmful agriculture interference in floodplains and water courses	
	Notes: nothing about water retention in soil, about climate – so why agri-environmental-climate measures?	
	keep agriculture procedures favourable to climate - without specification	
Land management - Incentives for farmers	Define fallow land as an agriculture measure favourable for climate	Government order No.61/2016 on laying down certain conditions for granting direct payments to farmers
	payments for wetland as ecological feature	
	information compilation on The principles of good agricultural practice in land management	
	cross compliance as a good tool for solution of the problems of water, soil and landscape	Guidance for farmers: The principles of good agricultural practice in land management – GAEC

	monitoring of soil erosion and crops planting – no sanctions for breach	Cross compliance 2017 - guidance for farmers
	increase soil water capacity and erosion minimization in coming time horizon – how???	
	Notes: only protection against nitrate pollution, carbon storage in soil, food security, animal evidence and welfare, soil does not fulfil the basic productive and non-productive functions why are the cross compliance mentioned in GAEC as a good tool for solution of the problems of water, soil and landscape ???nothing about improving soil retention	
Sustainable management of natural resources and climate actions	- Increasing soil protection at a time of climate change with a view to sustainable farming and to comprehensive development and landscape creation -support of agriculture biomass as a renewable resource -Stopping the degradation of agricultural land in particular through excessive erosion, compacting, loss of organic matter -Promoting natural retention and water uptake into the soil -Reducing the rate of decline of the agricultural land fund, in particular of the best soils -Motivating users to increase their own land property (not agriculture land leasing) -Support for the implementation of land consolidation	Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030

Table 6. The objectives touching the water issue in terms of land/soil

Overarching objectives	Specific objectives	Reference documents

Land consolidation as a tool for minimizing soil erosion, slowdown of water runoff, floods protection	In the plan of common facilities, the whole land consolidation will also be assessed in terms of soil erosion and flood risks, as well as the possibility of water retention in relation to the slowdown of surface runoff. The use of the individual protection measures depends mainly on their efficiency; requires reduction in soil washout, the reduction of maximum flows and the protection of water resources, watercourses, water reservoirs and built-up parts of the municipality. The plan of the common facilities must be completed by a proposal of agro-technical and organizational measures, with which landowners will be demonstrably acquainted; Furthermore, the plan of the common facilities includes an evaluation of the change of the runoff parameters as a basis for the solution of the runoff in the catchment area.	Government decree no. 13/2014 Coll. On the procedure for the implementation of land consolidation and the requirements of land consolidation proposal
	Landscape consolidation provides conditions for improving the quality of life in rural areas, including diversification of economic activities and improving agricultural competitiveness, improving the environment, protecting and regeneration the soil fund, improving forestry and water management, especially in the field of minimizing the adverse effects of floods and drought and increase the ecological stability of the landscape. The land reform results serve for the renewal of the cadastral project and as a basis for spatial planning.	Act no. 139/2002 Coll. On landscape consolidation and land offices
Agriculture soil protection	Define water features (reservoirs, flood protection measures...) as agriculture land fund	Act of the Czech National Council no. 334/1992 Coll., on agriculture soil protection
	Define changes in agriculture land fund are possible in case of water quality deterioration, erosion risks, soil characteristics deterioration	Government decree no. 13/1994 Coll., which amends some details on the protection of the agricultural land fund
Protecting and enhancing the ecological stability of the landscape and sustainable farming in the landscape	- increase ecological stability of the landscape - restoration of landscape water regime - mitigation of landscape fragmentation - Conservation and strengthening of non-production functions of agricultural landscapes and forests	State environmental policy
Better environment in urban areas	- support greening in urban areas - Improvement of rainwater management in residential areas	State environmental policy
Protection and sustainable use of	Limits for land occupation	State environmental policy

land		
Land consolidation, land property support	- land consolidation solution in areas threatened by climate change impacts, complex land consolidation should be directed primarily to areas of vulnerable water erosion and non-forested areas with a high risk of accelerated runoff; - arranging ownership relationships to land so as to allow the construction of flood protection structures and the implementation of plans for common facilities, including water and anti-erosion measures; - projects focusing on enhancing water retention in the landscape, such as proposals for the rehabilitation and construction of water reservoirs and anti-erosion measures; -with the help of simple and complex lands consolidation, to contribute to the enhancement of landscape retention capacity through water management and anti-erosion adjustments;	Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030

Table 7. The objectives touching the water issue in terms of climate

Overarching objectives	Specific objectives	Reference documents
Adaptation to climate change	increase efficiency of landscape measures(adjustments) with respect to climate change and water retention (ensure financial support, increase state land property for technical water retention measures,...) 2017-2022	Government decision no. 34/2017, National adaptation plan
	decrease /stop soil degradation, nutrient and organics losses (only improve monitoring, revise GAEC till 2020 – no particular measures how to achieve it)	
	decrease the impact of agricultural droughts by irrigation systems and small water reservoirs (2020, 2023)	
	increase natural retention ability of water courses and floodplains (natural and technical revitalization of water courses) – 2017 – 2020	
	Note: not complex and spatial measures in landscape	
	sustainable use of soil, increase its retention ability = factor for climate change adaptation	Government decision

	support of water retention (e.g. construction of small water reservoirs and irrigation systems) = drought mitigation	No.861/2015 Coll.,The Adaptation Strategy of the Czech Republic on climate changes
	adaptation measures of water management: One of the most important tools for implementing adaptation measures to ensure the stability of the water regime in the catchment area is complex land-use modifications, which create an opportunity to increase the retention capacity of the landscape through a plan of common facilities[1], proposals for good agricultural practice and spatial and functional arrangement of land. (In practice = revitalization of water courses, no measures on soil blocks)	
Climate protection	Climate change mitigation through emmmissions trading; CO_2 and anthropogenic emissions as only factors responsible for climate change	Government decision no. 207/2017 Coll., Policy of climate protection in the Czech Republic
Climate protection and air quality improvement	To reduce greenhouse gas emissions within the EU ETS by 21% and to reduce emissions of non-EU ETS to 9% by 2020 compared to 2005	State environmental policy
	Reducing the level of air pollution	
	Efficient and friendly use of renewable energy sources and increased energy efficiency	

Summary and notes: all these strategy documents are „on paper documents ", without any impact on real possibility to change the situation in soil conditions, water retention, climate change mitigation; no concrete suggestions how to achieve improvement, who is responsible, how to ensure financing and legal support – the documents are based on modelling, future scenarios, monitoring issues, recommendations.... No system of fines for non-compliance.

Notes to 6th national communication of the Czech Republic:

- the role of water retention in the landscape and vegetation as a factors influencing climate is neglected
- Surface and groundwater reserves and their replenishment are also related to the retention capacity of the landscape, which despite some positive changes after 1989 is still not satisfactory.
- water retention measures are realized as measures in floodplains and restoration of water courses, reservoirs

The main river basin plans introduce full support for the implementation of the adaptation measures set out by the National Program for Mitigation of Climate Change Impacts in the Czech Republic (Government decision No. 187/2004), focusing in particular on increasing water retention in the landscape and improving the landscape structure. This plan defines the following framework objectives in the field of flood protection: to limit activities in floodplains, degrading drainage conditions and increasing flood risks, to provide effective proposals for preventive flood protection measures based on good quality bases and optimization of flood protection concepts, using risk and cost analysis. In the preventive flood protection measures, to seek

[1] One part of the land consolidation proposal is a plan of common facilities, which forms the future framework for the restructuring of agricultural landscape and is therefore a form of landscape plan within land consolidation. These include, in particular, measures to make land accessible, i.e. by field or forest roads, anti-erosion and water management measures and measures to create and protect the environment. The proposed measures shall be supplemented, where necessary, with calculations or with the technical solutions necessary to determine the land area for common facilities.

appropriate combination of measures in the landscape increasing the natural accumulation and retention of water and technical measures influencing floods and volumes of flood waves, to use such methods of farming on agricultural and forest land so as to avoid deterioration of soil retention capacity and negative influence on water regime in the landscape; To prepare and implement appropriate economic instruments, to improve the technical condition of the water constructions and their operation with regard to flood protection.

Table 8. The objectives touching the water issue in terms of water

Overarching objectives	Specific objectives	Reference documents
Water conditions in the landscape	The evidence of decreasing retention ability of the landscape because of urbanization and suggestion how to compensate this; flood protection issue	Act no. 254/2001 Coll. on water
	Flood risk management plans may also include support for sustainable land use, soil water retention and controlled flooding of certain areas in the event of floods.	
Water management in catchment	define spatial pollution, high nutrient and matter losses, high need for water retention in the landscape as big issue – impact of agriculture	National plan of Labe catchment
	create a concept for implementation of anti-erosion measures and measures to increase water retention in the landscape and prepare legislative and financial instruments to implement the proposed measures.	
	reduce spatial and concentrated runoff of surface water by spatial water retention or by slowing the runoff by optimizing landscape structure and using both natural and technical measures to slow down the runoff. Note: Water retention targets are mainly proposed in the upper and middle parts of the river basin, where there is a lower representation of forest stands, in areas with meliorations, on large agricultural field blocks, on the upper sections of tubed streams.	
	apply "good agricultural and environmental condition" requirements and "cross compliance" requirements to increase water infiltration - restore and enhance the retention capacity of the landscape (grassing of spring areas and river meadows, planting forests and trees, opening of major drains, renaturation of channels and fortified streams, setting up of pools in sites with increased groundwater levels, etc.)	

	define discrepancy of CAP and EU energy policy (support of crops supporting erosion for energetic use)	
	suggest different measures to achieve the goals of the catchment plan, i.e. to improve and restore the retention ability of the landscape	
	define the land property as a major barrier for the optimalization and restoration of water regime (the measures should be realized on state property land); as well as missing legislation and financial support for large changes of landscape structure, construction and maintenance landscape features and measures for increasing water retention	
Drought mitigation	To set landscape planning as a tool for water retention	Preparation of measures to mitigate the negative impacts of drought and water scarcity; preparation actions approved by the Government decision no. 620/2015 on Preparation of measures to mitigate the negative impacts of drought and water scarcity GD no. 34/2017, National adaptation plan
	Specific objectives that occur in connection with retention of water in the landscape. To minimize drought, flood, climate change mitigation are (selection of the targets): . Protection and restoration of the natural water regime in forests · Improving the effectiveness of landscape consolidation with respect to climate change · Stop soil degradation, sealing, excessive erosion, loss of nutrients, loss of organic matter · Ensuring the sustainability and production function of agriculture in order to reduce the negative impacts of climate change · Limiting the emergence and impacts of agricultural drought · Improvement of the management of stormwater in urban areas · Improving the natural retention capacity of watercourses and floodplains · Effective protection and use of water resources · Enhance environmental stability and reduce the risks associated with temperature and air quality in urban areas · Improvement of ecological stabilization functions and landscape permeability	
	- To develop a comprehensive system of sustainable land management in the agriculture landscape and in the forests to enhance the soil and landscape retention capacity	
Flood protection	to increase the retention of water in the	Concept of the solution of flood

	landscape, construct water reservoirs, revitalization of floodplains, watercourses, improve soil characteristics	protection in the Czech Republic using both technical and nature measures approved by government decision no. 799/2010 Coll.

Notes:
Act no. 254/2001 Coll. on water
Landowners are obliged, unless otherwise provided in the special legal regulation, to provide care for the land so as not to worsen the water conditions. In particular, they are required to ensure: that under these conditions the drainage conditions are not deteriorated, the soil is not discharged by the erosion of water and ensure the improvement of the retention capacity of the landscape. = However, there are no sanctions for non-fulfillment of these obligations. It is necessary to introduce sanctions in the amendment to the Water Act.

Drought mitigation
In Central Europe, drought is often underestimated, because its impacts are not so obvious, they are developing slowly and are spread over much of the geographic area than the damage that results from other natural disasters. In contrast to most of the European states, almost all the water that comes from the Czech Republic comes from the rainfall.
Solving drought as a natural disaster has not yet been legally grounded in the Czech Republic. The drought assessment is based on various model scenarios, the common denominator is the water saving and construction of reservoirs. Evapotranspiration is taken as a loss of water, not as a tool for climate change mitigation and important factor in hydrological cycle. Higher temperatures result in higher vapour and thus loss of water. But for cities, where the change in hydrological balance is attributed to the predominance of impermeable surfaces (the same is sealed agriculture land) leads to reduction of available water to evapotranspiration, while at the same time reduce latent heat flux and increasing turbulent flow (sensible heat). In cities, evapotranspiration is taken as a mean of cooling the urban environment, so why is it considered so harmful for the landscape? (Page 33 GD no. 34/2017, National adaptation plan)

Table 9. The objectives touching the water issue in terms of energy

Overarching objectives	Specific objectives	Reference documents
Increase support of renewable energy resources	To set national target for the share of energy from renewable sources by 2020 in electricity, heating and cooling and transport. 13,5 % energy from renewable resources	National action plan of the Czech Republic for the renewable resources energy
	To support of ripe and corn planting for biomass production	

Note:
- supports erosion, deteriorates the soil quality – decrease water retention in soil, support landscape overheating = negative impacts on climate
- minimize diversity of agriculture crops; against GAEC

Table 10. General and specific policy instruments for climate

Climate policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Policies and measures to reduce	Emissions Trading and carbon	Act No. 383/2012 Coll. on the

emissions across sectors	capture and storage	conditions for trading in greenhouse gas emission allowances.
reduction of greenhouse gasses emission; so-called mitigation (ie reduction measures) in different sectors	introduction of carbon tax outside EU ETS	government decision no. 207/2017 Climate protection policy
	Efficient EU ETS implementation after 2020	
	Investment priorities related to EU ETS beyond 2020	
	EU ETS Indirect Cost Compensation Scheme	
	Law on the Reduction of Fossil Fuel Dependence	
	Smart cities and villages	
Adaptation to climate changes	Adaptation strategies in different sectors to climate change	government decision no.861/2015 Adaptation strategy to climate change in the Czech Republic Government decision no..34/2017, National adaptation plan
	Sustainable land use (eg erosion and soil degradation, soil retention, soil fertility) is a key condition for adaptation to climate change. The solution should be based on the principles of sustainable farming and good agricultural practice (*conditions e.g. CAP, GAEC, agri-environmental-climate measures, have been already adopted, implemented, however without any significant effect)*	6th national communication of the Czech Republic
	Ensuring flood protection based primarily on increasing the retention capacity of the landscape and slowing water drainage, including in the agriculture and aquaculture sector, as the main factor in the floods, as well as the implementation of other flood protection measures including technical ones.	

Adaptation to climate changes	Due to the great importance of soil, its sustainable use (e.g. erosion and degradation protection, soil retention, soil fertility) is a key condition for adaptation to climate change. The solution should be based in particular on the following principles of sustainable management: - a suitable spatial arrangement of agricultural land, - soil protection and anti-erosion measures, - improving the soil structure, - increasing the proportion of organic matter in the soil.	
	Agri-environmental – climate measures in agriculture are mainly based on carbon sequestration and N retention	

Table 11. General and specific policy instruments for water

Water policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Protection and restoration of natural water regime in forests	Revision of measures for forestry meliorations, streams and forest roads with a focus on protection and restoration of natural water regime in forests	National Forest Program until 2013 (NLP) State Environmental policy (SPŽP) Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMze) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe) Biodiversity Conservation Strategy (SOBR) Plans for flood risk management (PpZPR) National river basin plans (NPP) State Nature Conservation Program (SPOPK) State Forest Policy Principles (ZSLP)
	Minimizing technical drainage of forest land using natural and seminatural procedures	
	Implementation of measures for water retention in forests	
	Applying procedures and measures for harvesting and restoring forests to avoid or slow down surface drainage and soil erosion	
	Stabilizing the forest types affected by water and protection of wetlands in forests	
To process and ensure compliance with the principles of good		Biodiversity Conservation Strategy (SOBR) State Environmental policy

agricultural practice in terms of protection of water reservoirs and streams		(SPŽP) Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe) State Nature Conservation Program (SPOPK) National river basin plans (NPP)
Minimizing the impact of inappropriately drainage systems on the accelerated outflow of water from the landscape		State Environmental policy (SPŽP) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe) National river basin plans (NPP)
Improving the natural retention capacity of watercourses and floodplains	Complex revitalization of watercourses and floodplains and support of spontaneous renaturation	Biodiversity Conservation Strategy (SOBR) Water Policy Concept of the Ministry of Agriculture by 2015 (KVHP Mze) Action Plan Regional Development Strategy (APSRR) State Environmental policy (SPŽP) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe) The concept of flood protection in the Czech Republic using technical and nature-friendly measures (KPPO) National river basin plans (NPP) State Nature Conservation Program (SPOPK) Plans for flood risk management (PpZPR)
Effective protection and use of water resources	Ensure a forest management in the protection zones of water resources so that it cannot occur threatening the abundance of water resources	State Environmental policy (SPŽP) Strategy of the Ministry of Agriculture of the Czech

	Create more detailed plans of water resources protection, including the concept of wetland restoration and revitalization of watercourses, renewal of species and spatial forests composition, land - use optimization, etc.	Republic with a view to 2030 (SrMZe) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe) National river basin plans (NPP)
	Develop a comprehensive concept for drought and water scarcity and to prevent emergencies caused by long-term water scarcity	Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe) Environmental Security Concept (KEB) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe)
	Recovery of water management function of small water reservoirs in poor technical condition	Multiannual National Strategic Plan of the Czech Republic for Aquaculture (VNSPA) Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe)
	Support for surface water infiltration into ground waters	
Incorporate the concept of ecosystem services into the design of new river basin plans		Biodiversity Conservation Strategy (SOBR) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe)
Water management in catchment	suggest different measures to achieve the goals of the catchment plan – one of the measures is to improve and restore the retention ability of the landscape by: 1. Implementation of comprehensive measures (type A - according to catchment area management plans) on the agricultural land 2. Maintenance and management of technical and nature measures for the retention, accumulation and improvement of water quality on agricultural land 3. Support for the purchase of land for	National plan of Labe catchment

	the implementation of these measures 4. Reimbursement of economic damage from loss of production from the areas designated for the implementation of these measures Needs for changing agriculture policy, legislation, question of land owners, funding etc.	
Drought mitigation	In the areas of long-term water scarcity, the water supply should be targeted to increase the water supply by restoring the natural accumulation of water (floodplain forests, wetlands), increasing the capacity (reconstruction) of existing artificial accumulations (reconstruction of old water reservoirs) and implementing measures to restore or enhance natural retention of water in the landscape	Preparation of measures to mitigate the negative impacts of drought and water scarcity; preparation actions approved by the Government decision no. 620/2015 on Preparation of measures to mitigate the negative impacts of drought and water scarcity GD no. 34/2017, National adaptation plan
	implementing the measures contained in the River Basin Plans and the measures proposed in the framework of the land consolidation, thereby contributing to the restoration and increase of the retention capacity of the landscape	
Drought mitigation	Increase wetlands area and retention dams on agriculture land by private investments and specific financial support	Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe)
	Increase the area of state land property in areas with identified drought problems	
	Start preparation for the realization of technical and nature-friendly measures in the drought endangered areas	
	To prepare a new financial and subsidies programm to support water retention in the landscape by strengthening the retention capacity of the soil, construction of new ponds and small water reservoirs, support for the restoration of extinct ponds and the restoration of wetlands.	
	Wider application and control of compliance with GAEC standards	
	Inclusion of a section to support drought protection measures in legislation.	

Table 12. General and specific policy instruments for food/agriculture

Food /agriculture policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Stopping soil degradation by excessive erosion, depletion of nutrients, loss of organic matter	Revise good agricultural and environmental standards (GAEC) in order to better	Biodiversity Conservation Strategy (SOBR) State Environmental policy (SPŽP

and soil sealing	protect and increase biodiversity of land and soil; ensuring that more organic matter is added to the soil, motivation to greater use of soil protection technologies.	) Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe) State Nature Conservation Program (SPOPK) National river basin plans (NPP)
Restrictions on the occurrence and impact of agricultural drought	Construction of new and modernization of existing irrigation systems	State Environmental policy (SPŽP) Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe)
	Support maintenance, restoration and construction of small water reservoirs for irrigation and retention in agricultural landscape	
Strengthening the stability and biodiversity of agroecosystems	Supporting farming systems and restructuring landscape to mitigate the decline biodiversity linked to agricultural land	
	Greening in the EU Common Agricultural Policy - introducing a new mandatory eco-funded direct payments component	
Ensuring the sustainability and production function of agricultural farming in the landscape	To prioritize small farms in the framework of agricultural subsidies	Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe)
	Define the areas of arable land in floodplains where flooding occurs at increased flow rates (Q5 - Q20), determine appropriate farming practices and motivate agricultural subjects to apply appropriate farming practices	
Supporting program - soil protection against erosion, degradation and excessive drying	In the context of evaluating the current tools in the area of protection of the agricultural land fund ("Preparing for the implementation of measures to mitigate the negative impacts of drought and water scarcity"), prepare a multiannual training program and free consultations for farmers, with the aim of putting forward desirable practices in practice.	Government decision no. 207/2017 Coll., Policy of climate protection in the Czech Republic
Comprehensive monitoring of		Government decision no.

compliance with Good Agricultural and Environmental Conditions (GAEC) standards and compliance with Statutory management requirements (SMR)		207/2017 Coll., Policy of climate protection in the Czech Republic
Rural development program	Advantages for agricultural projects that accept specific commitments of AECM supporting the structural changes of czech agriculture	Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe)
	Targeting of AECM payments to ensure support and contribution of AECM to the structural change of Czech agriculture landscape with an emphasis on enhancing the ecological stability and biodiversity (through the appropriate setting of eligibility criteria, in particular the correct targeting of environmental measures on agriculture land (appropriate seed treatment, PG management)	

Table 13. General and specific policy instruments for land

Land policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Improving the efficiency of land consolidation	Financial and material support for land consolidation	Biodiversity Conservation Strategy (SOBR) Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe) The concept of flood protection in the Czech Republic using technical and nature-friendly measures (KPPO) State Nature Conservation Program (SPOPK) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe) State Environmental policy (SPŽP) The Concept of Research, Development and Innovation of
	Implement the necessary legislative arrangements to secure a state land reserve	
	Legislatively modify the instruments for financial support of purchase of land for implementation of common facilities, anti-erosion and water management measures incl. revitalization within land consolidation	
	Organizational support for the implementation of land consolidation	
	Implementation of complex land consolidation in terms of increasing the retention capacity of the landscape	

	Within the common facilities, combining technical and seminatural measures to increase the retention capacity of the landscape	Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe) Plans for flood risk management (PpZPR)
	Reduce the share of leased land to 70% by incentives to realize the investments in land purchase and continue support of the implementation of land consolidation. At the same time, an improvement in the relationship to the land is achieved.	
Stopping soil degradation by excessive erosion, depletion of nutrients, loss of organic matter and soil sealing	Measures to reduce water and wind erosion of agricultural land by 50 % by direct payments for greening, strict application of AECM, GAEC	Biodiversity Conservation Strategy (SOBR) State Environmental policy (SPŽP) Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe) State Nature Conservation Program (SPOPK) National river basin plans (NPP)
	Maintaining and increasing the ability of the soil to bind water – instruments are not still specified; application of GAEC, AECM	Biodiversity Conservation Strategy (SOBR) State Environmental policy (SPŽP) Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe) Plans for flood risk management (PpZPR)State Nature Conservation Program (SPOPK)
	Strict application of the Act of the Czech National Council no. 334/1992 Coll., on agriculture soil protection - reduce soil sealing, improve soil structure, increase the organic matter content of soil	

	In terms of greening implementation: -the obligation to apply the diversification of crops to improve the environment and, in particular, to improve soil quality -the obligation to respect the ratio of permanent grassland (PG) to the total number of arable land and the prohibition of ploughing PG and to change the type of agricultural crop within environmentally sensitive areas -set up ecological focus areas, whose main objective is to preserve and improve biodiversity (eg through fallow land, landscape features, catch crops, nitrogen-binding crops, etc.).	Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe)
Stopping soil degradation by excessive erosion, depletion of nutrients, loss of organic matter and soil sealing	Strengthening and effective application of Cross Compliance / GAEC rules in relation to the use, protection and improvement of agricultural land - in particular: -projection of real erosion risk into the respective LPIS layer and interconnection with the prescribed mode of landuse while providing sufficient soil protection technologies -major strengthening of the GAEC standards for improving the quality of soil and water - in particular under GAEC 1 and 3 (water protection by delimitation of non-fertilized streams along water courses and protection of groundwater against pollution), GAEC 4 (ensuring minimum land cover), GAEC 5 measures for erosion by introducing and requiring protection of soil from wind erosion), GAEC 6 (preservation of the content of organic matter) and GAEC 7 (in 2016 extension of landscape	Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe)

	elements by a new one - wetland, in the following years efforts to further enlargement of landscape elements e.g leakage, or other anti-erosion measures, in particular technical ones).	
Rural development program	Strengthen the prevention of soil degradation, strengthen the soil and landscape retention capacity	Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe)
Increase of ecological stabilization functions and landscape permeability	Protection, conservation and restoration of natural elements and ecosystems in the landscape	Biodiversity Conservation Strategy (SOBR) State Environmental policy (SPŽP) Strategy of the Ministry of Agriculture of the Czech Republic with a view to 2030 (SrMZe) State Nature Conservation Program (SPOPK) Plans for flood risk management (PpZPR)
	To analyze the performance of state administration in nature and landscape conservation and to analyze the methodological support of nature protection organizations activities in relation to climate change and landscape planning (based on spatial planning, land consolidation, water planning, forest planning, etc.)	
Increase of ecological stabilization functions and landscape permeability	Set conditions for keeping natural and seminatural ecosystems to protect soil in agricultural landscape without the need to their removal from agriculture fund	
	Inventarize peat bogs and other small wetlands and identify other areas suitable for restoration. To elaborate a timetable for the recovery of priority peat bogs and other selected wetlands and to evaluate the financial costs of the recovery.	
	Revise legislation and, if necessary, propose amendments to ensure better protection and restoration of wetlands.	
	Review and modify a set of land-analytical phenomena in order to capture historical landscape structures whose regeneration can contribute to increasing landscape retention and erosion threats.	Decree No. 500/2006 Coll., On Territorial Analytical Documents, on Territorial Planning Documents and on the Evidence on Territorial Planning Activity
Ensure national evaluation of		Biodiversity Conservation

ecosystem services		Strategy (SOBR) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe)

Table 14. General and specific policy instruments for energy

Energy policy		
General instrument or instrument category	Specific policy instruments	Reference documents
Renewable energy sources resisting the effects of climate change	Ensuring that biomass is available as an energy source and supporting energy sources that produce environmentally friendly and cost-effective production	National Action Plan of the Czech Republic for Renewable Energy 2010-2020 (NAPOZE) National Forest Program until 2013 (NLP) Biomass Action Plan 2012-2020 (APB) Action Plan Regional Development Strategy (APSRR) State Environmental policy (SPŽP) The Concept of Research, Development and Innovation of Ministry of Agriculture of the Czech Republic 2016-2022 (KVVIMZe)
	Define energy crops that will be able to adapt to climate change while not contributing to a worsening of the soil and water regime and requiring high inputs of additional energy, industrial fertilizers or biocides; to encourage the cultivation of these crops on less fertile soils in less favored areas	
Using renewable energy sources and increasing energy efficiency	Promote the use of renewable energy sources, with a focus on biomass production in accordance with the Biomass Action Plan.	Government decision no. 207/2017 Coll., Policy of climate protection in the Czech Republic
Support for biogas stations	Encourage the use of methane and prevent its spontaneous occurrence by processing residues of agricultural production in biogas stations, including support for prolonging the life of existing biogas stations.	Government decision no. 207/2017 Coll., Policy of climate protection in the Czech Republic
CAP	Enable the cultivation of multi-annual herbs for energy purposes and forage crops within "eco-friendly areas"	Biomass Action Plan.
	Set up the conditions for the providing subsidies for permanent grassland and less-favored areas to motivate the use of harvested material for further purposes	

BLOCK 2

Assessing policy coherence

1 Assess interactions between nexus critical objectives

This sub-chapter includes the following elements:

• **Table** with the description of the nexus critical **objectives** and **explanation** of the reason why these instruments are considered particularly critical or interesting to investigate in a nexus perspective

• **Scoring matrix** illustrating the interactions among the selected objectives

• **Justification** of the scoring (Appendix I.)

• **Description** of the overall assessment: what are the most relevant/striking **results**

• Reporting of the **validation** of assessment done with **stakeholders**

The aim of the transboundary case study is to solve the problem of surface water retention in the landscape, to improve the hydrological situation in the river basin and thus to improve the local climate and mitigate climate change. The common denominator is therefore an increase in the water retention ability of the landscape, which is related to compaction and occupation of agricultural land, change in the landscape structure, increase of organic matter in the soil, minimization of soil erosion. The selection of individual objectives was based on the analysis of relevant policy documents from the block 1 (Policy analysis). The key documents (among others) for this analysis were two government decisions No.861 / 2015, The Adaptation Strategy of the Czech Republic on climate change and its implementation no. 34/2017, National adaptation plan. Individual objectives are intertwined, complementary, or even identical, some are inconsistent. Some are precisely defined (e.g. To reduce greenhouse gas emissions within the EU ETS by 21%); some objectives could be used in more sectors (e.g. Land / soil, water) and could not be unambiguously categorized. Most are defined relatively broadly and indefinitely, with no precise specification of how to achieve the goal (e.g. climate change mitigation / adaptation, keep farming procedures favourable to climate, etc.) Table 1. contains the description of the nexus critical objectives and explanation of the reason why these instruments are considered particularly critical or interesting to investigate in a nexus perspective.

Table 1. Nexus critical objectives

Energy		
Code	Headings (short description)	Detailed description
E1	Increase biofuel production	Increase biofuel production in order to cover 13,5 % of all energy sources from renewable
Food/Agriculture		
Code	Headings (short description)	Detailed description
F1	Support of agriculture biomass as a renewable resource	Support maize and rape production in order to cover 13,5 % of all energy sources from renewables; grassland – biofuel for biogas stations
F2	Support non-production functions of agriculture	Support of non-production functions of agriculture in order to protect soil, water quality, air, maintenance of cultural landscape
F3	Establish soil blocks evidence	Information about drainage systems on field blocks, adjacency to water reservoirs, if suitable for greening because of concentrated drainage
F4	Set up conditions of agri-environmental and climate measures implementation in agriculture	Improve agriculture land quality
F5	keep agriculture procedures	Improve agriculture land quality (increase organic content,

	favourable to climate	stop erosion, etc.) – these procedures are related to water retention and thus influence climate
F6	Control of harmful agriculture interference in floodplains and water courses	Improve agriculture land quality, protect water courses against spatial pollution
Land		
Code	Headings (short description)	Detailed description
L1	Decrease soil erosion	create a concept for implementation of anti-erosion measures to decrease erosion in the landscape and prepare legislative and financial instruments to implement the proposed measures.
L2	Increase organics content in soil	In order to improve soil fertility, ability to retain water and improve water infiltration
L3	Increase soil water capacity	In order to retain water, refill groundwater level
L4	Decrease soil sealing	Significantly restrict urbanization of agriculture land – barrier for water retention
L5	Decrease soil compaction	Improve water infiltration and retention
L6	Restrict taking out arable land from agriculture land fund	Arable land is often built up and used for new industrial buildings or residential areas – support for soil sealing (e.g. the storehouses occupy 7 km^2 in the Czech Rep.)
L7	Increase land state property	In order to realize technical measures for soil water retention improvements
L8	Support land ownership	Decrease the share of leased land of agriculture subjects (max. 70 %), support private ownership of agriculture land in order to improve soil management practices
L9	Support for the implementation of land consolidation	In order to change landscape structure and modify land ownership; Land consolidation as a tool for improvement the environment, protecting and regeneration the soil fund, improving forestry and water management, especially in the field of minimizing the adverse effects of floods and drought and increase the ecological stability of the landscape.
L10	Heterogeneous landscape structure	Minimize field blocks area by their dividing into smaller ones by landscape features (balks, groves, grass and shrubs belts, wetlands, ponds, etc.) in order to minimize erosion, matter losses, improve soil quality, mitigate climate change, restore small water cycle
L11	Develop a comprehensive system of sustainable land management	To develop a comprehensive system of sustainable land management in the agriculture landscape and in the forests to enhance the soil and landscape retention capacity
L12	Ensure national evaluation of ecosystem services	Ecosystem services help to quantify (financially) all services that ecosystems provide (e.g. air conditioning, water retention, anti-erosion etc. functions) and may serve as a powerful tool to protect ecosystems not only from the biodiversity point of view
L13	Restoration of sowing procedures	Current land management completely distorted the sowing procedures – crop rotation, diversity of crops (now approx. 8 preferred crops instead of 15, no undergrowth crops, etc.)

Water		
Code	Headings (short description)	Detailed description
W1	Support expanding of greening areas in catchments	Greening in catchments – mix of permanent grassland and crops to improve water retention
W2	Keeping of sufficient buffer zones and vegetated strips along water courses	In order to decrease pollution, improve infiltration
W3	Promote natural retention and water uptake into the soil	In order to retain water, refill groundwater level
W4	Restore landscape water regime	Create a concept for implementation of measures to increase water retention in the landscape and prepare legislative and financial instruments to implement the proposed measures.
W5	Increase natural retention ability of water courses and floodplains	Increase natural retention ability of water courses and floodplains (natural and technical revitalization of water courses)
W6	Construction of small water reservoirs and irrigation systems	As water reserves for drought periods
W7	Reduce spatial and concentrated runoff of surface water	Reduce spatial and concentrated runoff of surface water by spatial water retention or by slowing the runoff by optimizing landscape structure and using both natural and technical measures to slow down the runoff.
W8	Apply "good agricultural and environmental condition" requirements and "cross compliance"	Apply "good agricultural and environmental condition" requirements and "cross compliance" requirements to increase water infiltration - restore and enhance the retention capacity of the landscape (grassing of spring areas and river meadows, planting forests and trees, opening of major drains, renaturation of channels and fortified streams, setting up of pools in sites with increased groundwater levels, etc.)
W9	Define the land property as a major barrier for the optimizing and restoration of water regime	define the land property as a major barrier for the optimizing and restoration of water regime (the measures should be realized on state property land); as well as missing legislation and financial support for large changes of landscape structure, construction and maintenance landscape features and measures for increasing water retention
W10	Establish landscape planning as a tool for water retention	Water retention is directly related to landscape structure changes – those can be reached by landscape planning
W11	Protection and restoration of the natural water regime in forests	By healthy forests, appropriate species composition and forest structure, good soil condition, adjustment of drainage systems etc. Revision of measures for forestry meliorations, streams and forest roads with a focus on protection and restoration of natural water regime in forests; Minimizing technical drainage of forest land using natural and seminatural procedures; Applying procedures and measures for harvesting and restoring forests to avoid or slow down surface drainage and soil erosion; Stabilizing the forest types affected by water and protection

		of wetlands in forests
W12	Limiting the emergence and impacts of agricultural drought	Measures to mitigate and prevent drought; support in new legislation amendment of Water Act no.254/2001 Coll.
Climate		
Code	Headings (short description)	Detailed description
C1	Climate change mitigation	The strategy for climate change mitigation is mainly based on decrease of greenhouse gasses in different sectors
C2	Climate change adaptation	Based on government decision No.861/2015, The Adaptation Strategy of the Czech Republic on climate changes and its implementation no. 34/2017, National adaptation plan– set of objectives, adaptation measures and tasks from agriculture, water, forestry, urban, biodiversity, industry, energy, health, transport, tourism in order to suggest strategies for climate change adaptation
C3	To reduce greenhouse gas emissions within the EU ETS by 21%	The strategy for climate change mitigation mainly based on decrease of greenhouse gasses with specified target of emissions reduction

Energy objectives were represented only by one – increase biofuel production in order to cover 13,5 % of all energy sources from renewables (E1). In the Czech Republic it can be achieved by increased production of biomass (maize, rape) (F1, against L13). These crops are planted on large field blocks (against L10), subsidized by open-handed state budget that directly support big companies, farming mostly on leased land (against L8). These two objectives (E1, F1) are in the discrepancy with almost all objectives targeted on water, land/soil, partly on agriculture. In the food/agriculture case the situation is ambiguous. In one hand there is a production of energy crops as renewable resources, on the other side there is a discrepancy with GAEC and agro-environmental and climate measures. There is an ambiguous relationship also with climate objectives; there is a support for biofuels in order to mitigate climate change; on the other hand, the effect of biofuels (maize, rape) on water regime, climate, soil characteristics and quality go directly against.

Food/agriculture objectives (F2, F4, F5, F6) are defined not very clearly (agriculture procedures favourable to climate, NPFA, etc.), however they are often enabling, reinforcing and often indivisible parts of the land objectives (L1 – L5, L10, 11, 13), as well as water objectives (W1-W5, 7, 8, 12) targeted on landscape water regime and drought mitigation. Because of their unclear definition directly correlates with formulas of climate change mitigation (C1) and adaptation (C2). The objective of establishing soil blocks evidence (F3) can provide information supporting better development of land consolidation (L9), together with landscape planning in terms of heterogeneous landscape structure (L10) and improvement of water regime (W1-W5, 7).

Land/soil objectives are targeted on improving soil characteristics (L1 – L5); land ownership (L7, L8, L9) and landscape structure (L6, L9, L10, L13). Soil quality may improve conditions for planting biomass/biofuels (E1, F1) and NPFA. Because of direct relation of soil quality and water retention, the highest impact is on water objectives (W3-5, 7, 12). Because water retention is also directly connected with landscape structure and land use, the positive relation is on W10. The land property rights (L7, L8) influence the land management. Farming on private land will motivate farmers to improve soil and landscape quality (L1-5, L10,11), restoration of traditional sowing procedures and increase crops diversity (depending on crops price), improve water regime (W1-W8, W12); state land property (L7) usually has an adverse effect; however, will enable construction of water retention features and measures in landscape (W1-7, W9, W12). Ensure national evaluation of ecosystem services (L12) is the objective with "enabling" character that may help to preserve or improve the natural characteristics of landscape and helps to protect (e.g. floodplains, forests, etc.) against harmful activities and therefore has relation nearly to all other objectives. Restoration of sowing procedures and crops diversity (L13) is a key objective for improving soil quality (LL1-L5) and water retention (W1-W8, W12), as well as requirements for sustainable landscape management (F2-F6) and climate issues (C1, C2). Current land management completely distorted the sowing procedures – crop rotation, diversity of crops (now approx. 8 preferred crops instead of 15, no undergrowth crops, etc.) with all negative effects on water, climate regime and soil quality. Crops diversity will contribute to heterogeneous landscape (L10, L11). We should start to respect our ancestors experience.

Water objectives are targeted mainly on restoration of landscape water regime and small water cycle thus are directly related to land and soil objectives. Greening/grassing in catchment (W1) and buffer zones (W2) will decrease soil erosion (L1) by landscape fragmentation (L10), by soil edaphon (soil fauna), increase of groundwater level, soil water capacity (L3, L4) and slowing down surface runoff (W7); in addition, will improve water quality (F6), support NPFA – F2 (by increasing humus content), help to restore small water cycle (F4, F5, L11). Grassland development may be supported by ecosystem services (L12) and part of restoration of traditional sowing procedures (L13). Restoration of water regime and water uptake into soil (W4, W3, W11, W5) is directly related to landscape objectives L1, L2, L3, L4, L5, L10, L11, L13 that concern soil improvement and landscape structure adaptation. Private land property (L8) should ensure better soil management. Dividing of large field blocks (L10) can be realize through land consolidation (L9). Realization of water retention measures should be realized by complex arrangements, mainly on state land (L7). Drought mitigation (W12) is crucial for realization nearly all objectives E1 – C2; however the relationship is like a feedback – if we do not realize F2 – C2 objectives, we cannot reach drought mitigation. Construction of more irrigation systems and reservoirs (W6) is not a right way how to achieve restoration of sustainable landscape water regime, as well as the revitalization of water courses (W5) that are targeted only on "water in stream beds". These measurements can be easily realized and supported; spatial water retention measures, which have highest efficiency, encounter incomplete and uncomplex solutions, the problems like drought, floods, erosion, etc. are solved individually.

Climate change mitigation and adaptation (C1 and C2) are overall, not clearly and precisely defined objectives. Except objectives (F3, L8 and W9) are positively related to all other food/agriculture, land, water objectives. In climate mitigation/adaptation strategies nearly all landscape, water, agriculture management practices and activities are usually mentioned in a connection to climate change. Everything we do, is in the name of climate change. Climate change mitigation / adaptation is usually directly related to reduction of greenhouse gases (C3). This objective draws attention in terms of low carbon activities and decrease of carbon dioxide and methane emissions and disguise greenhouse gases reduction as a remedy for climate changes. In reality preference of this objective suppresses the real measures that can lead to more effective climate change mitigation, thus is spatial water retention in landscape – restoration of small water cycle, soil quality improvement, sustainable land management, heterogeneous landscape. Therefore, the impact of C3 objective on land and water was labelled as counteracting or cancelling (F2, F4, F5, L1-3, L5, 10,11,13, W1-5, W7,8,11,12). The exceptions are E1 and F1 objectives supporting biomass production for renewables.

Table 2. Scoring matrix illustrating the interactions among the selected objectives

	E1	F1	F2	F3	F4	F5	F6	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	C1	C2	C3
E1		+3	-2	0	-2	-3/+1	-2	+1	+1	+1	+1	+1	+1	+1	-1/+1	0	-2	-1	-1	-3	-1	-1	+1	+1	0	0	-1	-3	0	0	0	+1	-3/+3	-3/+3	+3
F1	+3		-2	0	-2	-3/+1	-2/+2	+1	+1	+1	+1	+1	+1	+1	-1/+1	0	-2	-1	-1	-3	-1	-1	+1	+1	0	+1	-1	-3	0	0	0	+1	-3/+3	-3/+3	+3
F2	+2	+2		+1	+2	+1	+1	0	+1	+1	+1	+1	+1	+3	0	+1	+2	+1	+1	+2	+2	+2	+1	+1	+1	0	+2	+2	0	+1	0	+3	+3	+3	-2
F3	0	0	+2		0	0	+1	+3	0	0	0	0	0	0	0	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F4	-2	-1/+1	+2	+2		+2	0	0	0	0	0	0	0	0	0	0	0	+1	+1	+1	+1	+1	+1	+1	0	0	+2	+2	0	0	0	+2	+3	+3	-2
F5	-2/+2	-1/+1	0	+1	+2		+2	+3	0	0	0	0	0	0	+2	0	+1	+1	+1	+2	+2	+2	+1	0	0	0	+1	+3	0	0	0	+2	+3	+3	-3
F6	-2	-1/+1	+2	+2	+2	+2		0	0	0	0	0	0	+1	0	+1	0	+1	0	0	+3	+3	+1	+1	+1	0	+2	+2	0	0	0	0	+3	+3	0
L1	-3	-3/+2	+2	+1	+3	+2	+2		+3	+1	0	+1	0	0	0/+2	+1	+3	+3	+1	+2	+3	+3	+1	+2	0	0	+3	+3	+1/-1	+2	+3	+3	+3	+3	-3
L2	-3	-3/+2	+2	+1	+3	+2	+2	+3		+1	0	+2	0	0	0/+2	0	+2	+3	+1	+2	+3	+3	+2	+1	0	0	+3	+3	+1/-1	+2	+3	+3	+3	+3	-3
L3	-3	-3/+2	+2	+1	+3	+2	+3	+3	+3		+3	+3	0	-3/+3	0/+2	+1	+3	+3	+1	+2	+3	+3	+3	+3	+3	+1	+3	+3	+1/-1	0	+3	+3	+3	+3	-3
L4	0	0	+2	0	+3	+2	0	0	0	0		0	+3	0	0/+2	+1	0	+1	+1	0	+2	+2	0	+1	0	0	+3	+3	+1/-1	+1	+1	+3	+3	+3	0
L5	-2	-3	+2	0	+3	+2	+2	+2	+3	+1	+3		+1	0	0/+2	0	+1	+1	+1	+2	+2	+2	0	+1	+1	+1	+3	+3	+1/-1	+1	+1	+3	+3	+3	-3
L6	0	0	+1	0	+3	0	0	0	0	0	0	0		+1	0/+2	+1	0	+1	+1	0	0	0	0	+1	+2	0	+1	+1	+1/-1	0	0	+1	+3	+3	0
L7	0	0	0	0	0	0	0	0	0	0	0	0	+1		-3	0	0	0	0	0	0	0	0	+1	+3	0	+1	0	+3	-1/+1	0	+1	0/+2	0/+2	0
L8	0	0	0	0	0	0	0	0	0	0	0	0	0	-3		0	0	0	0	0	0	0	0	0	0	0	0	0	+1	0	0	0	0	0	0
L9	-2	-2	+1	+1	0	+1	0	0	0	0	0	0	0	-1/+1	0/+1		+1	+1	+1	0	+1	+1	+2	0	0	0	0	0	0/+1	+3	0	0	+3	+3	0
L10	-3	-3	+2	+1	+1	+2	0	0	0	0	0	0	0	-1/+1	0/+2	+3		+1	+1	+3	+3	+3	+2	+3	0	+1	0	+3	0/+1	+3	0	+3	+3	+3	-3
L11	-2	-2	+2	+1	+2	+1	+1	0	0	0	0	0	0	-1/+1	0/+1	+1	0		+1	+1	+1	+1	+2	+2	+1	+1	+2	+3	+1	+2	+2	3	+3	+3	-2
L12	0	0	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	+1	+1	+1	+1	+2	0	0	0	0	0	+2	+3	+3	+3	0
L13	-3	-3	+2	+1	+3	+3	+1	0	0	0	0	0	0	0	0/+3	0	+3	+1	+1		0	0	+1	+2	0	0	+3	+3	0	+2	0	+3	+3	+3	-3
W1	-3	-3/+3	+2	+2	+1	+1	+3	+2	0	0	0	0	0/+1	+3	0/+2	+1	+2	+2	+1	+3		+2	+3	0	+3	0	0	+3	+2	+1	+3	+3	+3	+3	-3
W2	-3	-3/+2	+2	+2	+1	+1	+3	+2	0	0	0	0	0/+1	+3	0/+2	+1	+2	+2	+1	+3	+2		+3	0	+3	0	0	+3	+2	+1	+2	+3	+3	+3	-3
W3	-3	-3/+2	+2	+1	+1	+1	+1	+2	+3	+3	+3	+3	0/+1	0/+3	0/+2	+1	+2	+2	+1	+3	+3	+3		0	+3	0	0	+3	+2	+3	+3	+3	+3	+3	-3
W4	0	0	+2	+1	+1	+1	+2	+3	+3	+3	+3	+3	0/+1	0/+3	0/+2	+1	+2	+2	+1	+3	+3	+3	+3		+3	+3	0	+3	+2	+3	+3	+3	+3	+3	-3
W5	0	0	+1	0	+1	+1	+3	+1	0	+3	+3	+3	0/+1	0/+3	0/+2	+1	+2	+2	+1	+2	+3	+3	0	+3		0	0	+1	+2	+1	+3	+3	+3	+3	-3
W6	0	0	+1	0	0	0	0	0	0	0	0	0	0/+1	0/+1	0/+1	+1	+1	0	0	+2	0	0	+3	+2	0		0	0	0	+1	0	+3	+3	+3	0
W7	-3	-3/+3	+2	+1	+1	0	+2	+1	+1	+3	+3	+3	0	0/+3	0/+1	+1	+2	+2	+1	+3	+1	+1	+3	+3	+3	+1		+3	+2	0	+3	+3	+3	+3	-3
W8	-2	-2/+2	+2	+1	+1	+1	0	0	0	0	0	0	0	0	0/+1	+1	+1	+2	+1	+2	+2	+3	0	+2	+3	+1	0		0	0	0	+3	+3	+3	-3
W9	0	0	0	0	0	0	0	0	0	0	0	0	0	+3	0/+1	+1	0	0	0	0	0	0	0	+3	0	0	0	0		0	0	+3	0	0	0
W10	0	0	0	+1	0	0	0	0	0	0	0	0	0	0	0	+2	0	+1	0	0	0	+1	+2	+3	0	0	0	+1	+2		0	0	+1	+1	0
W11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0/+1	+1	0	+1	+1	0	+1	+1	0	+3	0	0	0	0	0	0		+3	+3	+3	-2
W12	-3	-3/+2	+2	+2	+3	+3	+2	+3	+3	+3	+3	+3	0/+1	+3	0/+1	+1	+3	+3	+1	+3	+3	+3	+3	+3	+3	+3	+3	+3	+2	+3	+3		+3	+3	-3
C1	-3/+3	-3/+3	+2	0	+3	+3	0	+1	+3	+3	+3	+3	+3	+1	0	+1	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3		+3	-3
C2	-3/+3	-3/+3	+2	0	+3	+3	0	+1	+3	+3	+3	+3	+3	+1	0	+1	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3	+3		-3
C3	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	+1	0	+1	0	0	0	0	0	0	0	0	-3/+3	-3	

2 Assess interactions between nexus critical instruments and nexus critical objectives

This sub-chapter includes the following elements:

- the **table** illustrating the selected nexus critical **instruments**, including an **explanation** of the reason why these instruments are considered particularly critical or interesting to investigate in a nexus perspective
- **scoring matrix** illustrating interactions between nexus instruments and objectives
- the **justification** of the scores (Appendix II.)
- the **description** of the interaction between NCIs and NCOs, including an **explanation** how individual (one instrument) or multiple (more instruments together) interactions may hamper or support the achievement of the nexus critical objectives.

Table 3. Nexus critical instruments

Energy		
Code	Headings (short description)	Detailed description
Ea	National programme on subsidies for planting crops for biofuels	Support of maize and rape planting; Rape on 10 % of arable land in 2016;
Eb	Subsidies for biomass production within Common agriculture policy	Set up the conditions for the providing subsidies for permanent grassland and less-favoured areas to motivate the use of harvested material for further purposes
Ec	Support of new, more sustainable energy crops	Define energy crops that will be able to adapt to climate change while not contributing to a worsening of the soil and water regime and not requiring high inputs of additional energy, industrial fertilizers or biocides; to encourage the cultivation of these crops on less fertile soils in less favoured areas
Food/Agriculture		
Code	Headings (short description)	Detailed description
Fa	Statutory management requirements (SMR)	SMR 1-13 (are grouped into 3 categories - Environment, climate change, good agriculture and environmental soil conditions; Public, animal and crops health; Animal welfare) The statutory management requirements form part of cross- compliance and are laid down in a number of European Union directives and regulations. They concern public health, animal and plant health, identification and registration of animals, environment and animal welfare. These requirements apply independently of cross compliance (which only establishes the link between the full payment and the respect of such requirements).
Fb	Single area payment scheme (SAPS)	System of direct payments of CAP - The single area payment scheme provides a flat-rate decoupled area payment paid for eligible agricultural land and replaces almost all payments. Applied until 2020.
Fc	Good agricultural and environmental standards (GAEC)	Revise good agricultural and environmental standards (GAEC) in order to better protect and increase biodiversity of land and soil; ensuring that more organic

		matter is added to the soil, motivation to greater use of soil protection technologies. GAEC 1 (surface water protection against pollution), 4 (min. vegetation cover of soil) 5 (minimizing erosion), 6 (organic matter in soil), 7 (landscape features protection) Farmers are obliged to maintain their land in ‵ good agricultural and environmental condition ’. This concept includes the following: the protection of soil against erosion, the maintenance of soil organic matter and soil structure, and the safe-guarding of landscape features. It is the member states - not the European Union - which decide the exact specification of these parameters. Stopping soil degradation by excessive erosion, depletion of nutrients, loss of organic matter and soil sealing Measures to reduce water and wind erosion of agricultural land by 50 % by direct payments for greening, strict application of AECM, GAEC Maintaining and increasing the ability of the soil to bind water Strengthening and effective application of Cross Compliance / GAEC rules in relation to the use, protection and improvement of agricultural land - in particular: -projection of real erosion risk into the respective LPIS layer and interconnection with the prescribed mode of landuse while providing sufficient soil protection technologies -major strengthening of the GAEC standards for improving the **quality of soil** - in particular under GAEC 4 (ensuring minimum land cover), GAEC 5 measures for erosion by introducing and requiring protection of soil from wind erosion), GAEC 6 (preservation of the content of organic matter) and GAEC 7 (in 2016 extension of landscape elements by a new one - wetland, in the following years efforts to further enlargement of landscape elements e.g leakage, or other anti-erosion measures, in particular technical ones). - major strengthening of the GAEC standards for improving **the quality of water** - in particular under GAEC 1 and 3 (water protection by delimitation of non-fertilized streams along water courses and protection of groundwater against pollution)

Fd	Greening in the EU Common Agricultural Policy / green direct payment	Greening in the EU Common Agricultural Policy - introducing a new mandatory eco-funded direct payments component; The 2013 reform of the Common Agricultural Policy introduced several instruments to promote environmental sustainability and combat climate change. These instruments comprise a green direct payment, enhanced cross-compliance obligations, an obligation to allocate 30% of the Rural Development budget to projects and measures that are beneficial for the environment and climate change (including voluntary agri-environmental climate measures), training measures and support from the farm advisory services. The 2013 reform of the Common Agricultural Policy introduced a green direct payment which is paid to farmers on the condition that they undertake practices that are beneficial to the climate and to the environment. Member states must allocate 30% of their direct payment envelope to green direct payments. The basic practices that farmers must undertake are: - maintaining permanent grassland, - crop diversification, - having 5% (later 7%) of their land as ecological focus area. Subject to a decision by member states a farmer can, instead of applying these basic practices, undertake practices which are considered equivalent (such as crop rotation instead of crop diversification).
Fe	Agri-environment-climate measures (AECM) M10	Measure M10 (Rural development programme) – support of fruit, grapes, vegetable production, permanent grassland management, grassing of arable land, bio-belts, green plover protection, grassing of runoff corridors Targeting of AECM payments to ensure support and contribution of AECM to the structural change of Czech agriculture landscape with an emphasis on enhancing the ecological stability and biodiversity (through the appropriate setting of eligibility criteria, in particular the correct targeting of environmental measures on agriculture land (appropriate seed treatment, permanent grassland management.) These are practices, undertaken voluntarily by farmers, over a set period. Support may be provided through Rural Development programmes. The practices bring environmental benefits and /or help to mitigate and

		adapt to climate change. The payments compensate farmers for the extra costs that they incur and the income that they forego when they undertake these practices. The practices must go beyond a number of obligations which apply to farmers in any case – including (but not limited to) cross-compliance and relevant national legislation. A given practice which is funded through the greening provisions of pillar I may not also be funded through an agri-environmental climate measure.
Ff	Ecological farming M11 (AECM)	Measure M11 (Rural development programme); ecological farming - 6 % of agriculture land fund in the Czech Republic
Fg	Forest areas development M08 (AECM)	Measure M08 Reforestation (Rural development programme)
Fh	Tangible assets investments M04 (AECM)	Measure M04 (Rural development programme) – may support of inappropriate use of heavy mechanisation/machines
Fi	Small farms support	To prioritize small farms in the framework of agricultural subsidies; Rural development programme
Fj	Support of young farmers	Under Rural development programme
Fk	Supporting program - soil protection against erosion, degradation and excessive drying	In the context of evaluating the current tools in the area of protection of the agricultural land fund ("Preparing for the implementation of measures to mitigate the negative impacts of drought and water scarcity"), prepare a multiannual training program and free consultations for farmers, with the aim of putting forward desirable practices in practice.
Land		
Code	Headings (short description)	Detailed description
La	Arrangements to secure a state land reserve	Implement the necessary legislative and financial arrangements to secure a state land reserve;

Lb	Landscape planning instruments (complex land consolidation; plan of common facilities)	To set landscape planning as an instrument for water retention Complex land consolidation Landscape consolidation provides conditions for improving the quality of life in rural areas, including diversification of economic activities and improving agricultural competitiveness, improving the environment, protecting and regeneration the soil fund, improving forestry and water management, especially in the field of minimizing the adverse effects of floods and drought and increase the ecological stability of the landscape. The land reform results serve for the renewal of the cadastral project and as a basis for spatial planning. Implementation of complex land consolidation in terms of increasing the retention capacity of the landscape; need for organizational support for the implementation of land consolidation In the **plan of common facilities**, the whole land consolidation will also be assessed in terms of soil erosion and flood risks, as well as the possibility of water retention in relation to the slowdown of surface runoff. The use of the individual protection measures depends mainly on their efficiency; requires reduction in soil washout, the reduction of maximum flows and the protection of water resources, watercourses, water reservoirs and built-up parts of the municipality. The plan of the common facilities must be completed by a proposal of agro-technical and organizational measures, with which landowners will be demonstrably acquainted; Furthermore, the plan of the common facilities includes an evaluation of the change of the runoff parameters as a basis for the solution of the runoff in the catchment area. Within the common facilities, combining technical and semi-natural measures to increase the retention capacity of the landscape
Lc	Financial incentives for reduction the share of leased land to 70%	Reduce the share of leased land to 70% by incentives to realize the investments in land purchase and continue support of the implementation of land consolidation. At the same time, an improvement in the relationship to the land is achieved.
Ld	Strict application of the Act of the Czech National Council no. 334/1992 Coll., on agriculture soil protection	Strict application of the Act of the Czech National Council no. 334/1992 Coll., on agriculture soil protection - reduce soil sealing, improve soil structure, increase the organic matter content of soil Farmers or land tenants should manage the land so that they do not pollute soil and thus the food chain and drinking water sources with harmful substances that

		threaten the health or life of humans and the existence of living organisms, do not damage the surrounding land and the favourable physical, biological and chemical properties of the soil, and protect land under approved land consolidation projects.
Le	Ministry of Environment subsidies	Three nearly complementary programmes of Ministry of Environment: a) Environmental operational programme 6.3 - green planting in the landscape and soil protection according to approved complex land consolidation, restoration of shore stands, ... 6.4 – antierosion protection and reduction of negative consequences of surface runoff, restoration of shore stands, revitalization of watercourses and floodplains, ... b) Landscape protection programme Free landscape - renovation and stabilization of erosion consequences outside the watercourses and creation of biological anti-erosion measures as mowing, pasture c) Support for restoration of natural landscape functions: Anti-erosion measures, restoration of shores vegetation, revitalization of watercourses and floodplains, mowing, grazing, ...
Lf	Historical landscape structures data	Review and modify a set of land-analytical phenomena in order to capture historical landscape structures whose regeneration can contribute to increasing landscape retention and minimizing erosion threats. Historical data from Imperial Imprints of the Stable Cadastre of Bohemia
Water		
Code	Headings (short description)	Detailed description
Wa	National plan of Labe catchment	- to protect and improve the status of surface and groundwater and aquatic ecosystems, - to reduce the adverse effects of floods and drought, - the management of surface and groundwater and the sustainable use of these waters for providing water services and - to improve water conditions and to protect the ecological stability of the landscape. Also contain summaries of programs of measures to achieve these objectives and set out a strategy for their funding.
Wb	Concept of the solution of flood protection in the Czech Republic using both technical and nature measures	It sets out ways how to implement preventive flood control measures after 2013, including optimization procedures for individual measures. The system of flood protection measures also includes landscape measures as well as the new requirements of European legislation.
Wc	Water Policy Conception of the Ministry of Agriculture by 2015	It defines the general objectives and principles of the state water policy, namely: To create conditions for sustainable management of the limited water resources of the Czech Republic, which will allow the harmonization of requirements for all forms of water use with the requirements of water and aquatic ecosystems protection, with subsequent prevention of water hazards and risks. Long - term (strategic) goals for:

		Water protection as a component of the environment - to protect surface and groundwater, allow sustainable and balanced use of water resources, create conditions for protection and improvement the status of surface and groundwater and aquatic ecosystems as well as individual water species organisms and contribute to the protection of directly dependent terrestrial ecosystems and species. Flood protection - reduce the number of floods at risk and reduce the threat property, cultural and historical values while prioritizing the principle of prevention. Protection against the negative effects of drought - gradually adapt to the anticipated change climate. Water management services - ensure seamless supply to the population and others water customers with good quality drinking water and efficient disposal of waste water without negative impacts on the environment and at socially acceptable prices and with minimum demands on public finance.
Wd	Act no. 254/2001 Coll. on water	Landowners are obliged, unless otherwise provided by special legal regulation, to provide such management so as not to worsen the water conditions. In particular, they are required to ensure that the drainage conditions are not deteriorating, the soil is not discharged by erosive water activities and the improvement of the retention capacity of the landscape. The amendments is targeted on drought mitigation and protection measures.
Instruments in preparation /recommended – based on climate change mitigation/adaptation strategy, stakeholders consultations		
We	Plans of water resources protection in Europe	Create more detailed plans of water resources protection, including the concept of wetland restoration and revitalization of watercourses Water retention measures, flood and drought protection is based on green infrastructure (as part of 1. pillar of CAP, areas of ecological interest)
Wf	Concept for drought and water scarcity – just under construction	Develop a comprehensive concept for drought and water scarcity and to prevent emergencies caused by long-term water scarcity
Wg	Technical and natural measures for spatial water retention	to improve and restore the retention ability of the landscape by: 1. Implementation of comprehensive measures (type A - according to catchment area management plans) on the agricultural land 2. Maintenance and management of technical and nature measures for the retention, accumulation and improvement of water quality on agricultural land 3. Support for the purchase of land for the implementation of these measures 4. Reimbursement of economic damage from loss of production from the areas designated for the implementation of these measures

		Based on the National plan of Labe catchment
Wh	New financial and subsidies programme – intended	To prepare a new financial and subsidies programme to support water retention in the landscape by strengthening the retention capacity of the soil, construction of new ponds and small water reservoirs, support for the restoration of extinct ponds and the restoration of wetlands. Increase wetlands area and retention dams on agriculture land by private investments and specific financial support; Increase the area of state land property by (private) investments and specific financial support
Climate		
Code	Headings (short description)	Detailed description
Ca	Emissions trading	Climate change mitigation through emissions trading; CO_2 and anthropogenic emissions as only factors responsible for climate change; climate protection
Cb	Reduction of greenhouse gasses emission	so-called mitigation (i.e. reduction measures) in different sectors
Cc	Carbon sequestration and nitrogen retention	Adaptation, mitigation of climate change: agro-environmental – climate measures in agriculture are mainly based on carbon sequestration and nitrogen retention; GAEC – partly influence stock carbon stock by farming management practices

Table 4. Scoring matrix illustrating interactions between nexus instruments and objectives

	Ea	Eb	Ec	Fa	Fb	Fc	Fd	Fe	Ff	Fg	Fh	Fi	Fj	Fk	La	Lb	Lc	Ld	Le	Lf	Wa	Wb	Wc	Wd	We	Wf	Wg	Wh	Ca	Cb	Cc	Total n. (+)	Total n. (-)	Total n. (-/+)
E1	+3	+1	-1/0	0	0	0	-1	0	0	-1	0	0	0	0/+1	-1/+1	0	0	-1	0	0	-3	0	0	0	0	-1	0	0	0	0	0	3	6	1
F1	+3	+3	+3	0	0	+1	+1	0	0	0	0	0	0/+1	0/+1	+1	0	0	-1/+1	0	0	+1	0	0	0	0	-1	0	0	0	0	0	9	1	1
F2	-2/+2	+3	+3	0	-1	+1	+1	+2	+1	0	0	0/+1	0/+1	0/+1	0	+1	0/+1	+1	+2	+1	0	0	0	0	+2	+1	+2	+2	0	0	+1	19	1	1
F3	0	0	0	0	0	0	0	+3	0	0	0	0	0	0	0	+1	0	+1	0	+1	0	0	0	0	0	0	+1	0	0	0	0	5	0	0
F4	-1	+1	+1	0	-1	+1	+1	0	0	0	0	0/+1	0/+1	0/+1	0	+1	0	+1	+1	0	+1	+1	0	0	+1	0	0	0	0	0	+1	14	2	0
F5	-1	+3	+1	0	-1	+1	+1	+1	+1	0	0	0/+1	0/+1	0/+1	0	+1	0/+1	+1	+1	+1	0	+1	0	0	+1	+1	0	0	0	0	+1	18	2	0
F6	0	+3	+1	0	-1	+1	+1	+1	+1	0	0	0/+1	0/+1	0/+1	0	+1	0/+1	+1	+1	+1	+3	+1	+1	+1	+3	+1	+1	+1	0	0	-1/+1	22	1	1
L1	-2	+3	+1	0	-1	+1	+3	+1	+1	+3	-2	0/+1	0/+1	0/+1	0/+1	+3	0/+1	+3	+3	+1	+1	+1	0	+1	+2	+3	+3	+1	0	0	+1	24	3	0
L2	-2	+2	+1	0	-1	+1	+1	+1	+1	0	0	0/+1	0/+1	0/+1	0/+1	0	0/+1	+3	+1	0	+1	+1	0	0	0	+3	+1	+1	0	0	+1	19	2	0
L3	-2	+3	+1	0	-1	+1	+1	+1	+1	+3	-3	0/+1	0/+1	0/+1	0/+1	+3	0/+1	+3	+1	+1	+1	+1	0	0	0	+3	+1	+1	0	0	+1	22	3	0
L4	+1	+3	+1	0	-1	0	+1	+1	+1	0	0	0	0	0/+1	+1	+3	+1	+3	0	0	+1	+1	0	0	0	+3	0	0	0	0	0	14	1	0
L5	-2	+3	+1	0	-1	0	+1	+1	+1	0	-3	0/+1	0/+1	0/+1	0/+1	0	0/+1	+3	+1	0	+1	+1	0	0/+1	0	+3	+3	+1	0	0	0	18	3	0
L6	+1	+2	+1	0	+1	0	0	0	0	-1	0	+1	+1	0/+1	+1	+3	+1	+3	0	+1	0	-1	0	0	0	+3	0	0	0	0	0	13	2	0
L7	0	0	0	0	0	0	0	0	0	0	0	-1	-1	0	+3	-1/+1	-3	0	0	0	+3	+1	0	0	0	+3	+3	+1	0	0	0	6	3	1
L8	0	0	0	0	0	0	0	0	+1	0	0	+1	+1	0/+1	-3	-1/+1	+3	0	0	0	-3	-1	0	0	0	+3	-1	0	0	0	0	6	4	1
L9	0	+1	+1	0	0	0	+1	0	+1	+1	0	+1	+1	0/+1	+1	+1	+2	+1	+3	+2	+3	+1	0	+1	0	+3	+3	0	0	0	0	19	0	0
L10	-3	+3	+2	0	-2	+1	+3	+1	+1	+3	-1	+1	+1	0/+1	0/+1	+3	+2	+1	+3	+3	+3	+1	0	0	+3	+3	+3	0	0	0	0	21	3	0
L11	-3	+3	+2	0	0	+1	+1	0	+1	+1	0	0/+1	0/+1	0/+1	0/+1	+3	+1	+1	+3	+1	+1	+1	0	+1	0	+1	+1	0	0	0	+1	21	1	0
L12	0	0	0	0	0	0	0	0	0	+1	0	0	0	0	0	+1	0	0	+1	+1	0	+1	0	0	+1	0	0	0	0	0	0	6	0	0
L13	-3	+3	+3	0	-1	+1	+3	0	+1	0	0	0/+1	0/+1	0/+1	0	+1	0/+1	0	0	+1	+3	+1	0	0	0	+1	0	0	0	0	0	14	2	0
W1	-3	+3	+1	0	-1	+1	+3	+1	+1	0	0	0/+1	0/+1	0/+1	+1	+3	0/+1	0/+1	+3	+3	+3	+1	0	0	+3	+3	+3	+1	0	0	+1	22	2	0
W2	-3	+3	+1	0	-1	+1	+3	+1	+1	0	0	0/+1	0/+1	0/+1	+1	+3	0/+1	0/+1	+3	+3	+3	+1	0	+1	+3	+3	+3	+1	0	0	+1	24	2	0
W3	-3	+3	+1	0	-1	+1	+3	+1	+1	+3	-1	0/+1	0/+1	0/+1	+1	+3	0/+1	0/+1	+3	+1	+3	+1	+1	+1	0	+3	+3	+3	0	0	0	23	3	0
W4	-3	+3	+1	0	-1	+1	+3	+1	+1	+3	-1	0/+1	0/+1	0/+1	+1	+3	0/+1	0/+1	+3	+3	+3	+1	+1	0	+3	+3	+3	+3	0	0	0	23	3	0
W5	0	+2	+1	0	0	+1	+3	+1	0	0	-1	0/+1	0/+1	0/+1	+1	+3	0/+1	0/+1	+3	+2	+3	+1	+1	+1	+3	+3	+3	+3	0	0	+1	23	1	0
W6	0	0	0	0	0	+1	0	0	+1	+1	0	0/+1	0/+1	0/+1	+1	+1	0/+1	+1	0	+3	0	+3	+1	+1	+3	+1	+1	+3	0	0	+1	19	0	0
W7	-3	+3	+1	0	-1	+1	+3	+1	+1	+3	-1	0/+1	0/+1	0/+1	+1	+3	0/+1	0/+1	+3	+3	+3	+2	+1	+1	+3	+3	+3	+3	0	0	0	24	3	0
W8	-1	+3	+1	0	0	0	+1	+1	+1	0	0	0/+1	0/+1	0/+1	0	0	+1	+1	+2	0	+3	+2	+1	0	0	0	0	0	0	0	+1	15	1	0
W9	0	0	0	0	0	0	0	0	0	0	0	-1/+1	-1/+1	0/+1	+3	+2	-1/+1	0	0	0	+3	0	0	0	0	+2	+3	+1	0	0	0	7	0	3
W10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	0	0	+1	0	+3	+2	0	0	0	+2	+3	0	0	0	0	6	0	0
W11	0	0	0	0	0	0	0	0	+1	+3	0	0/+1	0/+1	0/+1	0	+3	0/+1	0	+1	+3	+1	+2	0	0	0	+3	+3	+1	0	0	+1	15	0	0
W12	-3	+3	+2	0	-1	+1	+3	+1	+1	+3	-1	0/+1	0/+1	0/+1	+3	+3	+3	0/+1	+3	+3	+1	0	0	+3	+3	+3	+3	+1	0	0	0	23	3	0
C1	-3	+3	+1	0	0	+1	+3	+1	+1	+3	-1	0/+1	0/+1	0/+1	+1	+1	+1	0	+3	+1	+1	+1	+1	+1	+1	+3	+3	+1	-3/+3	-3/+3	+1	24	1	3
C2	-3	+3	+1	0	0	+1	+3	+1	+1	+3	-1	0/+1	0/+1	0/+1	+1	+1	+1	0	+3	+1	+1	+1	+1	+1	+1	+3	+3	+1	0	0	+1	24	1	1
C3	0	0	0	0	0	0	0	0	0	+3	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	0	0	0	+3	+3	+3	6	1	0
Total n. (+)	4	26	25	0	1	21	24	20	24	15	0	26	27	30	22	27	26	23	24	23	26	26	9	13	17	28	24	19	1	1	3			
Total n. (-)	18	0	0	0	17	0	1	0	2	2	12	1	1	0	1	0	1	1	0	0	2	2	0	0	0	2	1	0	0	0	0			
Total n. (-/+)	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	2	1	1	0	0	0	0	0	0	0	0	0	0	1	1	0			

Energy instruments

Energy instruments are based on support of planting crops for biofuels (Ea), mainly rape and maize, subsidies for biomass production within CAP (Eb) and new energy crops support (Ec). These instruments have a distinctive effect on all objectives.

National programme for planting crops for biofuels is based on the business of maize and rape planting on large areas (i.e. rape was planted on 12 % of arable land in the Czech Republic in 2016 (366 000 ha; 4,7 % of the total area of the republic; ten years ago it was by 100 000 ha less). The support comes from national budget, from which 15 billion CZK spends the rape industry (from the total amount of planned expenditures 1 250,9 billion CZK in 2016). European Commission approved the prolongation of programme of biofuels support till 2020. Except the sharp increase of planting area, there are another two significant parameters that had changed. While earlier yields of rapeseed per hectare were around 2.5 tonnes, today it is 3.5 tonnes. And while ten years ago it ran between 5.5 and 7 thousand CZK per tonne, in the last two years the price has stabilized just under ten thousand CZK per ton. However, in 2010 and 2011, even over eleven thousand. The reason for all three changes - considerably higher yields, substantially higher purchase prices and planted land by rape- is the same: it is the creation of an extremely lucrative and state-aided biofuel trade. Higher yields per hectare are achieved by far higher fertilizer doses and robust pesticide use, compared to other crops. So extremely good business for chemical industry producing herbicides, insecticides, fungicides, fertilizers, trace elements and stimulants. Consumption of these inputs is abnormal compared to other crops. So no wonder that accompanied phenomena of rape (and maize) planting are serious deterioration of soil and water quality, worsening of landscape water regime and overheating the landscape. For that reasons all the objectives touching the land/soil, food/agriculture and water are assessed as negative. In other words, "What we do for rapeseed fields in our country would not be allowed in Austria," said small private farmers. The official reason for which the Czech Republic has given the European Union the opportunity to promote the rape business is the protection of the environment. Indeed, Czech Republic claims that is fighting and mitigating climate change. In fact, the real significance of industrially produced biofuels for climate change mitigation is purposefully overestimated with the aim of losing public funds to large agro-corporations (Santa Barbara 2007). That's what's happening today. The law prescribed for 6 percent of rapeseed oil methyl ester does not, of course, mean that greenhouse gas emissions will be reduced to the same extent. Paying eight and a half billion, the state in five years will get a 3.6 percent reduction in transport emissions. So the technology without bright future and immense negative effect on soil, water, landscape. The biofuels of the first generation (biofuel from oily, sugar and starch plants should be in five-year horizon subsidized by new energy crops (Ec). These crops should not require such huge amounts of additional energy and chemicals, should be planted on less fertile soils and without worsening the soil characteristics and water regime. So it may be some promise for the landscape. New CAP came up with subsidies for permanent grassland (Eb) and its use for energy biomass. This instrument may bring back traditional landuse (pastures, grassland) into less favourable areas (hills, mountains) with all positive effect of grassing into soil characteristics and water regime (positive relation nearly to all objectives) as decrease in the consumption of mineral nitrogen during fertilization significant decrease in N-NO3- concentrations in surface water. Grassing and afforestation reduces the impact of water erosion most significantly. Grassing and afforestation not only eliminates these consequences but also has a beneficial effect on:

• Landscape water regime - Increases soil retention capacity, increases interception, increases evapotranspiration, slows surface drainage, transforms surface runoff to groundwater, resp. hypodermic.

• The quality of water infiltrated in grassland and forest

Despite low efficiency the biomass may be used for biogas stations and as a natural biological measure for water retention and purification, which should accompany technical water retention measures. The effect of Eb and Ec instruments on climate cannot worsen the current situation, when compared to Ea. Neither of them have an effect on greenhouse gasses reduction. To conclude the rapeseed business is directly responsible for the current state of the Czech landscape with its all negative effects. There is no interest in change, because of personal involvement of high politicians in agri and chemical business that controls other sectors in ministries of agriculture, industry and environment. And in the name of climate change mitigation this strategy is approved by European Commission till 2020, despite the new rules to reduce indirect land use change. While biofuels are important in helping the EU meet its greenhouse gas reductions targets, biofuel production typically takes place on cropland which was previously used for other agriculture such as growing food or feed. Since this agricultural production is still necessary, it may be partly displaced to previously non-cropland such as grasslands and forests. Indirect land use change risks negating the greenhouse gas savings that result from increased biofuels because grasslands and forests typically absorb high levels of CO2. By converting these land types to cropland, atmospheric CO_2 levels may increase. In 2015 new rules came into force which amend the current legislation on biofuels – specifically the Renewable Energy Directive and the Fuel Quality Directive - to reduce the risk of indirect land use change and to prepare the transition towards advanced biofuels. One of the amendments is to limit the share of biofuels from crops grown on agricultural land that can be counted towards the 2020 renewable energy targets to 7%. The Czech Republic produced 6,75 % of renewable resources from biofuels in 2016 which meets the limits of EU regulation. However, this limit does not determine the area of land that can be used for biofuels production. Therefore, only indirectly protects the original land use to biofuels production.

Food/agriculture instruments

While energy tools are more or less based on an internal system of subsidies for biofuel support in the Czech Republic, food and agriculture instruments are mostly related to the CAP and its two basic pillars – direct payments and rural development programme.

Environment, climate change, good agriculture and environmental soil conditions are the first category of statutory management requirements (Fa). Beside the name of the measure that promises the improvement of environmental conditions, the impact on the landscape and all objectives is zero, because SMR deals mainly with biodiversity and pollution from point sources and contamination. System of direct payment (Fb) is the main agriculture subsidy payed for farmer per hectare. The amount of aid they receive is not linked to the volume of their production. The farmers should comply with strict rules on human health, animal health and welfare, plant health and the environment that is conditioned by cross compliance system. The conditions for obtaining a subsidy are enough to be an active farmer whose land is located in the territory of the European Union.

The motivation for farmers is to cultivate the largest and non-fracturing blocks of arable land. This effort goes against the objective of landscape heterogeneity (L10). There is no condition of sustainable land management when applying for subsidies. The soil is therefore used beyond the production maximum, there is no incentive for soil protection and water regime of the landscape. Therefore, the relationship of the Fb instrument to soil and water targets is mostly negative. The payment per hectare of cultivated land is EUR 267; if a farmer grows a rape, the payment per hectare is about 350 EUR (National Biofuel Support Program). Growing rape for biofuels is thus more lucrative than traditional agricultural production – for explanation see energy instruments. But this is the responsibility of the Czech Republic, not the EU (Jovanović 2011). In terms of CAP reform (Agenda 2000), the member states were required to take measures to ensure that agriculture activities were compatible with environment requirements. It allowed member states several options for such measures. These options included: support in return for agri-environmental commitments, the introduction of general mandatory environmental requirements and the introduction of specific environmental requirements constituting a condition for direct payments (cross-compliance). Member states were also able to decide on a sanctioning system punishing violation. Punishment should be appropriate and proportionate and could include withdrawal or even cancellation of direct payments.

Only Denmark, France, Greece, the Netherlands and the UK set down these limits for direct payments. In this aspect the Czech Republic completely failed, when missed the opportunity to set up conditions for substantial part of the direct payment, conditioned by strict sustainable land management which would lead to spatial water retention, improvement of soil properties (return of organics, reduction of soil compaction, minimization of erosion and matter losses etc.). Cross-compliance is considered to be an enforcement mechanism, alongside the legal sanctioning system that is under discretion of each member state. Cross-compliance involves three elements of standards: statutory management requirement (SMR), the good agricultural and environmental conditions (GAEC) and obligation to preserve permanent pastures at reference level of 2003.

Thus CAP already contains instruments for maintaining good agriculture and environmental conditions of landscape. GAEC standards **(Fc)** are considered as landscape managements tools leading to improvement of current state by the seven measures aimed at buffer strips next to watercourses, irrigation systems, groundwater protection against pollution, minimum level of land maintenance, soil erosion, soil organic matter, soil structure – landscape features maintenance).

Unfortunately, these standards are often set up very tolerant, without any significant effect on environment. In addition, their enforceability is very weak, supported by weak mandate of controlling institutions. There are no strict rules and fines for their breach, there are no rules for remedying the current state. Often, this is a solution only on paper. Measures (even those requiring greater effort from the farmer) should be established to meet the standard effectively.

Standard GAEC 5, resp. delimitation of erosional threatened areas has been set very tolerant. As a result, in practice, erosion situations occur repeatedly on areas where the standard does not prescribe or insufficiently prescribe any anti-erosion measures. According to GAEC classification, in the Czech Republic there is 89,3 % of soils classified as non-erosion risk; 10,2 % low erosion risk; 0,5 % high erosion risk; according to the Research Institute for Soil and Water Conservation the real situation is: 47,5 % non-erosion risk soils; 27,9 % low erosion risk; 24,7 % high erosion risk. Because of insufficient assessment of erosion risks under GAEC 5 standards, there is no impact, power and motivation to improve soil management and erosion risk mitigation remains more or less on voluntary basis of land managing subjects. There is demand on greater enforceability of the proposed agro technical and organizational measures within the framework of complex land consolidation[2]. GAEC 4 – (minimal vegetation cover of soil) can slightly contribute to crop diversification by using winter crops, multiannual crops, intercrops and leaving stubble on fields.

Concerning water issue (GAEC 1 -3), The Common Agricultural Policy supports investments to conserve water, improve irrigation infrastructures and enable farmers to improve irrigation techniques. It also helps to protect water quality and also traditional irrigation systems create diverse and intricate landscapes, which support a variety of wildlife and have important cultural and historic value. Agriculture can impact in different ways on the good chemical and good quantitative status of groundwater and surface waters. Water quality may be negatively affected by the presence of pesticide residues, nutrients from fertilisers, or sediments from soil erosion. So the central aim is to avoid water pollution through agricultural activity, mainly through a sustainable use of pesticides, fertilisers and avoid of nitrate pollution. If the impact of agriculture and effective water-related measures are judged only in terms of the effectiveness of irrigation systems and water quality, it cannot be considered as an effective measure for water retention in the countryside, drought and climate change mitigation. Therefore, GAEC standards are not an obstacle to water targets, but they are not a benefit either.

The agricultural policy should highlight and integrate technical and biological measures on agricultural land. The combination of technical measures, especially from the point of view of soil protection against erosion, accelerated surface runoff and water quality and biological from the point of view of water quality and subsurface runoff filtration, must be effectively intertwined. It is crucial to involve

[2] Complex land consolidation = process of unification, division and arrangement of land, associated with terrain, water management, anti-erosion, communication and other measures, usually carried out in the cadastral area, according to provisions of a generally binding legal regulation

technical measures on agricultural land and not only very vague and never sufficiently GAEC measures to protect against erosion and surface runoff. For a hundred-year precipitation, biological measures are inadequate. Or, GAEC will only address soil protection through agro-technical and organizational measures for the future? This is extremely low, it is necessary to solve large-volume retention and this is possible only when applying also technical measures (Kvítek 2013).

Greening is a major innovation brought in under the 2013 CAP reform, makes the direct payments system more environment-friendly. Greening is an instrument **(Fd)** which condition 30 % of direct payments by observing three environmental-friendly practices: a) crops diversification; b) maintaining permanent grassland; c) conserving 5 % areas as ecological focus area (aimed at biodiversity protection by fallow land, field margins, hedges and trees, buffer strips, planting of catch crops, nitrogen fixing crops). Generally greening instrument positively effects nearly all objectives. Theoretically may lead to the reduction of biofuels production - E1objective (arable land maybe replaced by permanent grassland), however in reality the farmers will not have any motivation for change from rape to grass, because of rich national financial support of rapeseed. Grass from permanent grassland maybe used in biogas station (F1). From all greening measures the only effect on water and land/soil objectives has only permanent grassland. Namely as an instrument for erosion decrease (L1), heterogeneous landscape structure (L10), water quality improvement and retention (W1-W5, W6, W7). Because of these impacts grassing has a positive effect in climate change adaptation and mitigation (C1, C2). Crops diversification has a benefit for objective L13. However, in reality greening has only a weak effect on sustainable land management, especially when is performed by measures a) and c).

The above mentioned instruments form the first pillar of CAP. The second one is based on Rural development programme that complements the direct payments scheme. The Czech rural development programme 2014 – 2020 is aimed at support of sustainable management of natural resources and encouraging climate-friendly farming practices. At 25 % of soil should be priority in biodiversity protection, 11 % improvement of water management, 12 % soil protection.

Agri-environmental measures (M10) under the Rural development programme (Fe) are voluntary instruments for sustainable farming. The measures are aimed at support of fruit, grapes and vegetable production, permanent grassland management, lapwing protection. Concerning real measures for environment and climate protection, one can consider only grassing arable land, bio-belts, grassing of runoff corridors. These measures are not detrimental to the landscape, however does not contribute to anything, only its name is promising in terms of climate change mitigation, as well as another instrument Ff – ecological farming (measure M11 of Rural dev. progr.). More promising seems to be Fg - forest areas development measure (M8). Forest development is essential part of sustainable land management in terms of small water cycle recovery (W11) and water retention, as well as local climate formation. Forests decrease soil erosion, runoff, attract precipitation, mitigate drought, keep groundwater level and have many other function. Directly mitigate climate change, and indirectly by carbon sequestration. Therefore, the reforestation and good forests health should be a priority in all water, climate and land issues of EU – not the official priority that is reduction of greenhouse gas emissions and sequestering carbon.

Tangible assets investments Fh (Rural development programme, measure M4) is an instrument that may support purchase and consequent use of heavy machines on agriculture land and is directly responsible for soil compaction with all negative effects on landscape. Soil compaction (L5) causes degradation of the physical properties of the soil, when it is compressed and created crust on the surface. Compaction adversely affects the production function of the soil. The compacted soil absorbs less water, thereby accelerating its surface runoff (L3, W7), increasing the risk of floods and flooding (W3,4,5), and erosion (L1). In addition, heavy machines welcome large field blocks (against L10). As a result, the self-cleaning ability of the soil and its acidification, which is associated with soil compaction, can also be reduced. In such soils life is suppressed by aggravation of the air, water and temperature regime of the soil. In the Czech Republic 40% of agricultural land is threatened with compaction. The main cause is heavy agricultural and forestry machinery such as tractors or combine harvesters,

especially in damp weather, as wet soil is more susceptible to its compaction. Easier accessibility of heavy machines for farmers is supported just by instrument Fh. Except heavy machinery, other causes of soil compaction include intense soil irrigation (W6) and poor farming practices (E1, F1).
The instruments Fi (Small farms support), support of young farmers (Fj) and supporting program for agriculture land protection (Fk) are based on the assumption that farmers farming on their own land will have a motivation to improve all the food/agriculture, land/soil, water and climate objectives with the idea of sustainable land management and restoration of relationship to the soil that had been, because of 50 years period of communism and collectivization, interrupted, disrupted and destroyed. So the effect on all objectives maybe positive, however in reality probably without significant relation.

Land/soil instruments

Land and soil instruments are presented by landscape planning and consolidation tools, as well as acts and financial incentives within landscape protection programs.
State land reserve (La) should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized. Private land property may perform a barrier by the reluctance of farmers realize water retention measures at the expense of crops production. The La instrument may have a positive effect on all water objectives, as well as may influence land objectives (L1,2,3,4,5,6,10,11). Another land property instrument are the financial incentives for reduction the share of leased land to 70 % (Lc). This instrument should improve the relationship to land and farming practices make more sustainable – however its only presumption.
Landscape planning, complex land consolidation with the plan of common facilities are instruments (Lb) that may help to design, plan and realize both technical and biological measures for water retention, minimizing erosion, heterogeneous landscape structure. The suitable location of the individual measures in the river basin, with the exception of the watercourses, is not legally solved, except for complex land consolidation measures. Complex land consolidation measures are planned in the Czech Republic over several decades' time horizon. They last for a long time and are mostly directed to land exchanges (the concentration of small fragmented plots of one owner into a single unit), which in itself will not be reflected in the landscape, since the management is in hands of tenants and not real owners. Plan of common facilities, involves measures such as the construction of field roads, small water reservoirs, dry polders, boundaries, ditches, terraces, etc.. These are very sporadic measures to increase water retention. However, it is an instrument that can only help solve water and land objectives by designing effective measures. The common denominator for the design of these measures should be the public interest in water retention, which is related to flood prevention, drought, soil quality and local climate. Without that, we will not be able to transform agriculture in order to encourage water retention in the catchment area (based on Kvítek 2013).
Strict application of the Act of the Czech National Council no. 334/1992 Coll., on agriculture soil protection (Ld) should reduce soil sealing, improve soil structure, increase the organic matter content of soil – so mainly touches the land objectives L1 -L6, with slight effect on food/agriculture issues. Farmers or land tenants should manage the land so that they do not pollute soil and thus the food chain and drinking water sources with harmful substances that threaten the health or life of humans and the existence of living organisms, do not damage the surrounding land and the favourable physical, biological and chemical properties of the soil, and protect land under approved land consolidation projects. However, in reality the main constrain is in law enforceability, no systems of fines for breach and a weak mandate of institutions remedy the situation. This instrument do not touch water objectives; the only reference is to minimize disruption of the organization of agricultural land fund, hydrological and drainage conditions in the area.

Three nearly complementary programmes of Ministry of Environment - Environmental operational programme, Landscape protection programme, Support for restoration of natural landscape functions can provide financial support for landscape measures as:

- green planting in the landscape (W1) and soil protection (L1, L10) according to approved complex land consolidation (L9), restoration of shore stands (W2)
– anti-erosion protection (L1) and reduction of negative consequences of surface runoff (W7), restoration of shore stands (W2), revitalization of watercourses and floodplains (W5)
-free landscape - renovation and stabilization of erosion (L1) consequences outside the watercourses and creation of biological anti-erosion measures as mowing, pasture (W1,W2, W8)
-Support for restoration of natural landscape functions (L11, F2, F4-6).
As it is evident, the same objectives may by financially supported from different sources. The measures are realized on voluntary basis; they do not perform complex solution for water retention in landscape.
Construction of water retention measures in landscape should be based on relevant data. The Imperial Obligatory Imprints of the Stable Cadastre were created based on field mapping that was carried out between 1826 and 1843 in order to obtain a detailed inventory of lands for the purposes of tax collection in the Austrian monarchy. As a result, colour maps were created at a scale of 1:2,880 with detailed distinction between various land covers, which are now available in digital form as individual scanned map sheets. Stable cadastre maps are an important source of information for land cover and land use in the 19th century. They show the Czech landscape as it was before agricultural intensification: before the targeted removal of small landscape features, integration of small plots into large field blocks and the extensive land drainage. In the ‘background’ of this map former water retention areas in the landscape, such as wet meadows and marshes, can be easily identified. Due to a “landscape’s memory of where features, such as wetlands, use to be”, the maps make a firm base of relevant information useful for site identification: areas where restoration or adaptation of water retention features would be most successfully realized. Identification of these areas from other map sources, such as archival or contemporary aerial photography, is quite difficult - practically impossible. Furthermore, data such as the latter (especially from the 1950s) show the Czech landscape *after* the aforementioned changes. Thus the Stable Cadastre maps were strongly preferred and have been used for the retrospective evaluation of retention areas in the landscape.
Information from the old Stable Cadastre maps help to identify possible retention features in the present landscape. If the location used to be a former wet meadow, then the site could: a) still have traces of increased wetness detectable at the time of observation; b) have remained unchanged; c) have been completely drained without any remaining wet signatures left in the landscape. These historical data should be a basis for land consolidation measures, landscape heterogeneity, design of anti-erosion and water retention measures.

Water instruments

National plan of Labe catchment (Wa) is probably the only instrument that can be a motivation for real changes in the landscape in terms of decrease of spatial pollution of waters from agriculture and spatial water retention. The main issues are: to protect and improve the status of surface and groundwater and aquatic ecosystems, - to reduce the adverse effects of floods and drought, - the management of surface and groundwater and the sustainable use of these waters for providing water services and - to improve water conditions and to protect the ecological stability of the landscape. Defines the necessity of spatial sources regulation by CAP, support greening along water courses and catchments (F6, W1, W2), improve anti-erosion measures (L1-5), complex measures in landscape for water retention (W3,4,5, W7-10) with respect to land ownership. Points out on the discrepancy between water quality and support of wide-rows crops planting for energy purposes (E1). Also contain summaries of programs of measures to achieve these objectives and set out a strategy for their funding. One of the particular instruments for water retention, defined in the plan, is called “Measure of type A” (Wg) = technical and natural measures for water retention. This instrument supports nearly all objectives of land and water and has a good potential for realization of these measures at least in selected river basins. However, for realization on the whole area of the Labe catchment needs financial and legal support that maybe performed by new financial and subsidies programme **(Wh)** to support water retention in the landscape by strengthening the retention capacity of the soil, construction of new ponds and small water reservoirs, support for the restoration of extinct ponds and the restoration of wetlands (W3-W7). One of the targets is to increase wetlands area and retention dams on agriculture land by private investments and specific financial support and increase the area of state land property (L7).

Concept of the solution of flood protection in the Czech Republic using both technical and nature measures (**Wb**) sets out ways how to implement preventive flood control measures after 2013, including optimization procedures for individual measures. The system of flood protection measures also includes landscape measures as well as the new requirements of European legislation.

The conception sets up the objectives what are necessary measures in terms of flood protection, deals with all food/agriculture, land and water objectives; however, does not have any tools for realization. So the measures stay on paper. And unfortunately there is no particular interaction between drought and flood mitigation that should be solved together under common denominator of landscape water retention.

It is supposed, one of the main instruments for the issues of water should be Water conception (**Wc**) and Water act (**Wd)**. The long-terms goals in water conception may indirectly influence the objectives W3-8 and F6. It defines that: Restrictions and inadequate enforcement of changes in farmland management in catchment areas to enhance rainfall retention, slowing down of runoff, and soil erosion. Generally, the conception does not have an impact on water retention. Similarly influence on water retention maybe attributed to Water act (**Wd**). The act is aimed at drinking water, water supply and consumption, infrastructure, water management services and flood protection, water in watercourses and flood management plans, fines for water pollution. There is no interaction with land, agriculture and surprisingly with most of the water objectives. The only water retention note is: Landowners are obliged, unless otherwise provided by special legal regulation, to provide such management so as not to worsen the water conditions. In particular, they are required to ensure that the drainage conditions are not deteriorating, the soil is not discharged by erosive water activities and the improvement of the retention capacity of the landscape. However, there should be an amendment that is targeted on drought mitigation and protection measures (W12).

Plans of water resources protection in Europe (**We**) are based on water retention measures, flood and drought protection is based on green infrastructure (as part of 1. pillar of CAP, areas of ecological interest). Create more detailed plans of water resources protection, including the concept of wetland restoration and revitalization of watercourses. Key instrument for water retention in landscape are fishponds and green infrastructure. The pressure from agriculture and flood protection can be mitigated or prevented altogether. It is possible to use methods such as the creation of buffer strips (W1, 2, 4-6, L1) that bring biological continuity between the rivers and their shores, and the use of green infrastructure whenever possible, for example, rehabilitation of wetlands and floodplains to retain water (F2, F4-6), promote biodiversity and heterogeneous landscape structure (L10) and fertility soil and prevent floods and droughts (W12).

The concept for drought and water scarcity (**Wf**) should be a key instrument related to all objectives. The drought mitigation should be supported by sustainable agriculture, which will enhance its non-production functions (F2, F5-6). The instrument should be related to all land/soil and water objectives. Drought mitigation is directly related to water retention and therefore on soil quality, landscape structure. There is a need of support rather technical water retention measures than only landscape structure adaptation; the efficient measures are a mosaic of technical and biological (e.g. greening, crops ecological niche respect...) measures. From the point of complex solution, it is use of technical and semi-technical measures in the area of the river basin (e.g. decentralized rainfall in the site of impact) and organizational and ecosystem measures (e.g. restoration of landscape features, revitalization and renaturation of watercourses and floodplain forests, spring areas and other wetlands).

To conclude – water instrument has rather low impact on all objectives related to water retention issue. The problem is the water is considered as a liquid component in watercourses. The existing instruments does not solve the water retention problems from the landscape/catchment point of view. The only exception is National plan of Labe catchment (Wa) that as the only one defines the problems needed to be solved comprehensively, including the problems resulting from agriculture activities and poor soil quality. The landscape instruments seem to be theoretically more effective.

Climate instruments

Climate instruments are based on the classical ones, usually considered as effective tools for climate change mitigation and adaptation and thus is emission trading (Ca) and reduction of greenhouse gasses emission (Cb). Emissions trading is considered as significant tool for greenhouse gasses reduction and thus climate change mitigation and GHGS are considered as the main factor responsible for climate change. For this reason, the direct influence of vegetation and the retention of water in the landscape on the climate is neglected, not preferred, no in the centre of interest and there is no impact on any objective except C3. The priorities are in GHGS reduction and not in sustainable landscape management that significantly mitigate the climate change.
Carbon sequestration and nitrogen retention are the other climate instruments (Cc) indirectly mitigating climate change mainly through land/soil objectives. Carbon accumulates in wetland soils, less in permanent grassland, forests. In wetland soils, carbon accumulates and thus reduces its content in the atmosphere. By draining the wetlands, by inducing mineralization, carbon dioxide is released into the atmosphere after oxidation (mineralization, decomposition) of organic matter. Similarly, the destruction of the meadows leads to rapid mineralization of organic matter and the release of carbon dioxide into the atmosphere (and the release of nutrients into soil and surface water). For that reason, there is an interest in following objectives as F6, W5,6 (protection of floodplains against intensive farming), support of greening and buffer strips (F2, W1,2), increase of soil organics (L2) and water content (L3, W3). In addition, the agri-environmental climate measures are based mainly on carbon sequestration and nitrogen retention (mainly by grassland development – F2, W1, W2).

Overall assessment

From the analysis follows that there are number of instruments with different efficiency that affect the retention of water in the landscape. Often they can well name the problem, suggest what should be done, but their effect is practically zero. The issue of water retention requires a comprehensive solution that would require a coherent concept of water, forest and farming, a unified approach of all participating ministries, subjects and stakeholders. However, this is one of the main obstacles, as well as the unclear setting of fines and corrective measures, a weak mandate for institutions to remedy. Also, the rules for soil management are set very tolerantly, without any significant penalty for the subject that conditions deteriorate. Last but not least, there are personal interests of political subjects that are economically involved mainly in the production of biofuels and related activities (e.g. the chemical industry). In principle, they do not want to address the situation in the landscape, even if the possibility of implementing more effective measures is offered.
The instrument has usually positive impact on the objectives – in theoretical level. In practice the real influence and practical impact is often very low – see the reasons mentioned above. If the practical and real impact was assessed, the scoring in most cases would be zero. The positive points many instruments gained by the scoring 0/+1 – meaning the instruments may have a potential positive effect on the objective (Fi, Fj, Fk, Lc, Ld). The instruments with most positive interactions and impact on water retention issues are: Eb, Ec, Fd, Wa, Wb, Lb, Le – where the common topic is greening and

Wh which is directly aimed at water retention and drought mitigation. Unfortunately, this instrument is currently under construction. On the opposite site are the instruments aimed at biofuels production – Ea, system of direct payments (Fb), and tangible assets investments (Fh) that directly worsen soil quality or conserve the current state of the landscape. Without any significant effect are: statutory management requirements (Fb), low impact has water policy conception (Wc) and water act (Wd), as well as climate instruments based on greenhouse gasses politics (Ca, Cb, Cc).

The instruments aimed at water retention have a low effect on the objectives: E1, F1 – biofuels production, F3 – soil blocks evidence, L7, L8 – land ownership, L12 - ecosystem services, W9, W10 – land consolidation and ownership objectives, C3-greenhouse gasses reduction. Climate change mitigation and adaptation measures (C1, C2) are not specific, are general and in the name of climate change fight may be influenced by nearly all instruments.

3 Assess vertical interactions between policies

In the sub-chapter Assessment of vertical interactions between policies with report:

• the **summary table** of vertical interactions (template above), including **description** of to what extend and why higher level policies are transposed and implemented at lower level and to what extend and why lower level policies are supported or hampered by higher level policies

• the **description** of how vertical interactions may hamper or support the achievement of the nexus critical objectives.

Table 5. The assessment of vertical interactions between policies

HIGHER >LOWER	
Higher level policies **successfully** implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
CLIMATE/ENERGY	
Directive 2009/28/ EC on the promotion of the use of energy from renewable sources	Objectives: increase biofuels production, support agriculture biomass as renewable resource, partly supports non-productive functions of agriculture The Support of Renewable Energy Sources Act no. 165/ 2012 Co. In accordance with the EU ambitious commitment to use 20 % of renewable energy by 2020 (the overall EU target). The National Renewable Energy Action Plan of the Czech Republic was developed on the basis of. The article 4 of this Directive mandates the Member States of the European Union to draw up and adopt a National Renewable Energy Action Plan (Renewable Energy Action Plan). Pursuant to the Directive, the national target for the Czech Republic of renewable energy in 2020 was set on 13,5 % (in 2005 this was 6.1%). To achieve the goal there is an abrupt increase of biofuel production, mainly maize and rape.
The United Nations Framework Convention on Climate change Kyoto Protocol Paris Agreement	UNFCCC: ratification on 7. October 1993 (80/2005 Statement of the Ministry of Foreigner Affairs) Kyoto protocol: Government decision no. 669/1998 (reduction of greenhouse gasses emission by 8 % in 2008 – 2012 compared to the based year 1990 and by 20 % till 2020. Paris agreement signed on 4 November 2017 Reporting as: National communication of the Czech Republic Objectives: Climate change mitigation and adaptation strategy with measures for different sectors are involved in: Government decision no. 34/20017 Implementation of adaptation strategy Government decision no. 861/2015 Strategy for climate change adaptation in the Czech Republic Government decision no. 207/2017 Climate protection politics
Regulation (EU) No 525/2013 of the European Parliament and of the Council on a mechanism for monitoring and reporting greenhouse gas emissions and	Objectives: climate change mitigation, adaptation, reduction of greenhouse gasses Government decision no. 34/20017 Implementation of

for reporting other information at national and Union level relevant to climate change	adaptation strategy Government decision no. 861/2015 Strategy for climate change adaptation in the Czech Republic Government decision no. 207/2017 Climate protection politics
EU strategy on adaptation to climate change (COM(2013)216)	Objectives: climate change mitigation, adaptation, reduction of greenhouse gasses The development and implementation of adaptation plans and measures is an integral part of the UN Framework Convention on Climate Change commitments Government decision no. 34/20017 Implementation of adaptation strategy Government decision no. 861/2015 Strategy for climate change adaptation in the Czech Republic Government decision no. 207/2017 Climate protection policy
Energy efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy	Objectives: climate change mitigation, adaptation, reduction of greenhouse gasses Energy Management Act. No 406 / 2000 Co., as amended Greenhouse gasses reduction by 40 % till 2030, compared to 1990
(EU ETS) directive 2009/29/ES on greenhouse gas emission allowance trading scheme of the Community	Objectives: climate change mitigation, adaptation, reduction of greenhouse gasses Act no. 383/2012 Coll. on the conditions for trading in greenhouse gas emission allowances; Climate change mitigation through emissions trading
FOOD/AGRICULTURE	
Common agriculture policy Regulation No 1307/2013 of the European Parliament and of the Council, establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy Regulation No 1305/2013 of the European Parliament and of the Council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) Regulation (EU) No 1306/2013 of the European Parliament and of the Council on the financing, management and monitoring of the common agricultural policy	Objectives: support of non-production functions of agriculture, AECM, favourable climate procedures, greening, size of soil blocks, arable land management No.50/2015 and its Amendment No.61/2016 on laying down certain conditions for granting direct payments to farmers No.252/1997 Coll. on agriculture

Proposal for a Regulation of the EU Parliament and of the Council establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy	Primarily promising greening as a condition for direct payments; Greening is mandatory for all farmers, but with exceptions (using non-production measures of greening like new landscape structures, grassing,…) the conditions are set so that the effect is close to zero. Reason is following: as greening measures are often reported already used management practices (mowing grassland, planting specialized crops = production greening variant) that do not require substantial changes in landscape management. Successful implementation without effect.
GAEC 4 (ensuring minimum land cover) GAEC 5 measures for erosion by introducing and requiring protection of soil from wind erosion) GAEC 6 (preservation of the content of organic matter)	Mandatory for all farmers – successful implementation because of very indulgent conditions GAEC 4 – 6 are not implemented in the Czech legislation – maybe in coming amendment of Soil protection act
WATER	
2000/60/EC Water framework directive	The Water Act no. 254/2001 Co. The implementation of the Framework Directive also requires international cooperation in order to meet its requirements for a common approach to the protection of international river basin districts, such the Labe. International cooperation is ensured by international commission which coordinates inter-state cooperation on the protection of waters.
Directive 2007/60/EC on the assessment and management of flood risk	The water Act No 254/ 2001 Co. art. 63 – 87 (Flood Protection) Objectives: water retention (technical measures)
Higher level policies **only partly** implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
Land/Soil	
Proposal for a Directive establishing a framework for the protection of soil and amending Directive 2004/35 / EC	Act of the Czech National Council no. 334/1992 Coll., on agriculture land fund protection Waiting for new soil directive Objectives: agriculture soil protection, its quality improvement??
European Landscape Protection Convention	Objectives: sustainable landscape management Good implementation in the Czech Forest Act (no. 289/1995 Coll.) and The Nature Protection Act No 114 / 1992 Co. as amended. The Agricultural Land Protection Act No.334/ 1992 Co. as amended is weak in implementation and did not stop the decrease of agricultural land in CR. About six thousand ha of agricultural land are taken off the land fund in CR each year. The retention of water in agricultural land is rapidly decreasing – now is only on 60 to 70 % of its potential. Big farmers (about 80 % farms area are above 2000 ha) and too big arable fields are threatened by erosion and suffer from insufficient content of organic matter.

Higher level policies **poorly** implemented at lower scale	
Policy	Description of reason and how NCOs are influenced

LOWER >HIGHER	
Lower level policies **fully supported** by higher level policies	
Policy	Description of reason and how NCOs are influenced
CLIMATE/ENERGY	
Government decision no. 207/2017 Climate protection policy	Climate Protection Policy in the Czech Republic defines the main objectives and measures in the field of climate protection at the national level to ensure the achievement of the goals of reducing greenhouse gas emissions in relation to obligations arising from international agreements (The UN Framework Convention on Climate Change and its Kyoto Protocol, the Paris Agreement and the obligations arising from European Union legislation). This 2030 climate protection strategy, with a view to 2050, should contribute to a long-term transition to a sustainable low-carbon economy in the Czech Republic. Climate policy in the Czech Republic is focused on the period 2017-2030 with a view to 2050.
National biomass action plan 2012 – 2020	Directive 2009/28/ EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources Objectives: Roadmaps how to achieve the goal of 13 % of energy from renewable resources Support of agriculture biomass as renewable resource – mainly rape and maize
National action plan of the Czech Republic for the energy from renewable resources	
WATER	
River Labe basin management plan	2000/60/EC Water framework directive Agreement on the International Commission for the Protection of the Elbe (signed 1990, came into force in 1993) The Water Act no. 254/2001 Co. Water quality objectives
AGRICULTURE/FOOD	
Strategy of Ministry of Agriculture till 2030	Common agriculture policy (mainly 1. Pillar – direct payments) 2000/60/EC Water framework directive (water management) Involve strategy of water management and related issues, in terms of agriculture is aimed at production, not soil quality management
Government order no. 48/2017 Coll. On the establishment of requirements under the acts and standards of good agricultural and environmental condition for the areas of cross compliance rules and the consequences of their breach for the provision of certain agricultural subsidies	Regulations No 1307/2013, No. 1306/2013, no. 1305/2013 of the European Parliament and of the Council Objectives: arable land management practices
Government order no. 49/2017Coll. On	The objectives:

Amending certain Government Orders in connection with the adoption of a Government Order laying down requirements under the acts and standards of good agricultural and environmental condition for the areas of cross compliance rules and the consequences of their violations for the provision of certain agricultural subsidies	Buffer zones along water courses: GAEC 1 and 3(water protection by delimitation of non-fertilized streams along water courses and protection of groundwater against pollution) GAEC 4 (ensuring minimum land cover) GAEC 5 measures for erosion by introducing and requiring protection of soil from wind erosion) GAEC 6 (preservation of the content of organic matter) GAEC 7 – landscape features protection (in 2016 extension of landscape elements by a new one – wetland) – heterogeneous landscape structure
Government order No. 47/2017 on conditions for the implementation of agri-environmental measures	Act no. 252/1997 Coll. on Agriculture, CAP (II. pillar, Rural development programme) Voluntary measures in landscape with support to: Sub-measure 10.1.4. management of permanent grassland Sub-measure 10.1.5. grassing of arable land Sub-measure 10.1.8. grassing of runoff corridors Objectives: support of non-production functions of agriculture, decrease soil erosion, heterogeneous landscape structure, support greening in catchment and along watercourses reduction of concentrated and spatial runoff
Act No. 254/2001 Coll., On Water	GAEC 1 and 3(water protection by delimitation of non-fertilized streams along water courses and protection of groundwater against pollution)
National action plan of climate change adaptation Strategy for climate change adaptation of the Czech Republic	Are based on the implementation and ongoing control of reporting obligations under Article 15 of the European Parliament Regulation and Council 525/2013, which requires EU member states to report on National Adaptation Measures in the interval of 4 years starting on 15 March 2015, will enable the processing of the Czech Republic's Adaptation Report to change climate at a four-year interval starting in 2019.
Concept of flood protection in the Czech Republic using technical and nature-friendly measures	2000/60/EC Water framework directive The Water Act no. 254/2001 Co. Directive 2007/60/EC on the assessment and management of flood risk Objectives: set up importance of GAEC standards, CAP, Cross compliance rules for flood protection
Lower level policies **partly supported** by higher level policies	
Policy	Description of reason and how NCOs are influenced
WATER	
River Labe basin management plan	Missing national legislation for drought mitigation Missing national legislation for support of spatial water retention in landscape – land ownership problems (insufficient state land reserves), financial support (new subsidies), need to establish water as public interest and consider water retention as set of complex measures (need of inter-resort communication)
LAND/SOIL	
Complex land consolidation	Missing national legislation for soil erosion (in preparation;

Act no. 139/2002 Coll. on Land Consolidation and Land Offices	2018 at the earliest, as regulation amending the Act no. 334/1992 Coll., on agriculture land fund protection) Through CLC can be realized Agri-environmental and climate measures, greening, GAEC; Promising support in new CAP after 2020 for gradual decrease of direct payments in favour of husbandry and improving of arable land quality and water sources Need to set up stricter condition for land management – it would incentive more and effective land consolidation actions leading to water retention
Lower level policies **hindered / disrupted** by higher level policies	
Policy	Description of reason and how NCOs are influenced
WATER	
River Labe basin management plan	Support of energy crops (wide-row crops) is against good water quality (Directive 2009/28/ EC on the promotion of the use of energy from renewable sources)

The transboundary case study is aimed at spatial water retention in the landscape; through water retention, permanent vegetation and restoration of small water cycle there is a direct effect on local climate and thus on climate change mitigation and adaptation measures.

The assessment of vertical interaction between policies is based on the interviews with stakeholders and policy experts; the information is also derived from the strategy documents of the Ministries of Environment and Agriculture. However, this information cannot be considered sufficient. Such a detailed and comprehensive analysis would require long term experience in the field of joint action of legislation, its implementation and first of all practice and men´s personal experience. For these reasons it was not possible to get all relevant information needed for the assessment. Basically most of the higher level policies have been sooner or later successfully implemented into lower level. How successful this implementation has been, whether there are any real contradictions between the effectiveness and efficiency of the policies, is very difficult to answer without the personal knowledge of the policy and practice.

Concerning the Nexus critical objectives analysed in the first section of this document, there is no particular policy support of these objectives. The main sources of the objectives are lower level policies, i.e. the strategy documents of the Ministries of Agriculture and Environment as: Strategy of Ministry of Agriculture till 2030, The conception of water policy of the Ministry of Agriculture till 2015, National action plan of climate change adaptation, Strategy for climate change adaptation of the Czech Republic, National action plan of the Czech Republic for the energy from renewable resources, National biomass action plan 2012 – 2020.

Essentially there are no lower level policies hindered / disrupted by higher level policies. Despite implementation of many EU policies enable the national modification and integration of tailored measures that can be integrated into legislation in order to make the legislation more effective and enforceable, in many cases the Czech Republic prefers the unified and general EU model. Therefore, on the basis of the known facts, there are no substantial discrepancies and therefore many higher level policies have been successfully implemented into national level. According to personal communication with an expert from the Ministry of Environment, the implementation of policies (mainly water) remains the same for all levels national – regional – local, without any significant amendments. The problem is often not in vertical interactions, however in horizontal. E.g. there are inter-resort discrepancies in water policy caused by different attitudes of the Ministry of Agriculture (which is in charge water policy) that prefers the technological water concept (i.e. measures targeted on adaptation of river/streambeds – deepening, flood protective barriers, construction of new water reservoirs from small ones to big dams, irrigation systems; “preference of concrete lobby”) and

Ministry of Environment preferring natural water retention measures (renaturation of riverbeds, natural flooding, respecting natural floodplains, restoration of floodplains, etc..).

Energy and climate

Policy for climate protection consists primarily in reduction of greenhouse gasses emission. This implies that the implementation of emission reduction commitments affects, in principle, all actors and interferes with all major sectors of national economies. The EU climate mitigation policies such as: introduction of carbon tax, effective implementation of EU ETS after 2020, setting up investment priorities in accordance with EU ETS after 2020, compensation scheme of indirect costs of EU ETS, act on the reduction of fossil fuels dependence, low carbon economy[3] etc. are taken into consideration at national level. Their implementation is realized mainly through decreasing greenhouse gasses emission and emission trading. The development and implementation of adaptation plans and strategies in the Czech Republic is an integral part of the UN Framework Convention on Climate Change commitments, as Government decision no. 34/2017 Implementation of adaptation strategy[4], Government decision no. 861/2015 Strategy for climate change adaptation in the Czech Republic, Government decision no. 207/2017 Climate protection policy (prevention to climate change based on decrease of greenhouse gasses production). This policy can be implemented, because of relatively easy quantification of CO_2 emissions and economic indicators that are related to low carbon economy. The measures for GHGs can be realized through new technologies development, EU ETS system is a good business; however, their impact on climate change mitigation is very low. The reason is an indirect effect of greenhouse gasses on climate (Pokorný et al. 2016).
The implementation of the Directive 2009/28/ EC on the promotion of the use of energy from renewable sources occurs through the act no. 165/ 2012 Co. on the support of renewable energy sources. The directive creates provisions regulating the content and creation of the National Action Plan. The national action plan sets the national binding target for the Czech Republic (13,5 %) and creating the conditions for its fulfillment, the maintenance of bioliquids and laying down the conditions for issuing guarantees of origin and certificates of origin of electricity from renewable and secondary sources and high- electricity and heat generation. These policies support the objectives of increasing biofuels production and support of agriculture biomass as renewable resource, partly non-production functions of agriculture.

Agriculture/food

In the field of agriculture, vertical interaction mainly applies to the implementation of the Common Agriculture Policy. The transposition of the CAP into the Czech national legislation occurs through several government orders, including government order no. 47/2017, 48/2017, 49/2017 concerning direct payments, cross compliance, GAEC standards, and agri-environmental measures. The first pillar of the CAP and its direct payments are successfully implemented in the national legislation (see more details in Strategy of Ministry of Agriculture till 2030).
A special chapter in the system of direct payments is called Greening. It is a policy that at its inception has the potential of greening the landscape, thanks to specific objectives aiming to improve soil quality, water retention, and reduce erosion. The three greening measures include: (a) crop

[3] According to the Plan for moving to a competitive low-carbon economy in the EU by 2050, emissions in this sector should gradually decline by as much as 80% by mid-century
[4] Page no. 6 of this document: „The Adaptation Strategy aims to mitigate the impacts of climate change by adapting to this change in greatest possible extent, maintaining good welfare and preserving and potentially improving economic potential for future generations".

diversification; (b) maintenance of permanent grassland (c) conservation of 5% or arable land as ecological focus areas (EFA).
However, as result of the implementation of these obligations in 2015 73% of all EFAs in Czech Republic consisted of nitrogen-binding crops, inter-crops and cover crops - EFA's production variants. Of the non-productive options, the most popular, namely fallow land regime, was applied to only one fifth of the EFA areas. There has also been no increase in the share of permanent grassland, as the greening condition meets the mere mowing of existing grassland areas. Diversification of crops is also used at a minimum. In general, the greater potential to fulfill the original meaning of EFA surfaces lays in the non-productive variants of the available options, such as headlands, protective belts (in sufficient width), and landscape features. However, these measures have been implemented only to a little extent. There is no interest actively change landscape structure by new landscape features. Implementation of greening measures is mandatory for all farmers that receive EU CAP subsidies, but with exceptions (like grassing and other non-productive measures) the conditions are set so that the effect is close to zero. As greening measures are often reported already used management practices (mowing grassland, planting specialized crops = production greening variant) that do not contribute to the increasing of soil quality and improving water regime. A very simple check of the failed implementation of the greening measures is a visit to the agricultural landscape, where one could see that nothing has changed since the adoption of this measure in 2015. For successful greening one can recommend realization mainly its non-production variants.

The good agriculture and environmental conditions rules in the CAP have had effects similar to the greening measures. The national legislation has implemented standards GAEC 1 and 3 (water protection by delimitation of non-fertilized buffer zones along water courses and protection of groundwater against pollution). The obligation to prevent the penetration of fertilizers into water follows directly from Section 39 (1) of Act No. 254/2001 Coll., On Water. The terms of the standard apply to all parts of soil blocks adjacent to surface water bodies (i.e. those outside the nitrate vulnerable areas). The GAEC 3 standard contains the requirements laid down in Sections 38 and 39 of the Water Act to protect surface and groundwater and the environment when handling, storing and discharging contaminants. Anyone who treats harmful substances is obliged to take reasonable measures to prevent these substances from entering into surface or groundwater.
While GAEC 1 and 3 have a support in the Water Act, the other standards GAEC 4, 5 and 6 are not implemented in the Czech legislation. The cause is voluntary implementation of GAEC standards into national legislation. The only remark is in the act no. 334/1992 Coll. On soil land fund protection, where is indefinite and general principles of protection of agricultural land.
The GAEC 7 standard provides for measures that will contribute to the preservation of specified landscape features and is supported by the government order No. 307/2014 Coll., laying down the details of land use records according to user relations.
Due to the not very strict conditions of these measures (the member states where allowed to choose the stringency level of the GAEC), we can say there has been successful transposition of the EU regulation into the national legislation, and implementation but again with no effect on improving the state of the agricultural landscape.

Agri-environmental and climate measures are involved into the II Second Pillar of Common agriculture policy as a part of Rural development program. The objective of the measure is to promote agricultural land use, which is in line with the protection and improvement of the environment, landscape and its characteristics. These measures are voluntary, so the success rate of its implementation is dependent on the administrative load of the applicants for the subsidies. Water retention measures can be supported by the sub-measures 10.1.4. management of permanent grassland; 10.1.5. grassing of arable land and 10.1.8. grassing of runoff corridors with the intendent support for the objectives: support of non-production functions of agriculture, decrease soil erosion, heterogeneous landscape structure, support greening in catchment and along watercourses reduction of concentrated and spatial runoff. The sub-measure is implemented in the form of five-year commitments. By entering the commitment, the applicant undertakes to manage the entire duration of the obligation in accordance with the terms of the sub-measure or title on the entire area of agricultural land entered into the commitment and in accordance with the cross-compliance conditions and other conditions established by the applicable European and national legislation. This policy is successfully implemented, but its effectiveness in promoting good landscape status is very low because only few farmers have chosen to adopt these measures due to the heavy bureaucracy involved in the procedure to obtaining the EU funds and low awareness of farmers that landscape structure changes may improve water regime and soil quality.

Strategy of Ministry of Agriculture till 2030 is aimed mainly at agriculture production, however does not mention soil quality that is essential for ensuring sustainable production. As water policy is fully in charge of Ministry of Agriculture, therefore the strategy involves also strategy for water management. The water management strategy of the Ministry of Agriculture follows the vision "Creating conditions for sustainable management of the limited water resources of the Czech Republic in order to harmonize the requirements for use of water resources with the requirements of water protection and at the same time to implement measures to reduce the harmful effects of water caused by hydrological extremes as floods and drought".
National River Basin Management Plans and flood risk management plans that have been prepared in accordance with the requirements of European Parliament and Council Directive 2007/60 / EC on the assessment and management of flood risks and Directive 2000/60 / EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policies are the main concepts of water management valid for the period 2016-2021. With ongoing climate change, there are also strategic documents, influencing water management strategy, dealing with drought. The materials for management of areas protected for the accumulation of surface water were processed in connection with the prospective of construction new water reservoirs. In 2017, in cooperation with the Ministry of the Environment, a proposal for the Concept of the Prevention of Drought Impacts for the Czech Republic was elaborated and submitted to the Czech Government; the material was approved as Government order no. 620 of July 2015, which the Government approved the material "Preparing the Implementation of Measures to Mitigate the Negative Impact of Drought and water scarcity "presented by the ministers for agriculture and the environment as an outcome of the Inter-ministerial Water-Drought Commission. The landscape water management is supported by the long-term Flood Prevention Program that continues in the period 2014-2019 already in the third stage aimed at increasing water retention in the landscape and water retention in river basins. Another program running in the years 2016-2021 is “Support of water retention in the landscape in ponds and water reservoirs”, which should serve in particular to improve the retention and accumulation capacity of ponds and water works. The Ministry of agriculture also supports the maintenance of neglected riverbeds of small watercourses, banks, and small water reservoirs. Management of watercourses and reservoirs should be realized with an emphasis on improving the hydromorphological and ecological status of watercourses in accordance with the Water Framework Directive and River Basin Management Plans. The water management part of the Strategy also pays attention to the soil erosion as a serious problem of agricultural land. Conditions for the occurrence of water erosion are specific in the Czech Republic - considering it has the largest size of soil blocks within the EU. In addition, the intensification of agricultural production in the past has led to a degradation of hydrographic and landscape features (ploughing the balks, grassed valleys, field roads, scattered greenery, etc.) that would effectively prevent accelerated erosion. Similarly, erosion is also increased in forest stands as a result of the use of heavy techniques. The main manifestation of water erosion is the loss of the humus/organic soil layer and the clogging of water streams and reservoirs, causing a reduction in the flow of river beds and reservoir accumulation spaces. Limiting erosion is necessary not only to increase the protection of water resources but also to maintain a favorable structure and composition of agricultural land. Despite the fact the Ministry in the Strategy presents that in view of the development of climate change and the economic situation, it is necessary to pay particular attention following areas:

• Supporting the natural retention ability of the landscape,
• a strategy for limiting the consequences of drought and designing appropriate adaptation measures,

the Nexus objectives related to the spatial water retention in the landscape are completely neglected. The attention is paid only to the support of construction new water reservoirs, riverbeds restoration, support of irrigation systems. The complex measures for water retention are neglected, the only action is statement of problems with water retention and erosion and “on paper” support natural retention measures. The Ministry of agriculture does not have an interest in conceptual solution of water retention that does not require the simple measures as water retention in reservoirs, however needs the complete changes in agriculture soil management.
Concerning the decrease of area of soil blocks, the Strategy states that there is a need to tighten the conditions for providing direct payments on the basis of GAEC and to consistently apply the cross-compliance rules, including limiting of maximal soil blocks area. The requirement for a reduction in the size of soil blocks, which is an important measure in terms of spatial retention of water in the landscape, is in fundamental contradiction with the prevailing business structure of Czech agriculture. The existence of “landholding concentration” allows companies to benefit from the size and it is not realistic that farming entrepreneurs want to give it up since it enables them to compete on the European market in the field of crop production. Under these conditions, the topic of water retention is completely blocked. If large soil blocks are not divided, the improvement of retention capacity of the landscape cannot be expected.

Water

From the water´s objectives point of view, the main policy document is considered The Water Framework Directive (2000/60 / EC) of the European Union of 23 October 2000, which is the most significant and, to date, the most comprehensive legislation on water. The Directive is one of the most complex directives developed by the European Commission that covers the entire area of the environment. Fulfilling the tasks and objectives of the Water Framework Directive is not only a matter for water managers and conservationists, but agriculture, industry, forestry, land-use planning and other fields also play a crucial role in the implementation of the Water Framework Directive. The implementation of the Water Framework Directive does not mean simply applying new technical standards, but the need to introduce a completely new system of water and water management based on the river basins, regardless of existing administrative or (nationally) international boundaries. This requires close international cooperation in international river basins, which was launched in the Czech Republic at the end of last century within the framework of the international commissions for the protection of the Labe, the Danube and the Odra, which consistently incorporated the principles and tasks set out in the Water Framework Directive into their work. The reason for this is to unify the different ways of protecting existing waters within the Community and to promote integrated environmental management. At present, the Water Framework Directive is complemented by several daughter directives and linked to the Flood Risk Management Directive (2007/60 / EC). The Water Framework Directive takes a broad view of water management and its main objective is to prevent any deterioration in the status of water bodies and to protect and improve the status of aquatic ecosystems and adjacent wetlands. It focuses on promoting sustainable water use and will help mitigate the consequences of floods and droughts.
The Water Framework Directive covers all water bodies - inland surface waters, groundwater, coastal and coastal waters. Europe-wide introduces the principle of integrated approach for issues related to water quality and quantity and surface water and groundwater issues and for water management, the Directive introduces a river basin management principle - this principle has been introduced in the Czech Republic since the 1960s. Water is therefore considered to be a coherent unit. The primary objective of this policy is to achieve the "good status" of all waters by 2015. This is precisely defined by the Water Framework Directive.

On the other hand, the directive more or less concerns only "liquid water in stream beds" and its quality. In terms of the Czech Republic, it is implemented in the form of Act No. 254/2001 Coll., On Water, which also includes flood issues, with prepared amendments including drought issues. It does not solve the surface retention of water in the landscape, basically it has no impact on critical objectives.

The only document with the potential to take into consideration most of the water objectives, is National management plan of Labe catchment. The territory of the Czech Republic belongs to three international river basin districts where water protection interests are concerned secured through international treaties. This agreement signed, the Czech Republic, the Federal Republic of Germany and the European Union in order to cooperate in the protection of the Labe waters and its catchment areas through the International Commission for the protection of the Labe. The basic legislative regulation for water planning is the provisions of Sections 23 to 26 of the Water Act, in which the requirements resulting from the Water framework directive have been transposed.

National management plan of Labe catchment is probably the only document which mentions (besides others): the problems resulting from agriculture (planting of energy crops) and CAP, high need of measures for spatial water retention, lack of state land in order to improve water regime of landscape, etc. In order to realize all measures needed for spatial water retention, we need to proclaim water as public interest, start to consider water retention as complex measure that needs inter-resort communication and legislation support, especially in agriculture, water, land. The water retention and its quality are objectives disrupted by the policies supporting biomass production for renewable resources. The management plan is complex document and for all these reasons appears as fully, poorly supported, as well as disrupted by higher level policies.

The other document that can influence spatial water retention policy is The conception of water policy of the Ministry of Agriculture till 2015 (new one till 2021 still does not exists). According the official statement of the Ministry in the conception, there was a successful implementation of the Water Framework directive; due to increased incidence of floods as well as drought and the scenario of possible climate change, the adoption of Directive 2007/60 / EC on the assessment and management of flood risks leads to the EC recommendation that the planning process should include adaptation activities. There is no problem in the Czech Republic with this recommendation, as water planning has already been comprehensive in water planning and includes actions on water management and improvement of aquatic ecosystems including proposals for flood control measures and a plan for the development of water supply and sewerage systems. It is clear that this integration of basic water management activities is necessary as these directions are closely related. Similarly, the Czech Republic did not have problems with river basin management in hydrological catchments. At present, the implementation of river basin management plans is progressing and it is clear from the current course that the water protection against pollution from point sources of sewage is particularly successful. From the area of hydromorphology care of the watercourses channel, attention is paid mainly to the renewal of the river continuum by the construction of fish transitions and the revitalization of small watercourses. According to this document the Czech Republic successfully and complexly solve the water issues.

Concept of flood protection in the Czech Republic using technical and nature-friendly measures is in addition to classical water management legislation, based on the Cross Compliance System and GAEC standards, which contribute to addressing soil erosion protection and indirectly to flood prevention. In fact, these measures do not have a major effect on surface water retention. Implementation of the flood protection measure is based mainly on European and national development programs (Rural development program, etc.). This is mainly the support of local technical measures, not a comprehensive concept for surface water retention in the landscape.

Land/soil

The land objectives have a weak support in policy implementation. Despite the fact the Czech Republic ratified the **European landscape protection convention**, Some Czech laws are relatively good in implementation of this convention e.g. The Czech Forest Act or The Nature Protection Act No 114 / 1992 Co. as amended. The biggest problems concern the state of agricultural landscape. The Agricultural Land Protection Act No.334/ 1992 Co. is weak in implementation and did not stop the decrease of agricultural land in CR. About six thousand ha of agricultural land are taken off the land fund in CR each year. The retention of water in agricultural land is rapidly decreasing – now is only on 60 to 70 % of its potential. Big farmers (about 80 % farms area are above 2000 ha) and too big arable fields are threatened by erosion and suffer from insufficiency of organic matter content. The fully implementation of the convention should sustain the development of the landscape, based on balanced harmonious relations between social needs, economic activity, protection and the creation of the environment which can be considered as complex landscape treatment. Such a complex landscape approach is missing in the Czech policy documents.

The aim of the proposed amendment of **Soil Framework Directive** is to create an EU-wide framework for soil protection and the preservation of its ecological, economic, social and cultural functions. To this end, the Directive lays down measures to prevent soil degradation processes, whether occurring naturally or as a result of a variety of human activities. Extensive part of Member States' legislation, like the air and water components of the environment, is subject to EU legislation by this proposal - among other things, preventive measures as a central element of the proposal for a directive, remediation of contaminated areas, elimination and mitigation, rehabilitation of soil functions degraded due to erosion, organic matter loss, compaction, salinisation and landslides. On the basis of the existing soil directive, Member States themselves decide on the severity of the action and lay down adequate sanctions. In case of the Czech Republic the sanctions are near to zero.
With the protection of the agricultural land fund, the protection of soil against erosion, the reduction of the consequences of drought and torrential rains, the issue of **complex land consolidation** (CLC) is related. These adjustments have been underway since 1991, but have been underestimated over the long term. Both financially and conceptually. Implementation of a series of landscape non-production functions that aim at improving the water regime should be implemented through the CLC. E.g. 60% of the spent resources for CLC since 1991[5] went to the construction of roads, only 8% for the implementation of hydrological and ecological measures. CLC needs support in amending missing legislation for soil erosion (in preparation; 2018 at the earliest, as regulation amending the Act no. 334/1992 Coll., on agriculture land fund protection). Through CLC can be realized agri-environmental and climate measures, greening, GAEC; Promising support appear in new CAP after 2020 for gradual decrease of direct payments in favour of husbandry and improving of arable land quality and water sources.

Summary

Water, as a climate-forming medium, is not included in any strategic concepts for climate change, mitigation, or adaptation. At the legislative level, the higher level policies are usually implemented successfully at lower scale. In the field of climate protection, this is mainly the implementation of the United Nations Framework Convention on Climate Change, the Kyoto Protocol, the Paris Agreement and the EU Strategy on Climate Change, which are reflected in national policies and climate protection and climate change mitigation and adaptation measures. Basically, it is a reduction in greenhouse gases, which is relatively easy to quantify, and today, in the name of climate change, a wide range of measures can be implemented in different sectors. These measures are, in principle, very general and unspecified, with the same validity for national and local levels. (I.e. At national level the policy objective is water retention; at local level the objective is the same – only on paper, without

[5] CLC are mainly financed from the State land fund (national budget) and EU budget (EAFRD).

specification how to achieve it and realize it). Climate change is also related to the promotion of renewable energy sources. On the basis of the Directive 2009/28 / EC on the promotion of the use of energy from renewable sources, the Czech Republic has committed to 13.5% of renewable energy sources. This requirement has been successfully implemented from national to local level. To achieve this goal there is a steep increase in biofuel production, mainly maize and rape.
Common agriculture policy can be considered as successfully vertically implemented. We are talking about successful implementation due to a relatively liberal GAEC, cross-compliance, statutory management requirements, which, besides administrative burdens, do not call for changes in farm management and the improvement of the landscape (and water) quality. In particular, the system of single area payment scheme (SAPS) is a strong incentive for Czech entrepreneurs in agriculture to benefit from this size-based subsidy system. This system helps preserve the legacy of the past regime, which are large soil blocks. Similarly, questions about the quality of agricultural land, which could be dealt with by stricter rules, are not consistently addressed at national and local level. The Czech Republic uses the possibility of implementing looser rules that are easy to follow and do not motivate for change. E.g. the problem of soil erosion and related drainage / water retention is not solved for over 50 years and the results are still the same. The Ministry of the Environment and the Ministry of Agriculture are currently preparing a so-called "anti-erosion decree" to amend the Act on the Protection of Agricultural Land Fund, but its adoption is postponed until 2018. The new framework directive on soil protection maybe could help. The measures implemented under the AECM are also voluntary. Water retention in the country needs inter-departmental and comprehensive access to the landscape. Although the Czech Republic has adopted the European Landscape Convention, its implementation into national legislation is only partial. A policy that could conceptually address the issue of surface water retention in the landscape is already existing concept of complex land consolidation. Their more successful and effective implementation is dependent not only on financial support that makes possible realization of specific changes in the landscape, leading, among other things, to improving the water regime, but also on supporting legislation. A CAP reform could help, which consists in redirection of SAPS funds to improve arable land quality and water resources and tightening and streamlining farming rules. This is, however, also a task for the national level.

Water management policy is under the responsibility of the Ministry of Agriculture. It relies primarily on the implementation of the Water Framework Directive and the Flood Directive, which is reflected in the national legislation mainly in the Water and Floods Act. This is primarily about addressing the quality and availability of water, point-source pollution and, in general, " water in water beds". In terms of flood protection, technical measures on watercourses are preferred. Although the fact of poor quality of agricultural land and related problems of insufficient water retention are mentioned in the strategic documents (Strategy of the Ministry of Agriculture until 2030, The concept of water policy of the Ministry of Agriculture until 2015, Concept of flood protection in the Czech Republic using technical and nature-friendly measures, etc.), this issue is never addressed. The only document based on both European and national legislation (Water Act) is the River Labe basin management plan. This comprehensive document is fully supported in the field of water resources management. It identifies the need of surface water retention in the landscape as a set of complex measures implemented in the area of the whole catchment. Also mentions discrepancy with agricultural policy (crop preference erosion, which are also dependent on industrial fertilizers and chemistry - rape); Water management in catchments needs support in new (and still missing) legislation for drought mitigation, erosion mitigation, as well as legislation support for spatial water retention in landscape which will solve land ownership problems (insufficient state land reserves), financial support (new subsidies). So there is a need to establish water as public interest and consider water retention as set of complex measures with a need of inter-resort communication (cooperation between ministries, mainly environment, agriculture) and functional policy framework.

4 Identify formal and informal rules and practices to handle conflicts, negotiate trade-offs and exploit synergies

In the sub-chapter Formal and informal arrangements adopted to address conflicts, negotiate trade-offs and exploit synergies are reported as:

- The summary table of the formal and informal arrangements
- A description of the formal and informal rules and practices
- A description of the enabling and hindering factors.

Table 6. Reporting the formal and informal arrangements in place in the case study

Type of arrangement formal/informal	Description of arrangement	Function of the arrangement (coordination, decision making, knowledge sharing, etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of nexus critical objectives
Formal	Inter-resort commission WATER-DROUGHT Consists from the 15 experts from ministries and research institutions, State land soil fund + 22 members of advisory board (usually from research institutions, universities), Meeting +/- half a year	Preparation of measures to mitigate the negative impacts of drought and water scarcity based on cooperation of Ministry of Agriculture and Ministry of Environment; providing information about drought (maps, methodology of monitoring, scientific knowledge and expertise, etc…) Effort for systematic education of public in terms of water resources and drought In 2016 prepared strategical document Concept for protection against drought consequences for the Czech Republic The document was approved by the Government of the Czech Republic on 28 July 2017, J.Pokorný was member of the team. The document states strategy for monitoring, action and prevention of drought/floods	The commission has been working, because the drought is being hot topic; after adopting the strategic document *Concept for protection against drought consequences for the Czech Republic* and primary scientific drought analysis the activities seems to be slightly declining – no particular subsequent activities leading to suggestion and implementation of concreate measures in order to improve drought	Potential to suggest changes in landscape in order to solve landscape - water-drought issues; however again lack of complex treatment of all objectives related to land – water – climate – agriculture – energy; one cannot expect successful changes leading to improvement of landscape water retention ability The commission has provided extensive research analyses and tools for monitoring; the recommendations should be implemented into policy The strategical document has been in force for 10 months. As other similar documents its implementation goes slowly namely in real measures of drought prevention in landscape. There are principal miss-conceptions on functioning of vegetation, water cycle, water bodies among scientists and

				other experts The document fits with the nexus critical objectives and with the objectives of the transboundary case study (CZ-G-SK): retention of water in landscape, erosion prevention, direct effect of vegetation on local climate and negative feedbacks of cultivation of biofuel crops.
Formal	Office of the Government of the Czech Republic, Department for Sustainable Development Committee on Landscape, Water and Biodiversity 30 members fro m universities, research institutions and ministry	Addressing policy issues of spatial development; elaboration of a long-term integrated inter-departmental cooperation program to improve the landscape water regime and other adaptation measures to climate change; restoring landscape ecological infrastructure; to ensure effective cooperation between the landscape users and managers	No particular impact on water and landscape issues; the recommendations in most cases stay on paper despite the political mandate; the decisions are sometimes implemented into policy documents (the ones convenient for the top politicians)	Potential to suggest changes in landscape in order to improve landscape water regime – however there is no political interest to implement water retention measures
Formal	Technology Platform for Sustainable Water Resources Association of business subjects (14), state enterprises (2), universities (4), research institutions (4), public benefit corporations (4) whose common link is water	Focus on water management (and land) in the landscape with regard to climate change in connection with agricultural and non-agricultural use of the landscape, as well as the reuse and recycling of water in industry, developing systems to support decision-making and monitoring, intelligent technology.	Irregular activities based mainly on excursions, education, workshops, project preparation, etc… No political mandate only formulating visions	Water as a common issue in landscape for subjects with different background – so their comments on water and soil management could be potentially taken into consideration in policy arrangements
Formal	New project of The Technology Agency of the Czech Republic (BETA 2) Preparatory and announcement of	Ministry of Environment Czech Republic formulated a call for pilot project showing practical measures and strategies in drained agriculture landscape towards sustainable Landscape	ENKI actively participates; topics on water retention can be involved	potential to realize other projects on agriculture landscape changes

	the new project System of Landscape Adjustments for Adaptation of the Agricultural (agro-forestry) Landscape to Climate Change in the Period 2030+	adjusted for climate change. The call was opened in May 2018 by Technological Agency of the Czech Republic and research organisation should apply till June 2018. One of the main conditions is ownership of c. 600ha agriculture land on which the measures can be realised. The Actors are: Ministry of Environment, Technological Agency of the Czech Republic, research organisation and land owner which win the tender		
Informal	Regular seminars (since 2015; already 8) on water in landscape and urban areas organized by ENKI and city councils of Třeboň and Dačice	Seminars for regional offices, state administration, schools, business (usually 60 – 110 participants); knowledge sharing	Deep interest of all participants, potential for acquiring and spreading knowledge about water-vegetation-climate; potential to implement the water-vegetation-climate concept on regional decisions	Providing simple and science-based approaches to assess the role of water and vegetation in the climate and the distribution of solar radiation for schools and the state administration; education and potential implementation in practice should start from the ground level
Informal	Associations for rural development act on regional and communal level supported via Ministry of Agriculture from EU funds	The Association joins local municipalities, small land owners, farmers and small entrepreneur living in a given region	There are dozens of Associations of different activities. They organize seminars on agriculture policy, environmental issues etc. Working because of the men´s enthusiasm	In year 2017 three seminars in different regions were organised by the association in which S4N team actively took part and met stakeholders for the March 2018 meeting at Třeboň. The Association provides valuable feedback on real conditions in rural areas for the transboundary case study CZ-G-SK

In the Czech Republic, there are commissions (above mentioned) to deal with climate change, landscape and water management. Both at governmental and informal levels. Almost without exception, however, their activity is only a formal meeting, without results that should be supported from above and should be implemented in practice and policy documents. Outcomes are often case studies that address the issue on a scientific basis, without real implementation, or general draft strategies and conceptual documents that are also not elaborated on the level theory to implementation. These documents lack essential provisions such as: 1) specific proposals for measures; 2) organizational and operational measures; 3) financial and technical support; 4) legislative support; 5) monitoring of the effectiveness of the measures etc. So the decisions and recommendations from the formal subjects stays mainly on paper, sometimes due to the political decisions. The recommendation from the commissions sometimes go against the political interest.

While the informal arrangement usually impels the power to push things to the highest level, they have some impact on local/regional authorities namely through education, communication, rising awareness and suggestions for concreate projects. They work because of the enthusiasm of the involved people. However, the issue of water retention needs the interest and willingness for large changes from the top political structures in order to realize complex measures, inter-resort communication and commissions whose recommendation will be taken into consideration and implemented.

As a summary we can use the following statement from one officer from the Ministry of Environment…"The Ministry of the Environment is still preparing documents for the minister who is always on the road and everywhere he wants to brag about what we do against drought ... but we are doing nothing at the same time. We are a year since the adoption of the Concept for protection against drought consequences, but there is no government and all projects are halted. But I have no idea what to do. And I'm a bit troubled by how difficult it is in this country to get things that a little kid understands"…

The money and time for creating strategies and action plans and other committees are running out of need. The reality is drought and no changes to remedy, the only thing that is subsidized is monitoring, or money is spent for drilling, tanks and water imports. The landscape is drying. The climate models are not able to adequately describe / model the relationship between different land cover types - atmosphere - temperature - evapotranspiration - and rainfall. This is the most important nexus. Because the modelers cannot do it, they are not talking about it, and the main problem is concealed, so there's no solution to it. What we cannot model, this does not exist for many scientists and politicians.

5 Identify success stories and failures

The sub-chapter involves:

- the summary table
- description of the success stories and success factors in the case study area
- description of the failures and failure factors in the case study area

In the Czech Republic, the area of agricultural land is approximately 53%. The main crops grown are cereals, that is, steppe grasses that need drained land for successful cultivation. The intensive drainage of agricultural landscape occurred mainly in the years 1960 - 1989. At that time, floodplains of small watercourses were transformed into arable land as compensation for land occupation for the construction of factories, roads, and extension of urban development. Riverbeds have been deepened and straightened so that water can runoff faster from the landscape. In total 36,000 km (about 40%) of the watercourses were straightened, thus their length was reduced by 1/3. In addition to river beds, peat bogs, springs and small wetlands in the landscape were affected. Estimates are there were severely damaged by 90% of all springs areas. At present, more than 1 million ha of agricultural land drained by pipe drainage (13% of the area of the Czech Republic) is registered. Groundwater level dropped by more than 1 m. 270 000 ha of meadows and pastures, 145 000 ha of balks (800 000 km), 120 000 of field paths, 35 000 ha of groves and 30 000 km of linear vegetation was removed (Vašků 2011). More than 50 % of arable land is under water erosion threat. So these numbers provide a wide field of measures leading to landscape remedy. Despite the complex water retention measures in landscape should be one of the priorities for climate change mitigation, there are not so many actions realized in the landscape in order to support restoration of water regime a heterogeneous agriculture landscape. As a fatal error we can consider that the only official way for climate change mitigation is GHGs reduction. The reason was described in previous paragraph „*The climate models are not able to adequately describe / model the relationship between different land cover types - atmosphere - temperature - evapotranspiration - and rainfall. This is the most important nexus. Because the modellers cannot do it, they are not talking about it, and the main problem is concealed, so there's no solution to it. What we cannot model, this does not exist for many scientists and politicians "*. Just the relationship of landcover – temperature – water plays the main active role in mitigation measures (Ellison et al. 2017).

Some local cases (there are only few in the Czech Republic) are introduced as examples. Their connecting link is an enthusiasm and common sense of the people who have decided to use the experience of the ancestors and restore the landscape. Some of them without any public support and policy implementation, only by on their own.

As an unsuccessful policy arrangement we can consider such action that had been or still are realized, however their impact on landscape water regime is arguable, with zero or negative effect.

Table 7. Reporting success stories

Type of successful policy arrangement	Description	Factors of success, do's
Implementation of agri-ecological and climate measures	Ecoagro- farming aimed at supporting non-agricultural functions of agrarian landscape - Measures aimed at water retention in the landscape	- Private land: Buy or otherwise acquire land and farm on ... I manage on my own ... I do not need to consider the others .... - Get your own machines and related mechanization - Handle "conservative mentality" in village environment - Key factor for success is the

		readiness and professionalism (of all partners and co-workers and the ability to improvise ...) - Use financial support from EU and national sources (Rural development program) - Fully identify with the purpose of the measures - Education, awareness, enthusiasm
Implementation of water framework directive (Natural watercourse is labeled as good ecological status pattern under the Water Framework Directive)	Revitalization of river systems (see explanation below for examples) Using financial support from operational programs (OP), complex land consolidation (OP of the Environment 2007-2013)	- Support from Ministry of environment - Constructions of small scale infrastructure (in comparison with spatial water retention measures)
Reclamation of mining sites (financial support from state budget, mining companies)	Reclamation of coal open-casts mining sites in north-west territory of the Czech Republic; mining sites in Ostravsko etc.	Large financial investments into landscape reclamation as a compensation for landscape damage
Ecological farming Revitalization of river systems Program of land management (Ministry of Environment)	Organic farm Miroslav Šrůtek	Invention, experience, common sense, respect for the ancestral experience of the landscape management
No policy implementation – own effort	Landscape for life – life for landscape Robert Blíženec	Invention, experience, common sense, respect for the ancestral experience of the landscape management

Type of unsuccessful policy arrangement	Description	Factors of failure, dont's
Using financial support from - Revitalization of river systems, Operational program of the Environment 2007 – 2013)	Revitalization of river systems	Better involvement of land owners (through higher awareness made land owner to agree with larger revitalization actions that would touch their land property) would enable larger actions
Program of maintenance of small water courses of Ministry of Agriculture	The aim of the program is to significantly improve the technical state of small watercourses and small water reservoirs that support the drainage of the landscape,	Realized measures have negative effect on landscape water regime – support of increased and fast runoff of water from landscape

	strengthen water retention in the streambeds and increase safety at increased flow rates. Measures will help to improve safe runoff from critical sites and thus increase flood protection in the event of floods.	
Drought mitigation	23 mil. EUR for drought mitigation provided by Ministry of Environment for new water resources (new dwells) from 2018	Strengthening and building new sources of drinking water. The support applies not only to underground but also to surface resources and, quite recently, to the construction of new or reconstruction of non-functioning drinking water supply systems. The problem is steep decrease of groundwater level in the Czech Republic in the last 5 years – so the question is where to take groundwater? The Ministry do not see that the main task is to retain water in landscape in order to supply and refill groundwater – so this arrangement is going to rapidly worsen the drought

Ecoagro- farming aimed at supporting non-agricultural functions of agrarian landscape - Measures aimed at water retention in the landscape

Dr. Petr Marada has been responsible for the revitalization and restoration of the landscape on intensively farmed land mainly in the cadastral territories of Šardice, Nenkovice, Želetice and Hovorany in southern Moravia. Through these projects, he has significantly contributed to increasing biodiversity on large arable land (soil blocks), increasing of landscape heterogeneity, severely reducing water and wind erosion, increasing the ability of the landscape to retain water and mitigate to climate change.

In the above mentioned cadastral territories, he has bought land from his funds and, with the help of the programs of the Ministry of the Environment and the Ministry of Agriculture (Revitalization of river systems, OP of the Environment), he has constructed several wetlands and pools, secured grassing of suitable soils, afforestation of difficult-to-manage land and planting of trees within bio-corridors, biocenters and other interaction elements. In spite of the initial misunderstanding and significant concerns of farmers and other landowners, Petr Marada managed to demonstrate the ability of his interventions to minimize the negative effects of farm management, soil wash out, erosion and local floods during torrential rains, provided shelter and food for wild animals and returned other amphibians and some species, mainly field birds.

By realizing these modifications in the landscape of South Moravia, which is very vulnerable to both water and wind erosion, Petr Marada showed a practical way how to proceed with the restoration of so-called ecosystem functions in the landscape. For his management and related projects, he received the prize Adaptation Measure in 2015 from the hands of the Minister of the Environment in 2015. The elements in the landscape realized by Petr Marada serve as examples of good practice and demonstration projects for students of universities from the whole Czech Republic. Petr Marada has shown the way for farmers, foresters and other landowners how to prevent climate change, retain water in landscape, minimize erosion, increase biodiversity, and make the landscape heterogeneous, attractive and accessible to all rural actors.

He has demonstrated how to use and effectively implement agri-environmental and climate measures; the conditions for success are the ownership of land and means of production (mechanization), to master a new kind of thinking than is that one traditionally used in the villages, a good team of co-workers, the personal identification with realized measures to which raising of public awareness and education are needed. Although this method of restoration of agricultural landscapes is given as a textbook example, the ministries propagate it as an example of a successful adaptation to climate change (but this is a way of prevention), in the Czech Republic, according to the available information, there is no similar example of the implementation of water retention measures on agricultural land in such an extent (28 ha of extensive orchards, 22 hectares of arable land, 6 hectares of wooded land and 14 hectares of new landscape features).

So the positive examples in terms of restoration of the hydrological regime of the landscape consist mainly in the revitalization of river systems and peat bogs.

The program of **revitalization of river systems** was adopted by the Government of the Czech Republic on May 20, 1992 by Resolution No. 373 and is officially formulated as a "program of restoration, stabilization and care of the landscape water regime with the following basic objectives of realization:

- to support and increase the retention capacity of the landscape,
- to slow down surface and underground runoff,
- to increase the infiltration properties and retention capacity of the soil profile,
- accumulate water in ponds, wetlands and small reservoirs,
- Systematically correct the negative consequences of inappropriate land and soil management and large-scale drainage
- to restore the natural functions of watercourses and stream beds,
- to remove inappropriate watercourses adjustments,
- to increase by natural means the resistance of shores and the channels against erosion and their stability during floods,
- by the roughness the watercourses bottom and banks to promote self-cleaning water ability,
- to stabilize water levels, ensure minimum flow rates and conditions for biological recovery

In practice the term revitalization refers to the redevelopment of a technically modified stream or river bed into a near-natural state, or to the construction of a new, nature-friendly channel that will replace the old. The conditions, methods and objectives of the revitalization may vary considerably depending on whether it is a part of watercourse in the open landscape or in the vicinity of the settlement. Intravilan revitalization seeks to improve the ecological status of the watercourse, however while maintaining a flood flow sufficiently, in order to protect the surrounding area. Revitalization in the open landscape should be realized in the way closer to the natural state. They should therefore pursue the following objectives in particular:

- Restoration of the naturally large spatial extent of the watercourse, riverbed and naturally flooded floodplains.
- Creation of a riverbed of natural (morphologically faithful) shapes, naturally shallow, large, and naturally small flow capacities.
- Restoration of natural migratory permeability for aquatic animals
- Creation of conditions for the development of natural shores and accompanying stands. Various restrictive conditions may only allow partial approximation to these objectives.

However, it is important to at least partially achieve significant water and ecological effects such as:

- Restoring the natural development of the riverbed (spontaneous development of meanders, etc.)
- Promoting flooding to floodplains (and thus strengthening flood protection of settlements)
- Restoration of the biodiversity

The projects under the program of revitalization of river systems was primarily targeted on small adjustments of stream/riverbeds e.g. putting small elements into watercourse in order to support meandering and flooding. While the restoration actions in the Europe have developed to the large

projects which have shifted from small scale adjustments into complex revitalization of natural processes of river system (in Denmark – rivers Gels, Torning, Brede, Skjern; Great Britain, Germany, The Netherlands, France etc.), in the Czech Republic the revitalization of smaller streams, which are aimed at restoring natural geomorphology and flow paths, are currently being carried out. In most cases it is only a local scale solution in length of several hundred meters or kilometers. Complex restoration including at least the whole floodplain area are rare because of complicated land owners' relationship of affected areas. In addition, the incentives for landowners (rising awareness of the restoration benefits) to pay more attention to river restoration would enable more complex measures. Complex restoration of streams and peat bogs have been realized in the Šumava National Park since 2013 under the program of restoration of Šumava wetlands and peat bogs. The restoration program was primarily targeted on peat bogs restoration, in 2013 the restoration of streams is accompanied. At present, three watercourses of 5.5 km have been reconstructed and previously drained peat bogs with an area of 610 ha have been restored, representing 62 km of blocked drainage channels. Other example of restoration of larger scale is Revitalization of Stropnice River (in South Bohemia). The river Stropnice was in the 1980s straightened to make space for the construction of Temelín nuclear power plant. Six kilometers of the riverbed was fortified with blocks. It was preceded by complex land consolidation. In 2014, the phase I of the project was completed in a length of revitalization 3.41 km. The new, relatively shallow, morphologically heterogeneous riverbed has no fortifications and communicates with the surrounding floodplain. During the flood, the water can spill into the surrounding floodplain, thus slowing the flood wave. In addition, substantial parts of the catchment and the other areas under the Novohradské Mountains have undergone the significant land cover change in terms of substitution of arable land by permanent grassland and pastures.
Another small actions of restoration have been realized e.g. on Litovice stream (in length of 2,34 km, restoration of floodplain 6,8 ha), Loděnice (1,8 km) Říčanka (1 km) all in the Prague vicinity.

The opposite benefits for restoration of water regime brings **program of small watercourses maintenance** by Ministry of Agriculture. Probably because of the lobby from various interest's groups the program allows inappropriate applications, leading to ineffective deterioration of morphological and ecological status of watercourses. It is the regeneration of the amelioration channels in the fields and meadows by a good act in fighting drought and floods? The actions are based on deepening the drainage channels in fields with subsequent putting of extracted sediments next to the channel. Such sediment treatment is in discrepancy with Water act (ecological status of water course and floodplain, enabling sufficient flow area between the bed and floodplain), landscape protection act (ruderalization of banks and floodplain, damage of important landscape feature of floodplain), waste treatment act (sediment = waste).

Mining sites reclamation
Mining sites reclamation is the only positive example of landscape restoration in large scale in the Czech Republic. State, as well as mining companies spent large amount of money for construction of new landscape after open cast mining of brown coal in the north-west territory of the Czech Republic (Mostecko, Sokolovsko – Nort Bohemain browncoal field), as well as in brown coal mining sites in Ostravsko (north-east territory). Financial support of reclamation is relatively well provided by the Mining Act, according to which the mining company is obliged to pay finance for remediation and reclamation work to the state budget, from which it is subsequently redistributed to selected sanitation and reclamation works. Reclamation is an example of how to rebuild a functional landscape with different uses (water, agriculture, forestry, recreation, ...). Reclamation has taken place since the 1950s. These examples illustrate how the return of water and vegetation to the landscape affects the local climate.
Reclamation means the active restoration and creation of soil and land cover in the area devastated by industrial activity. Reclamation is realized in small parts of a large brown coal basin. Every free hectare must be reclaimed, but in the end the individual parts functionally and structurally should fit in order to respect not only the natural but also the social and economic conditions of the area.

The most important reclamation requirements are as follows:
- the landscape must be ecologically balanced, the most effective stabilizing elements are the planting of forests, parks, forest parks and water areas
- the country must be economically efficient; it must be represented by highly productive forms of agricultural reclamation (demands for fertility of new soils)
- the water is important for the creation of macroclimatic and bioclimatic conditions
- the quality of reclaimed soils is also essential in which bacteria, fungi and other micro-organisms on which the desired cycle of substances and energy are to be represented
- Aesthetic requirement

Local cases

Robert Blíženec is originally a forester who owns nearly 150 hectares in the Novohradské Mountains near Horní Stropnice (South Bohemia), trying to maintain and care for the landscape similarly to the Buquoy - former owners of this estate. He returns the original character to the landscape, with groves, alleys, ponds. Since 1996 he is also engaged in agricultural production (extensive breeding horses and sheep on pastures), however, the goal is not only to maximize profit but to manage farming in harmony with nature and to remedy damage caused by agricultural adjustments in the 1970s. After negative experience with different grants and support from public sources he has started to rely only on its own expertise and sources. His success is based on his own invention, experience, common sense, respect for the ancestral experience of the landscape management.

Miroslav Šrůtek has been farming on farm which he founded in 1992 at a local, agricultural cooperative devastated farm in the village and cadaster of the Benešov (South-east Bohemia). The economy of farm was initially and consciously subordinated to the general principles of nature conservation, especially the restoration and protection of wetland ecosystems. Conversion to organic farming was only a natural part of other projects leading to the restoration of individual landscape features of the open agricultural landscape in the upper part of the river Včelnička. His project "Restoration of a Part of the Cultural Landscape" won the first prize in the national competition "Ecological project in 1993". Individual parts of this project were implemented between 1993 and 1996, primarily with the financial support of the Ministry of the Environment, from the Revitalization of River Systems program and the Landscape management program. Šrůtek's organic farm cultivates 106.23 hectares of agricultural land (31.74 hectares of arable land, 74.49 hectares of meadows and pastures), the farm is located in potato production area and LFA. The farm is currently focused mainly on the production of raw cow's milk in the quality of bio. Milk production is supplemented by growing potatoes to about 1 hectare. During the growing season, it provides services in plant production, mainly hay and straw.

As **unsuccessful policy arrangements** can be considered such measures that go against the improvement of landscape water regime. In most cases, these measures consist of activities attempting to improve the drainage conditions of the landscape based on the notion that it is necessary to quickly divert water to prevent floods and built new water reservoirs to increase water retention. These measures are ineffective in the long-term. Long-term effective solutions are improvement in soil quality and measures to promote natural retention of water in the landscape and soil.

Another unsuccessful policy is the funding of new boreholes for the provision of water in times of droughts. This has led to a drop in groundwater level. The Czech Republic has been exposed to dry periods in the last 5 years, which dramatically reduced groundwater supplies. In addition, this WP 2 report is written under situation when in April and May 2018 completely disappeared precipitation, the rivers have extremely low outflows, there is a threat of crop failure and loss of groundwater from near-surface aquifers. The state has paid no attention to groundwater in the last 30 years, taking them automatically as a non-drying source, as well as have not taken into consideration that drought may be even worse than floods. When soil is not able retain water, the groundwater is not supplied. The state should pay attention mainly how to spatially retain water in landscape and ensure subsequent supplying of groundwater. In case we are not able to secure it, pumping of deep-water appears to be a not-too-reasonable measure to prevent drought; after some time, it can lead to depletion of groundwater and in extreme case to desertification.

6 Validation of the assessment of policy interactions

The results of policy coherence assessment and analysis have been discussed with stakeholders at various cases – personal meetings, conferences, workshops, etc.

The most important source of information was a stakeholders' workshop on 7. – 9. March 2018 in Třeboň (Czech Republic), where the stakeholders from all three states of transboundary study met under a discussion on common topics.

The stakeholders were represented by:

Czech representatives (14 participants)

- representative of Ministry of Environment CZ, municipality offices from Třeboň, entrepreneur (biogas, agriculture, water supply), State water management/Povodí Vltavy, hydrometeorological institute, landscape architect and planner, association of private and municipal forest owners, research: agriculture economy, soil and water conservation, environmental law – cooperating with the Czech Parliament and owners of small agriculture lands managed by large companies.

German representatives (5 participants)

- Federal Institute for Research on Building, Urban Affairs and Spatial Development, Urban Climate, Brandenburg State Authority for the Environment – Water Bodies of Brandenburg, Vattenfall GmbH – Energy

Slovak representatives (6 participants)

- Agency for Regional Development East Slovakia, PEWA - Polymer Research and Application, KREAPROJEKT – Research and Development of systems for environmental monitoring, NGO People and Water, Rain for Climate, Biomasa

Under a broad discussion all three partners of transboundary case study have agreed on following issues concerning the interactions between NCOs, NCIs, interactions between policies and success stories, that have been already deeply analysed in previous sections.

The conclusions are following:

- The Czech Republic, Eastern Germany, and Slovakia experienced a common period of collectivization, causing increased field block areas and large-scale drainage; the ramified hydrological web of the agricultural landscape disappeared.
- To fulfil the EU aim of 20 % of renewable energy sources till 2020, governments in CZ and SK support plant biomass production: rape for biofuel, maize for biogas, wood for wooden chips etc.
- Germany 30% renewable energy now, 40% in 2020 (wind power)
- Consequences for water and energy supply, food supply and local/regional climate. Is it sustainable use of resources?

Czech parallel session

What are the most critical challenges?

- drying out of landscape
- soil degradation

- We do not have specific and tailored legislation for these two topics in order to solve serious environmental problems resulting from drought and soil degradation
- No national landscape politics and conception
- Landscape heterogeneity in terms of property rights
- Conceptions and strategies are under one ministry (no communication between ministries – agriculture and environment)

- Economics interests prevents the changes in landscape structure (large fields blocks, exceptions to CAP cross-compliance and greenings)
- Government is not willing to set up strict conditions for land management (GAEC, greening,..)
- Obtaining the subsidies from the single payments scheme (direct payments) is the main motivation for farmers (no interest in sustainable management because are not the owner of the land; they manage leased land)
- Weak mandate of institutions for sanctions demanding for legislation breach and restoring measures
- Czech national policy on renewable energy is too much based on biomass sources, because of low potential of water, wind, solar and geothermal energy; This cause serious problems in agricultural soil protection

Policy opportunities in CZ and cross-border

- Amendments in national legislation in water and soil management; new legislation – national landscape politics should be prepared (now only discussion within the amendments of Building Act)
- lack of intersectional or coherent policy approach (Nexus problems could reflect better “umbrella” strategy than national sectoral policy, for example “landscape integral planning” as new tool in our legislation policy (not existing, suggestion)
- Define water as public interest which would (maybe) enable easily enforce water retention measures in the landscape (today the public interest is considered e.g. flood protection, construction of roads; in the public interest, in exceptional cases, land may be expropriated; however public interest is not defined in any legal instrument)
- Conceptual and complex consideration/measures of water retention in the whole catchment – especially upper parts (need of inter-ministerial communication) have following impacts:

= tool for drought and flood mitigation (decrease outflow)
= water quality improvement
= increase groundwater level
= Decrease of erosion
= effect on local climate

Policy goals and instruments

- Water retention measures – ecosystem services assessment (farmers should realize better than compensations for drought is prevention = water retention)
- Changes in CAP – revise direct payments, greening system – financial support and subsidies for water retention
- Increase land state property in order to realize water retention technical measures
- Cancel quotas for renewable resources i.e. all production from renewable resources should be the responsibility of Member states (no obligation how much energy should be from renewables)
- Fines and penalties for poor landscape management – need to develop indicators of good landscape management
- Implementation of technical and biological measures for water retention resulting from the Management Plan of Labe River

German parallel session

- Removal of double taxation for electricity being transferred to a pumped-storage facility
- Laws prohibiting decentralisation: Additional VAT-Taxation of private households for generating photovoltaic electricity, Rain water users must install extra water clocks and pay money for usage
- Area consumption of renewables (wind, solar), conflicts with environmental protection, agriculture, and health. + There is a legal prohibition to combine photovoltaics and agriculture.
- How about water retention under energy plantations short rotation coppice, maize, rape,…)
- Photovoltaics have the highest untapped energy potential (20% efficiency, versus 1% photosynthesis)
- Laws fostering biomass usage lead to carbon removal from soils; in Berlin, dead wood is collected from the city forests. Also negative consequences for biodiversity.
- The system of subsidies in agriculture generates a lot of false incentives
- Forest devastation in countries from which wood (low carbon fuel) is imported

Slovak parallel session

What are the most critical challenges?
1. Landscape drainage – lack of water in the landscape
2. Economic interests prevail over the ecosystem services importance
3. Loss of the personal identification and responsibility of local people for landscape management
4. Un-effective motivation tools for landscape management
Policy opportunities in SK and cross-border
1. Implementation of the Concept for landscape revitalization at national level
2. Connection to social policy
3. Ecosystem-based approach for water retention in landscape
4. Promotion of best practices at international level
Policy goals and instruments
1. To change the motivation tools towards effective water retention measures in the landscape through the sectors (agriculture, forestry, industry, households, etc.)
2. To implement new water policy instruments for rain water
3. PR – general public education towards the importance of the ecosystem-based measures in landscape.

One of the most incentive discussion was provided by prof. Tomáš Kvítek (Povodí Vltavy s.p.) whose long term interest are complex land measures aimed at spatial water retention in landscape and water quality improvement. His (and his co-workers team) conclusions on water regime improvement:
- The fundamental structural differences between natural and artificial persons in agriculture are the result of the forced collectivization of Czech agriculture, the consequences of which are manifested to this day. The achieved degree of landholding concentration is quite different from most of the EU member states
- It is stated in the Strategy of the Ministry of Agriculture until 2030 that it will be necessary to bind the granting of direct payments to the condition of the maximum limitation of soil blocks; however, it is not a solution for decrease of erosion and increasing the retention ability of agricultural land. It cannot be expected that entrepreneurs will give up this benefit, as it is a fundamental prerequisite for plant production
- Only under the conditions of the farmer = the landowner, can be, in the long term, satisfied the condition of sustainable soil management and increased water retention
- From direct payments, including also other payments, increase the share of resources intended to improve soil quality and reduce the share of payments to direct production
- Increase farmers' responsibility for implementing measures aimed at mitigating the effects of climate change

- The need to adopt key policy decisions to stimulate complex structural measures in favor of water retention and accumulation in the landscape; financially demanding measures must have support in the state budget; the proposed measures need to be prepared well in advance and can only be tackled at a society-wide level without departmental barriers and unguarded competencies
- Increase state financial support of the complex land consolidation, which has been critically underestimated since 1991. If they are considered as a basic system of state measures in favor of reducing erosion, droughts, torrential rain. An average of 1.4 billion CZK / year is spent (25 mil. EUR), 60% of the measures are for the construction of roads, 8% for the realization of hydrological and ecological measures
- Number of non-production functions, aiming, among other things, to improve the water regime I s realized through complex land consolidation. It is possible to supplement the system, which under the competence of the State land Office provides management, repair, operation of main drainage, irrigation and anti-erosion measures, on the organizational structure, which will develop activities toward more effective complex land consolidation and with state support will implement measures for water retention, minimizing drought and erosion
- It is necessary to change the approach for the retention and accumulation of water on the agriculture land - erosion and associated water drainage and its quality is solved in the Czech Republic for over 50 years with the same results
- The solution cannot be just nature-friendly measures that are unable to solve larger volumes of water from the outflow, it cannot be either by increasing the organic matter in the soil or by changing/diversity the crops. Interconnection of natural and technical measures is necessary
- A promising proposal in the Strategy to reduce SAPSs by using part of the payments and measures in favor of improving the quality of agriculture land and water resources; support for measures aimed at reducing damage caused by climate change
- Payments to LFAs and SAPS, which are linked to GAEC and greening rules, should not be under pressure from different interest groups; other support – AECM and organic farming prefer in terms of sustainable soil and water resources management
- Offer investors ideas on how to participate in projects aimed at water retention in the landscape
- The current water management policy focuses on strategic objectives such as ensuring sufficient drinking water resources of the required quality, the necessary volume of water for irrigation in the areas most at risk of drought, raising minimum flows in rivers, increasing retention and accumulation of water on agriculture land, use of water for recreation, sport and for energy purposes. The fundamental strategic role of water in the above-mentioned contexts would deserve to set up better responsibilities in the over-ministerial setting from the social point of view. Consider and prioritize the importance of the proposed priorities by individual resorts and, on the basis of a political decision, to realize that water as a natural resource similar to land and air are irreplaceable and require a completely different degree of urgency and complexity treatment.

Conclusions

There is a common understanding that the current practice of farming in the cultural landscape leads to its drying out and soil degradation. The lack of water in the landscape has deepened noticeably over the past decades. Only thanks to the infrastructure from the past, i.e. the dams and water distribution system, and to distances over 100 km, most municipalities are provided with sufficient quality water. However, further drying out of the countries will lead to a lack of water and reservoirs as their source of water is a cultural landscape with forests. It is necessary to change the way of farming, respect the empirically proven role of permanent vegetation in the landscape and to dampen the overheating of the landscape. This overheating leads to its drying out by transport and loss of water vapors by overheated air (sensible heat). The direct role of water and vegetation in the local climate and the short water cycle is not the focus of contemporary science, which focuses on the indirect role, i.e. reduction of producing or sequestering greenhouse gases.

An exact description of the processes of solar energy and water distribution on the interface of the different landscape cover - the atmosphere, contemporary science does not hold. There are no reliable models that would be able to describe these phenomena and predict changes caused by changing the landscape coverage. Science cannot describe these processes; therefore, these critical processes of local climate formation are not paid attention. The importance of land cover and its direct effect on surface temperature is supported by thermal images, where forests, wetlands, growing vegetation have a surface temperature of up to 30 ° C, while the built-up area, like harvested fields and lawns, have a surface temperature above 50 ° C. The warm air coming from these hot surfaces drains the landscape by "atmospheric rivers". Thus, more water flows out of the air flow than by the rivers, where we carefully monitor the water balance of the landscape.
And all these facts we should try to respect and implement into policies that are targeting to solve the problem of climate change and water scarcity.

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APPENDIX I – Justification of the scores assigned to interactions among objectives

Energy is affecting food / land / water / climate

Interaction	Score	Justification
E1>F1	+3	Czech Republic can reach 13,5 % energy from renewable resources mainly by biofuels support
E1>F2	+2	One of non-production functions of agriculture may be biomass production for biofuels
E1>F3	0	No particular interaction
E1>F4	-2	Because of negative effects of biofuels production on soil quality is their production counteracting to agri-environmental and climate measures implementation
E1>F5	-2/+2	Because of negative effects of biofuels production on soil quality is their production counteracting to agriculture procedures favourable to climate /biomass production for biofuels contributes to obligation of 13,5 % energy from renewable resources
E1>F6	-2	Negative effects of biomass production in floodplains on water quality
E1>L1	-3	Because of negative effects of biofuels production (maize, rape) on soil quality is their production cancelling the objective of decrease soil erosion
E1>L2	-3	Because of negative effects of biofuels production (maize, rape) on soil quality is their production cancelling the objective of increase of organic content in soils
E1>L3	-3	Because of negative effects of biofuels production (maize, rape) on soil quality is their production cancelling the objective of increasing water capacity
E1>L4	0	No particular interaction
E1>L5	-2	Cultivation of large field blocks of maize and rape by heavy machines and poor farming practices contributes to soil compaction
E1>L6	0	No particular interaction
E1>L7	0	No particular interaction
E1>L8	0	No particular interaction
E1>L9	-2	Planting biomass for biofuels is convenient on large field blocks thus is counteracting to land consolidation
E1>L10	-3	Planting biomass for biofuels is convenient on large field blocks thus is cancelling the support of heterogeneous landscape structure
E1>L11	-2	Planting biomass for biofuels is counteracting to sustainable land management
E1>L12	0	No particular interaction
E1>L13	-3	Planting biomass for biofuels prefers few crops (maize, rape)
E1>W1	-3	Support for maize and rape instead of greening
E1>W2	-3	Maximization of subsidies for energy crops results in soil cultivation in buffer zones of water courses
E1>W3	-3	Maize and crops deteriorate the soil water retention ability
E1>W4	0	No particular interaction
E1>W5	0	No particular interaction
E1>W6	0	No particular interaction
E1>W7	-3	Planting biofuels contributes to increased runoff of surface water
E1>W8	-2	Planting biofuels is counteracting good agriculture and environmental conditions and cross compliance requirements to water infiltration
E1>W9	0	No particular interaction
E1>W10	0	No particular interaction
E1>W11	0	No particular interaction
E1>W12	-3	Planting biofuels directly contributes to deterioration of landscape water regime and thus is responsible for agriculture drought
E1>C1	-3/+3	Negative effects of biofuels production on soil and water regime negatively effects local climate and contributes to climate change / Biofuels production is indivisibly related to climate change mitigation (increase energy from renewable resources)

E1>C2	-3/+3	Negative effects of biofuels production on soil and water regime negatively effects local climate and contributes to climate change / Biofuels production is indivisibly related to climate change adaptation (increase energy from renewable resources)
E1>C3	+1	Biofuels production helps to decrease greenhouse gasses emissions

Food is affecting energy / land / water / climate

Interaction	Score	Justification
F1>E1	+3	Biomass production is indivisibly related to biofuels production
F1>F2	+2	Biomass production for renewable resources is one of non productive functions of agriculture
F1>F3	0	No particular interaction
F1>F4	-1/+1	Biomass production can + / - effect setting up conditions for agri-environmental and climate measures in agriculture
F1>F5	-1/+1	Biomass production can + / - effect setting up conditions for keeping agriculture procedures favourable to climate
F1>F6	-1/+1	Biomass production is sometimes realized in floodplains (crops negative effect, grassland – positive)
F1>L1	-3/+2	Maize and rape as biofuels have negative effect on soil erosion/grassland positive
F1>L2	-3/+2	Maize and rape as biofuels have negative effect on organic content in soil/grassland positive
F1>L3	-3/+2	Decrease soil water capacity/grassland improves
F1>L4	0	No particular interaction
F1>L5	-3	Cultivation of maize and rape on large fields support heavy machines use and thus support soil compaction
F1>L6	0	No particular interaction
F1>L7	0	No particular interaction
F1>L8	0	No particular interaction
F1>L9	-2	Planting biomass for biofuels is convenient on large field blocks thus is counteracting to land consolidation
F1>L10	-3	Planting biomass for biofuels is convenient on large field blocks thus is cancelling support of heterogeneous landscape structure
F1>L11	-2	Planting biomass for biofuels is counteracting to sustainable land management
F1>L12	0	No particular interaction
F1>L13	-3	Planting biomass for biofuels prefers few crops (maize, rape)
F1>W1	-3/+2	Support for maize and rape instead of greening / grassland – water retention
F1>W2	-3/+2	Maximization of subsidies for energy crops results in soil cultivation in buffer zones of water courses/ grassland – water retention
F1>W3	-3/+2	Maize and crops deteriorate the soil water retention ability
F1>W4	0	No particular interaction
F1>W5	0	No particular interaction
F1>W6	0	No particular interaction
F1>W7	-3/+3	Planting biomass (maze/rape) contributes to increased runoff of surface water/grassland decrease runoff
F1>W8	-2/+2	Planting biomass (rape/maize) is counteracting good agriculture and environmental conditions and cross compliance requirements to water infiltration / grassland support infiltration
F1>W9	0	No particular interaction
F1>W10	0	No particular interaction
F1>W11	0	No particular interaction
F1>W12	-3/+2	Planting biomass directly contributes to deterioration of landscape water regime and thus is responsible for agriculture drought / grassland – water retention

F1>C1	-3/+3	Negative effects of biomass production on soil and water regime negatively effects local climate and contributes to climate change / Biomass production is indivisibly related to climate change mitigation (increase energy from renewable resources)
F1>C2	-3/+3	Negative effects of biomass production on soil and water regime negatively effects local climate and contributes to climate change / Biomass production is indivisibly related to climate change adaptation (increase energy from renewable resources)
F1>C3	+1	Biomass production for biofuels may help to decrease greenhouse gasses emissions
F2> E1	-2	Non-productions functions of agriculture (soil protection, water quality, air, cultural landscape management, etc.) are counteracting to biofuels production
F2> F1	-2/+2	Non-productions functions of agriculture are counteracting to biomass (maize, rape) production / reinforcing by grassing
F2> F3	+2	Non-productions functions of agriculture are supported by establishing soil blocks evidence, because it contains information on drainage systems, areas suitable for greening
F2> F4	+2	Non-productions functions of agriculture reinforce setting up conditions of AECM
F2> F5	+2	NPFA reinforce agriculture procedures favourable to climate
F2> F6	+2	NPFA should be targeted to floodplains
F2> L1	+2	NPFA supports antierosion measures
F2> L2	+2	NPFA increase organic matter in soil
F2> L3	+2	NPFA should improve water retention in soil
F2> L4	+2	NPFA reinforce urbanization of agriculture land
F2> L5	+2	NPFA reinforce soil compaction
F2> L6	+1	NPFA should protect agriculture land fund
F2> L7	0	No particular interaction
F2> L8	0	No particular interaction
F2> L9	+1	NPFA should be respected in land consolidation procedures
F2> L10	+2	NPFA create heterogeneous landscape structure
F2> L11	+2	NPFA are tightly connected with sustainable landscape management
F2> L12	+1	NPFA will be supported in case of functional system of ecosystem services evaluation
F2> L13	+2	NPFA support crops diversity
F2> W1	+2	NPFA support greening in catchments
F2> W2	+2	NPFA support buffer zones along water courses
F2> W3	+2	NPFA promote natural retention and water uptake into soil
F2> W4	+2	NPFA support restoration of water regime by adaptation of landscape structure
F2> W5	+1	NPFA enable and support natural retention ability of water courses
F2> W6	+1	Small water reservoirs are considered as NPFA
F2> W7	+2	NPFA like grassing may reduce surface runoff
F2> W8	+2	NPFA are related to GAEC
F2> W9	0	No particular interaction
F2> W10	0	No particular interaction
F2> W11	0	No particular interaction
F2> W12	+2	NPFA reinforce drought mitigation and prevention
F2> C1	+2	NPFA by improving soil characteristics and water regime may help to climate change mitigation
F2> C2	+2	NPFA by improving soil characteristics and water regime may help to climate change adaptation
F2> C3	0	No particular interaction
F3> E1	0	No particular interaction

F3> F1	0	No particular interaction
F3> F2	+1	Soil blocks evidence as support for NPFA in terms of localization of concreate measures related with NPFA
F3> F4	+2	SBE as a control mechanism for AECM implementation
F3> F5	0	No particular interaction
F3> F6	+2	Control mechanism for agriculture practices in floodplains
F3> L1	+1	SBE may provide information about soil erosion in field blocks
F3> L2	+1	Will provide information about soil quality
F3> L3	+1	Information about drainage systems, etc.
F3> L4	0	No particular interaction
F3> L5	0	No particular interaction
F3> L6	0	No particular interaction
F3> L7	0	No particular interaction
F3> L8	0	No particular interaction
F3> L9	+1	Information useful in landscape consolidation
F3> L10	+1	Information useful for heterogeneous landscape structure adaptation
F3> L11	+1	Information useful for landscape management practices
F3> L12	0	No particular interaction
F3> L13	+1	Information about crops in field blocks
F3> W1	+2	Information about areas suitable for greening because of concentrated drainage
F3> W2	+2	Information about buffer zones width
F3> W3	+1	Information where to promote natural retention
F3> W4	+1	Information useful for measures for landscape water regime restoration
F3> W5	0	No particular interaction
F3> W6	0	No particular interaction
F3> W7	+1	Info where to realize measures to slow down runofff
F3> W8	+1	Info about field blocks in terms of GAEC requirements
F3> W9	0	No particular interaction
F3> W10	+1	SBE as an information for landscape planning
F3> W11	0	No particular interaction
F3> W12	+2	Where to implement drought mitigation measures
F3> C1	0	No particular interaction
F3> C2	0	No particular interaction
F3> C3	0	No particular interaction
F4> E1	-2	Should restrict biomass for biofuels planting
F4> F1	-2	Should restrict biomass for biofuels planting
F4> F2	+2	Support for NPFA
F4> F3	0	No particular interaction
F4> F5	+2	AECM should be favourable to climate
F4> F6	+2	AECM should be control mechanism for agriculture activities in floodplains
F4> L1	+3	AECM target
F4> L2	+3	AECM target
F4> L3	+3	AECM target
F4> L4	+3	AECM target
F4> L5	+3	AECM target
F4> L6	+3	AECM target
F4> L7	0	No particular interaction
F4> L8	0	No particular interaction
F4> L9	0	No particular interaction

F4> L10	+1	AECM should support heterogeneous landscape
F4> L11	+2	AECM should be complementary to sustainable landscape management
F4> L12	0	No particular interaction
F4> L13	+3	AECM should support crops diversity
F4> W1	+1	AECM target
F4> W2	+1	AECM target
F4> W3	+1	AECM target
F4> W4	+1	AECM target
F4> W5	+1	AECM target
F4> W6	0	No particular interaction
F4> W7	+1	Set up conditions for runoff mitigation
F4> W8	+1	Set up conditions for water infiltration
F4> W9	0	No particular interaction
F4> W10	0	No particular interaction
F4> W11	0	No particular interaction
F4> W12	+3	Measures should be targeted on drought mitigation
F4> C1	+3	Indivisible part of climate change mitigation strategies
F4> C2	+3	Indivisible part of climate change adaptation strategies
F4> C3	0	No particular interaction
F5> E1	-3/+1	Biofuels production (biomass - maize, rape) does not correspond with sustainable management / biofuels = climate protection
F5> F1	-3/+1	Biomass production - maize, rape does not correspond with sustainable landscape management / biomass as renewable resource = climate protection
F5> F2	+1	Agriculture procedures favourable to climate = support of NPFA
F5> F3	0	No particular interaction
F5> F4	+2	APFC help to set up conditions for AECM
F5> F6	+2	APFC reinforce control of harmful procedures is floodplains
F5> L1	+2	APFC should decrease soil erosion
F5> L2	+2	APFC should increase organic content in soil
F5> L3	+2	APFC should increase soil water capacity
F5> L4	+2	APFC should be prevention against soil sealing
F5> L5	+2	APFC should decrease soil compaction
F5> L6	0	No particular interaction
F5> L7	0	No particular interaction
F5> L8	0	No particular interaction
F5> L9	+1	APFC should be support for land consolidation
F5> L10	+2	APFC should create heterogeneous landscape structure
F5> L11	+1	APFC = sustainable landscape management
F5> L12	0	No particular interaction
F5> L13	+3	APFC = crops diversification
F5> W1	+1	APFC support greening in catchment
F5> W2	+1	APFC should create buffer zones along water courses
F5> W3	+1	APFC should promote natural retention and water uptake into soil
F5> W4	+1	APFC can support restoration of landscape water regime
F5> W5	0	No particular interaction
F5> W6	0	No particular interaction
F5> W7	+1	APFC can help reduce spatial runoff
F5> W8	+1	APFC = GAEC requirements in terms of water infiltration
F5> W9	0	No particular interaction

F5> W10	0	No particular interaction
F5> W11	0	No particular interaction
F5> W12	+3	APFC is indivisible related to drought mitigation
F5> C1	+3	APFC = climate change mitigation
F5> C2	+3	APFC = climate change adaptation
F5> C3	0	No particular interaction
F6> E1	-2	Can restrict planting biomass for biofuels along water courses
F6> F1	-2/+2	Can restrict planting biomass (rape, maize) along water courses / grassing is supported
F6> F2	+1	Support of NPFA in floodplains (grassing)
F6> F3	+1	Will support evidence of agriculture activities in floodplains
F6> F4	0	No particular interaction
F6> F5	+2	Will support APFC in floodplains
F6> L1	+2	Will restrict soil erosion in floodplains
F6> L2	+2	Decrease of intensive farming in floodplains may improve soil organic content
F6> L3	+3	Respect of natural floodplains without intensive farming will contribute to increase of soil water capacity
F6> L4	0	No particular interaction
F6> L5	+2	Decrease of intensive farming in floodplains may improve soil compaction
F6> L6	0	No particular interaction
F6> L7	0	No particular interaction
F6> L8	0	No particular interaction
F6> L9	0	No particular interaction
F6> L10	0	No particular interaction
F6> L11	+1	Will contribute to sustainable landscape management
F6> L12	0	No particular interaction
F6> L13	+1	Can bring new species suitable for floodplains into agriculture
F6> W1	+3	Will support greening in catchment
F6> W2	+3	Is directly related with buffer zones control
F6> W3	+1	Direct relation with natural retention of soils
F6> W4	+2	Direct relation to landscape water regime
F6> W5	+3	Direct relation to increase of natural ability of water courses
F6> W6	0	No particular interaction
F6> W7	+2	Can reduce surface runoff
F6> W8	0	No particular interaction
F6> W9	0	No particular interaction
F6> W10	0	No particular interaction
F6> W11	0	No particular interaction
F6> W12	+2	Can help mitigate drought
F6> C1	0	No particular interaction
F6> C2	0	No particular interaction
F6> C3	0	No particular interaction

Land is affecting energy / food / water / climate

L1> E1	+1	Decrease of soil erosion improves soil quality for energy crops planting
L1> F1	+1	Decrease of soil erosion improves soil quality for energy crops planting
L1> F2	0	No particular interaction
L1> F3	+3	Will support soil blocks evidence containing soil erosion information
L1> F4	0	No particular interaction

SIM4NEXUS

L1> F5	+3	High soil erosion should induce agriculture procedures to stop erosion
L1> F6	0	No particular interaction
L1> L2	+3	Direct relation
L1> L3	+3	Direct relation
L1> L4	0	No particular interaction
L1> L5	+2	Direct relation
L1> L6	0	No particular interaction
L1> L7	0	No particular interaction
L1> L8	0	No particular interaction
L1> L9	0	No particular interaction
L1> L10	0	No particular interaction
L1> L11	0	No particular interaction
L1> L12	0	No particular interaction
L1> L13	0	No particular interaction
L1> W1	+2	Will support greening in catchments
L1> W2	+2	Will support buffer zones along water courses
L1> W3	+2	Direct relation
L1> W4	+3	Direct relation
L1> W5	+1	Direct relation
L1> W6	0	No particular interaction
L1> W7	+1	Direct relation
L1> W8	0	No particular interaction
L1> W9	0	No particular interaction
L1> W10	0	No particular interaction
L1> W11	0	No particular interaction
L1> W12	+3	Direct relation
L1> C1	+1	Will improve soil characteristics thus may help to mitigate climate change
L1> C2	+1	Will improve soil characteristics thus may help to adapt to climate change
L1> C3	0	No particular interaction
L2> E1	+1	Improving soil quality for biomass planting
L2> F1	+1	Improving soil quality for biomass planting
L2> F2	+1	Improving soil quality can support NPFA
L2> F3	0	No particular interaction
L2> F4	0	No particular interaction
L2> F5	0	No particular interaction
L2> F6	0	No particular interaction
L2> L1	+3	Direct relation
L2> L3	+3	Direct relation
L2> L4	0	No particular interaction
L2> L5	+3	Direct relation
L2> L6	0	No particular interaction
L2> L7	0	No particular interaction
L2> L8	0	No particular interaction
L2> L9	0	No particular interaction
L2> L10	0	No particular interaction
L2> L11	0	No particular interaction
L2> L12	0	No particular interaction
L2> L13	0	No particular interaction
L2> W1	0	No particular interaction

L2> W2	0	No particular interaction
L2> W3	+3	Direct relation
L2> W4	+3	Direct relation
L2> W5	0	No particular interaction
L2> W6	0	No particular interaction
L2> W7	+1	Direct relation
L2> W8	0	No particular interaction
L2> W9	0	No particular interaction
L2> W10	0	No particular interaction
L2> W11	0	No particular interaction
L2> W12	+3	Direct relation
L2> C1	+3	More carbon storage in soil – climate change mitigation
L2> C2	+3	More carbon storage in soil – climate change adaptation
L2> C3	0	No particular interaction
L3> E1	+1	Improved soil quality for biomass planting
L3> F1	+1	Improved soil quality for biomass planting
L3> F2	+1	Improving soil quality can support NPFA
L3> F3	0	No particular interaction
L3> F4	0	No particular interaction
L3> F5	0	No particular interaction
L3> F6	0	No particular interaction
L3> L1	+1	Direct relation
L3> L2	+1	Direct relation
L3> L4	0	No particular interaction
L3> L5	+1	Direct relation
L3> L6	0	No particular interaction
L3> L7	0	No particular interaction
L3> L8	0	No particular interaction
L3> L9	0	No particular interaction
L3> L10	0	No particular interaction
L3> L11	0	No particular interaction
L3> L12	0	No particular interaction
L3> L13	0	No particular interaction
L3> W1	0	No particular interaction
L3> W2	0	No particular interaction
L3> W3	+3	Direct relation
L3> W4	+3	Direct relation
L3> W5	+3	Direct relation
L3> W6	0	No particular interaction
L3> W7	+3	Direct relation
L3> W8	0	No particular interaction
L3> W9	0	No particular interaction
L3> W10	0	No particular interaction
L3> W11	0	No particular interaction
L3> W12	+3	Direct relation
L3> C1	+3	Higher water content in soil will help to climate change mitigation
L3> C2	+3	Higher water content in soil will help to climate change adaptation
L3> C3	0	No particular interaction

L4> E1	+1	Preserving of agriculture land fund for farming
L4> F1	+1	Preserving of agriculture land fund for farming
L4> F2	+1	Preserving of agriculture land fund for farming
L4> F3	0	No particular interaction
L4> F4	0	No particular interaction
L4> F5	0	No particular interaction
L4> F6	0	No particular interaction
L4> L1	0	No particular interaction
L4> L2	0	No particular interaction
L4> L3	+3	Direct relation
L4> L5	+3	Direct relation
L4> L6	0	No particular interaction
L4> L7	0	No particular interaction
L4> L8	0	No particular interaction
L4> L9	0	No particular interaction
L4> L10	0	No particular interaction
L4> L11	0	No particular interaction
L4> L12	0	No particular interaction
L4> L13	0	No particular interaction
L4> W1	0	No particular interaction
L4> W2	0	No particular interaction
L4> W3	+3	Direct relation
L4> W4	+3	Direct relation
L4> W5	+3	Direct relation
L4> W6	0	No particular interaction
L4> W7	+3	Direct relation
L4> W8	0	No particular interaction
L4> W9	0	No particular interaction
L4> W10	0	No particular interaction
L4> W11	0	No particular interaction
L4> W12	+3	Restrict occupation of farmland by industrial development will help mitigate drought
L4> C1	+3	Sealed surfaces (concreate etc.) have negative effect on climate, hydrology - restriction of soil sealing will help to mitigate climate change
L4> C2	+3	Restriction of soil sealing = climate change adaptation measure
L4> C3	0	No particular interaction
L5> E1	+1	Improved soil quality for biomass planting
L5> F1	+1	Improved soil quality for biomass planting
L5> F2	+1	Improved soil quality for farming
L5> F3	0	No particular interaction
L5> F4	0	No particular interaction
L5> F5	0	No particular interaction
L5> F6	0	No particular interaction
L5> L1	+1	Direct relation
L5> L2	+2	Direct relation
L5> L3	+3	Direct relation
L5> L4	0	No particular interaction
L5> L6	0	No particular interaction
L5> L7	0	No particular interaction

L5> L8	0	No particular interaction
L5> L9	0	No particular interaction
L5> L10	0	No particular interaction
L5> L11	0	No particular interaction
L5> L12	0	No particular interaction
L5> L13	0	No particular interaction
L5> W1	0	No particular interaction
L5> W2	0	No particular interaction
L5> W3	+3	Direct relation
L5> W4	+3	Direct relation
L5> W5	+3	Direct relation
L5> W6	0	No particular interaction
L5> W7	+3	Direct relation
L5> W8	0	No particular interaction
L5> W9	0	No particular interaction
L5> W10	0	No particular interaction
L5> W11	0	No particular interaction
L5> W12	+3	No particular interaction
L5> C1	+3	Soil compaction worsen soil water retention ability; its decrease = climate change mitigation
L5> C2	+3	Soil compaction worsen soil water retention ability; its decrease = climate change adaptation
L5> C3	0	No particular interaction
L6> E1	+1	Preserving farmland for agriculture
L6> F1	+1	Preserving farmland for agriculture
L6> F2	+1	Preserving farmland for agriculture
L6> F3	0	No particular interaction
L6> F4	0	No particular interaction
L6> F5	0	No particular interaction
L6> F6	0	No particular interaction
L6> L1	0	No particular interaction
L6> L2	0	No particular interaction
L6> L3	0	No particular interaction
L6> L4	+3	Prevent farmland from urbanization activities
L6> L5	+1	Agriculture better than urbanization
L6> L7	+1	conservation of agricultural land for possible repurchases of the state in order to realize water retention measures in landscape
L6> L8	0	No particular interaction
L6> L9	0	No particular interaction
L6> L10	0	No particular interaction
L6> L11	0	No particular interaction
L6> L12	0	No particular interaction
L6> L13	0	No particular interaction
L6> W1	0/+1	The measurements for water retention in landscape should be realized on agriculture land
L6> W2	0/+1	The measurements for water retention in landscape should be realized on agriculture land
L6> W3	0/+1	The measurements for water retention in landscape should be realized on agriculture land
L6> W4	0/+1	The measurements for water retention in landscape should be realized on

		agriculture land
L6> W5	0/+1	The measurements for water retention in landscape should be realized on agriculture land
L6> W6	0/+1	The measurements for water retention in landscape should be realized on agriculture land
L6> W7	0	No particular interaction
L6> W8	0	No particular interaction
L6> W9	0	No particular interaction
L6> W10	0	No particular interaction
L6> W11	0	No particular interaction
L6> W12	0/+1	The measurements for water retention in landscape should be realized on agriculture land
L6> C1	+3	Arable land can has a chance to improve its quality in order to mitigate climate change – sealed surfaces not – they significantly contribute
L6> C2	+3	Arable land can has a chance to improve its quality in order to adapt to climate change – sealed surfaces not - they significantly contribute
L6> C3	0	No particular interaction
L7> E1	+1	may support state biofuel business
L7> F1	+1	may support state biomass business
L7> F2	+3	As NPFA can be considered measures for spatial water retention and those can be easily realized on state land
L7> F3	0	No particular interaction
L7> F4	0	No particular interaction
L7> F5	0	No particular interaction
L7> F6	+1	Intensive agriculture activities should be realized outside floodplains; respect of natural floodplains as measure for spatial water retention can be easily realized on state land
L7> L1	0	No particular interaction
L7> L2	0	No particular interaction
L7> L3	-3/+3	State is not a good manager – see heritage of 50 years of communism with all impacts / measures for spatial water retention can be easily realized on state land
L7> L4	0	No particular interaction
L7> L5	0	No particular interaction
L7> L6	+1	State should have some land reserves
L7> L8	-3	contradictory
L7> L9	-1/+1	State land property may enable better land consolidation / or not ???
L7> L10	-1/+1	State land property may enable better land consolidation and thus support changes in landscape structure / or not ???
L7> L11	-1/+1	State land property may enable changes to improve landscape structure, implement water retention measures and thus develop system of sustainable management / or not??? – remind Czech history
L7> L12	0	No particular interaction
L7> L13	0	No particular interaction
L7> W1	+3	measures for spatial water retention – greening, can be easily realized on state land
L7> W2	+3	measures for spatial water retention – buffer zones along water courses can be easily realized on state land
L7> W3	0/+3	measures for spatial water retention can be easily realized on state land / or not???
L7> W4	0/+3	measures for spatial water retention can be easily realized on state land / or not???
L7> W5	0/+3	measures for spatial water retention can be easily realized on state land / or not???
L7> W6	0/+1	measures for spatial water retention can be easily realized on state land / or not???

L7> W7	0/+3	measures for spatial water retention can be easily realized on state land / or not???
L7> W8	0	No particular interaction
L7> W9	+3	indivisible
L7> W10	0	No particular interaction
L7> W11	0	No particular interaction
L7> W12	+3	measures for spatial water retention in order to mitigate drought can be easily realized on state land
L7> C1	+1	measures for spatial water retention can be easily realized on state land – climate change mitigation
L7> C2	+1	measures for spatial water retention can be easily realized on state land – climate change adaptation
L7> C3	0	No particular interaction
L8> E1	-1/+1	May enhance biofuel business / or not
L8> F1	-1/+1	May enhance biomass business / or not
L8> F2	0	No particular interaction
L8> F3	0	No particular interaction
L8> F4	0	No particular interaction
L8> F5	+2	Private property of farmland should motivate farmers for better land management
L8> F6	0	No particular interaction
L8> L1	0/+2	Private property of farmland should motivate farmers for better land management
L8> L2	0/+2	Private property of farmland should motivate farmers for better land management
L8> L3	0/+2	Private property of farmland should motivate farmers for better land management
L8> L4	0/+2	Private property of farmland should motivate farmers for better land management
L8> L5	0/+2	Private property of farmland should motivate farmers for better land management
L8> L6	0/+2	Private property of farmland should motivate farmers for better land management and creates relationship to soil which has been lost in the past
L8> L7	-3	cancelling
L8> L9	0/+1	Private property of farmland should motivate farmers to solve farmland property conflicts that can be solved by land consolidation
L8> L10	0/+2	Private property of farmland should motivate farmers for better land management that is related to heterogeneous landscape structure
L8> L11	0/+1	Private property of farmland should motivate farmers for better land management = sustainable management
L8> L12	0	No particular interaction
L8> L13	0/+3	Private property of farmland should motivate farmers for better land management = restoration of crops diversity and rotation
L8> W1	0/+2	Private property of farmland should motivate farmers for better land management thus is directly related to improving farmland water regime
L8> W2	0/+2	Private property of farmland should motivate farmers for better land management thus is directly related to improving farmland water regime
L8> W3	0/+2	Private property of farmland should motivate farmers for better land management thus is directly related to improving farmland water regime
L8> W4	0/+2	Private property of farmland should motivate farmers for better land management thus is directly related to improving farmland water regime
L8> W5	0/+2	Private property of farmland should motivate farmers for better land management thus is directly related to improving farmland water regime
L8> W6	0/+1	Private property of farmland should motivate farmers for better land management thus is directly related to improving farmland water regime
L8> W7	0/+1	Private property of farmland should motivate farmers for better land management thus is directly related to improving farmland water regime

L8> W8	0/+1	Private property of farmland should motivate farmers for better land management thus is directly related to improving farmland water regime
L8> W9	0/+1	Private property of farmland should motivate farmers for better land management thus is directly related to improving farmland water regime
L8> W10	0	No particular interaction, cooperation of farmers is welcomed
L8> W11	0/+1	Land owners should have an interest in protection and restoration forests water regime
L8> W12	0/+1	Private property of farmland should motivate farmers for better land management thus is directly related to improving farmland water regime and drought mitigation
L8> C1	0	No particular interaction
L8> C2	0	No particular interaction
L8> C3	0	No particular interaction
L9> E1	0	No particular interaction
L9> F1	0	No particular interaction
L9> F2	+1	Land consolidation = tool for NPFA support
L9> F3	+1	Soil blocks evidence can provide information for land consolidation
L9> F4	0	No particular interaction
L9> F5	0	No particular interaction
L9> F6	+1	Land consolidation may improve/control/restrict agriculture activities in floodplain
L9> L1	+1	LC can design antierosion measures
L9> L2	0	No particular interaction
L9> L3	+1	LC can design measures for soil water capacity increase
L9> L4	+1	LC can design landuse
L9> L5	0	No particular interaction
L9> L6	+1	LC implementation can design landuse
L9> L7	0	No particular interaction
L9> L8	0	No particular interaction
L9> L10	+3	LC implementation design landscape structure
L9> L11	+1	LC implementation should help to develop comprehensive system of sustainable land management
L9> L12	0	No particular interaction
L9> L13	0	No particular interaction
L9> W1	+1	Implementation of LC may support greening
L9> W2	+1	LC may control buffer zones design
L9> W3	+1	LC may design measures to promote natural retention of soils
L9> W4	+1	LC may design measures for landscape water regime restoration
L9> W5	+1	LC may design water courses and floodplains revitalization
L9> W6	+1	LC incorporates design of reservoirs and irrigation systems
L9> W7	+1	LC can design measures for spatial runoff reduction
L9> W8	+1	LC can design landuse in accordance with GAEC
L9> W9	+1	LC solves land ownership as a tool for water retention measures
L9> W10	+2	Direct relation
L9> W11	+1	LC can design measures for forest water regime restoration
L9> W12	+1	LC can design measures to mitigate drought
L9> C1	+1	LC can design measures for climate change mitigation
L9> C2	+1	LC can design measures for climate change adaptation
L9> C3	0	No particular interaction
L10> E1	-2	Biofuels production = preference maize, rape, landscape structure unification

L10> F1	-2	Biomass production = preference maize, rape, landscape structure unification
L10> F2	+2	Direct relation
L10> F3	0	No particular interaction
L10> F4	0	No particular interaction
L10> F5	+1	Direct relation
L10> F6	0	No particular interaction
L10> L1	+3	Direct relation
L10> L2	+2	Direct relation
L10> L3	+3	Direct relation
L10> L4	0	No particular interaction
L10> L5	+1	Direct relation
L10> L6	0	No particular interaction
L10> L7	0	No particular interaction
L10> L8	0	No particular interaction
L10> L9	+1	Direct relation
L10> L11	0	No particular interaction
L10> L12	0	No particular interaction
L10> L13	+3	Direct relation
L10> W1	+2	Direct relation
L10> W2	+2	Direct relation
L10> W3	+2	Direct relation
L10> W4	+2	Direct relation
L10> W5	+2	Direct relation
L10> W6	+1	Direct relation
L10> W7	+2	Direct relation
L10> W8	+1	Direct relation
L10> W9	0	No particular interaction
L10> W10	0	No particular interaction
L10> W11	0	No particular interaction
L10> W12	+3	Direct relation
L10> C1	+3	Direct relation
L10> C2	+3	Direct relation
L10> C3	0	No particular interaction
L11> E1	-1	Sustainable land management does not correspond with biofuels production
L11> F1	-1	Sustainable land management does not correspond with biomass production
L11> F2	+1	Direct relation
L11> F3	0	No particular interaction
L11> F4	+1	Direct relation
L11> F5	+1	Direct relation
L11> F6	+1	Direct relation
L11> L1	+3	Direct relation
L11> L2	+3	Direct relation
L11> L3	+3	Direct relation
L11> L4	+1	Direct relation
L11> L5	+1	Direct relation
L11> L6	+1	Direct relation
L11> L7	0	No particular interaction
L11> L8	0	No particular interaction
L11> L9	+1	Direct relation

L11> L10	+1	Direct relation
L11> L12	0	No particular interaction
L11> L13	+1	Direct relation
L11> W1	+2	Direct relation
L11> W2	+2	Direct relation
L11> W3	+2	Direct relation
L11> W4	+2	Direct relation
L11> W5	+2	Direct relation
L11> W6	0	No particular interaction
L11> W7	+2	Direct relation
L11> W8	+2	Direct relation
L11> W9	0	No particular interaction
L11> W10	+1	Cannot avoid without landscape planning
L11> W11	+1	Direct relation
L11> W12	+3	Direct relation
L11> C1	+3	Direct relation
L11> C2	+3	Direct relation
L11> C3	0	No particular interaction
L12> E1	-1	In the system of ecosystem services biofuels production can be assessed negative
L12> F1	-1	In the system of ecosystem services biofuels production can be assessed negative
L12> F2	+1	Ecosystem services provide support for NPFA
L12> F3	0	No particular interaction
L12> F4	+1	ES may help to set up AECM
L12> F5	+1	Ecosystem services may justify climate-favourable agriculture procedures
L12> F6	0	No particular interaction
L12> L1	+1	ES system development may help to support measures that will lead to decrease of soil erosion
L12> L2	+1	ES system development may help to support measures that will lead to...
L12> L3	+1	ES system development may help to support measures that will lead to...
L12> L4	+1	ES system development may help to support measures that will lead to...
L12> L5	+1	ES system development may help to support measures that will lead to...
L12> L6	+1	ES system development may help to support measures that will lead to...
L12> L7	0	No particular interaction
L12> L8	0	No particular interaction
L12> L9	+1	ES system development may help to support measures that will lead to...
L12> L10	+1	ES system development may help to support measures that will lead to...
L12> L11	+1	ES system development may help to support measures that will lead to...
L12> L13	+1	ES system development may help to support measures that will lead to...
L12> W1	+1	ES system development may help to support measures that will lead to...
L12> W2	+1	ES system development may help to support measures that will lead to...
L12> W3	+1	ES system development may help to support measures that will lead to...
L12> W4	+1	ES system development may help to support measures that will lead to...
L12> W5	+1	ES system development may help to support measures that will lead to...
L12> W6	0	No particular interaction
L12> W7	+1	ES system development may help to support measures that will lead to...
L12> W8	+1	ES system development may help to support measures that will lead to...
L12> W9	0	No particular interaction
L12> W10	0	No particular interaction
L12> W11	+1	ES system development may help to support measures that will lead to...

L12> W12	+1	ES system development may help to support measures that will lead to...
L12> C1	+1	ES system development may help to support measures that will lead to...
L12> C2	+1	ES system development may help to support measures that will lead to...
L12> C3	0	No particular interaction
L13> E1	-3	Maize, rape = monoculture
L13> F1	-3	Maize, rape = monoculture
L13> F2	+2	Direct relation; e.g. crops for soil improvement
L13> F3	0	No particular interaction
L13> F4	+1	direct relation; traditional crops and sowing procedures may influence AECM
L13> F5	+2	Direct relation; e.g. maize can be planted with undergrowth crops in order to maintain humidity and low temperature in the field
L13> F6	0	No particular interaction
L13> L1	+2	Direct relation; grassing of floodplains; sunflowers etc.
L13> L2	+2	Direct relation; e.g. by lucerne; intercropping
L13> L3	+2	Direct relation; e.g. by agrotechnical measures, root/row crops
L13> L4	0	No particular interaction
L13> L5	+2	Direct relation; agrotechnical measures, intercropping
L13> L6	0	No particular interaction
L13> L7	0	No particular interaction
L13> L8	0	No particular interaction
L13> L9	0	No particular interaction
L13> L10	+3	Direct relation; crop diversity, crops divided by non-crop belts
L13> L11	+1	Direct relation; developing new sowing system respecting crops ecological niche and ancestors experience
L13> L12	0	No particular interaction
L13> W1	+3	Direct relation; grasssing
L13> W2	+3	Direct relation; grassing, woody plants (fast growing) etc.
L13> W3	+3	Direct relation; crops respecting ecological niche, with potential to improve soil quality (aeration, increase organics, vertically structured crops growth to retain water, low temperature)
L13> W4	+2	Direct relation crops respecting ecological niche, with potential to improve soil quality (aeration, increase organics, vertically structured crops growth to retain water, low temperature)
L13> W5	+2	Direct relation; using grassland an woody plants in buffer zones
L13> W6	+3	Direct relation (some crops need irrigation)
L13> W7	+2	Direct relation, crops planting with respect to slope and relief, grassing
L13> W8	0	No particular interaction
L13> W9	0	No particular interaction
L13> W10	0	No particular interaction
L13> W11	0	No particular interaction
L13> W12	+3	Direct relation; respecting ecological niche of crops, agrotechnical and sowing procedures respecting water regime, soils characteristics; landscape structure determined by heterogeneous mosaic of crops
L13> C1	+3	Direct relation; restoration of traditional sowing procedures
L13> C2	+3	Direct relation; restoration of traditional sowing procedures
L13> C3	0	No particular interaction

Water is affecting energy / food / land / climate

W1> E1	-1	Support of greening areas in catchments can decrease area with biomass (rape, maize)

W1> F1	-1	Support of greening areas in catchments can decrease area with biomass (rape, maize)
W1> F2	+2	Soil protection against erosion, water retention in landscape, biodiversity support
W1> F3	0	No particular interaction
W1> F4	+1	Humus creation, soil ability to retain water
W1> F5	+2	Small water cycle support, landscape cooling
W1> F6	+3	Anti-erosion soil measures, protect water sources against spatial pollution
W1> L1	+3	Landscape diversification into smaller segments – landscape heterogeneity increase, reduction of the speed of precipitation water / runoff
W1> L2	+3	Strengthening of soil edaphon, biodiversity support, water retention in soil
W1> L3	+3	Direct influence on ground water level, increase of soil capillarity
W1> L4	+2	Reduction of crossing fields by large and heavy agricultural machinery
W1> L5	+2	Reduction of crossing fields by large and heavy agricultural machinery
W1> L6	0	No particular interaction
W1> L7	0	No particular interaction
W1> L8	0	No particular interaction
W1> L9	+1	Greening areas design should support proper implementation of land consolidation
W1> L10	+3	Small water cycle and biodiversity support
W1> L11	+1	Influence on energy-matter flows in landscape
W1> L12	+1	Increase of landscape ecosystem value
W1> L13	0	No particular interaction
W1> W2	+2	Greening can have a function as buffer zones
W1> W3	+3	Higher natural water retention on grassland areas
W1> W4	+3	Increase evapotranspiration in green areas, support small water cycle and local climate
W1> W5	+3	Supporting the functioning of the depression cone of groundwater
W1> W6	0	No particular interaction
W1> W7	+1	Greening enables decrease of spatial water pollution
W1> W8	+2	Greening for landscape diversity
W1> W9	0	No particular interaction
W1> W10	0	No particular interaction
W1> W11	+1	Small water cycle restoration, local climate creation
W1> W12	+3	Small water cycle restoration, local climate creation
W1> C1	+3	Small water cycle restoration, local climate creation
W1> C2	+3	Small water cycle restoration, local climate creation
W1> C3	+1	Reducing drive mechanization
W2> E1	-1	Support buffer zones in catchments can decrease area with biomass (rape, maize)
W2> F1	-1	Decrease of production farming areas
W2> F2	+2	W2 increases non-production of agriculture, inter alia by eliminating heavy metal nitrates
W2> F3	0	No particular interaction
W2> F4	+1	Humus creation, soil ability to retain water
W2> F5	+2	Small water cycle support, landscape cooling
W2> F6	+3	Soil erosion protection, protect water sources against spatial pollution
W2> L1	+3	slowdown of precipitation runoff, decrease of soil erosion
W2> L2	+3	Strengthening of soil edaphon, biodiversity support, water retention in soil
W2> L3	+3	Direct influence on ground water level, increase of soil capillarity
W2> L4	+2	Reduction of crossing fields by large and heavy agricultural machinery
W2> L5	+2	Reduction of crossing fields by large and heavy agricultural machinery

W2> L6	0	No particular interaction
W2> L7	0	No particular interaction
W2> L8	0	No particular interaction
W2> L9	+1	Buffer zones design should support proper implementation of land consolidation
W2> L10	+3	Supporting a small water cycle, promoting biodiversity, most of the water courses are without W2, when we introduce these elements into practice, we diversify the structure of the landscape
W2> L11	+1	Effect on energy-matter flows in the landscape
W2> L12	+1	Increase of ecosystem value of the area, e.g. the ability of the system to bind nutrients
W2> L13	0	No particular interaction
W2> W1	+2	Greening can have a function as buffer zones
W2> W3	+3	Higher natural water retention on grassland areas
W2> W4	+3	Increase evapotranspiration in green areas, support small water cycle and local climate
W2> W5	+3	Supporting the functioning of the depression cone of groundwater
W2> W6	0	No particular interaction
W2> W7	+1	Buffer zones enable decrease of water pollution from spatial sources
W2> W8	+3	Buffer zones diverse landscape, efficient protection of water resources
W2> W9	0	No particular interaction
W2> W10	0	No particular interaction
W2> W11	+1	Small water cycle support, local climate creation
W2> W12	+3	Small water cycle support, local climate creation, water spill into landscape
W2> C1	+3	Small water cycle support, local climate creation
W2> C2	+3	Small water cycle support, local climate creation
W2> C3	+1	Reducing drives of heavy mechanization on fields
W3> E1	+1	Increase plants biomass, higher production, CO2 sequestration
W3> F1	+1	Increase plants biomass, higher production, CO2 sequestration
W3> F2	+1	Small water cycle support, increase of biodiversity, local climate creation
W3> F3	0	No particular interaction
W3> F4	+1	Small water cycle support, local climate creation
W3> F5	+1	Small water cycle support, local climate creation
W3> F6	+1	Water and harmful substances retention
W3> L1	+1	Saturated soil is more compact, do not erode so easily
W3> L2	+2	Decrease of mineralization speed, suitable conditions for edaphon
W3> L3	+3	Suitable W3 measures improve soil structure, decrease soil compaction, increase of organic matter in soil…
W3> L4	0	No particular interaction
W3> L5	0	No particular interaction
W3> L6	0	No particular interaction
W3> L7	0	No particular interaction
W3> L8	0	No particular interaction
W3> L9	+2	Landscape diversification and heterogeneity
W3> L10	+2	Small water cycle support, increase of biodiversity, local climate creation
W3> L11	+2	Small water cycle support, increase of biodiversity, local climate creation
W3> L12	+1	Increase of landscape ecosystem value
W3> L13	+1	Better condition for crops growth, higher species variability
W3> W1	+3	Decrease soil erosion, higher roots biomass, support of soil edaphon, stable groundwater layer
W3> W2	+3	Decrease soil erosion, higher roots biomass, support of soil edaphon, stable

		groundwater layer
W3> W4	+3	Decrease soil erosion, higher roots biomass, support of soil edaphon, stable groundwater layer
W3> W5	0	No particular interaction
W3> W6	+3	Water saturated river basin with functional small water cycle
W3> W7	+3	Plants in good health (high roots biomass) prevents from soil erosion
W3> W8	+2	Decrease of mineralization
W3> W9	+3	Owner decides
W3> W10	0	No particular interaction
W3> W11	0	No particular interaction
W3> W12	+3	Small water cycle support, stable groundwater level, increase of evapotranspiration
W3> C1	+3	Small water cycle support, local climate creation
W3> C2	+3	Small water cycle support, local climate creation
W3> C3	0	No particular interaction
W4> E1	+1	Increase plants biomass, higher production
W4> F1	+1	Increase plants biomass, higher production
W4> F2	+1	Functional landscape with high variety of landscape features (balks, etc…)
W4> F3	0	No particular interaction
W4> F4	+1	Better conditions for agri-environmental measures implementation
W4> F5	0	No particular interaction
W4> F6	+1	Water and harmful substances retention
W4> L1	+2	Plants and soil in good condition, greening a buffer zones…
W4> L2	+1	High biomass, landscape heterogeneity, abundant soil edaphon, CO2 sequestration
W4> L3	+3	Direct relationship
W4> L4	+1	Direct relationship
W4> L5	+1	Direct relationship
W4> L6	+1	For water cycle recovery and retention we need soil, not buildings and industrial zones
W4> L7	+1	Support of ecosystem services, soil purchase for ecosystem functions support
W4> L8	0	No particular interaction
W4> L9	0	No particular interaction
W4> L10	+3	Landscape heterogeneity
W4> L11	+2	Water is life precursor and basis
W4> L12	+1	Increase of landscape ecosystem value
W4> L13	+2	Improvement of conditions for crops growth, higher species diversity, vertically structured crop growth
W4> W1	0	Greening supports water cycle, W1 must be precursor of W4
W4> W2	0	Support of small water cycle, W2 must be precursor of W4
W4> W3	0	W3 is precursor of W4
W4> W5	+3	Rehydration of landscape
W4> W6	+2	Rehydration of landscape
W4> W7	+3	Low surface water runoff
W4> W8	0	No particular interaction
W4> W9	0	No particular interaction
W4> W10	+2	Long-term water retention in landscape
W4> W11	+3	Positive effect on small water cycle, local climate improvement
W4> W12	+3	Positive effect on small water cycle, local climate improvement
W4> C1	+3	Positive effect on small water cycle, local climate improvement
W4> C2	+3	Positive effect on small water cycle, local climate improvement

W4> C3	+1	Sequestration of CO2
W5> E1	0	No particular interaction
W5> F1	0	No particular interaction
W5> F2	+1	Support of small water cycle, water retention, higher biodiversity, positive effects on local climate
W5> F3	0	No particular interaction
W5> F4	0	No particular interaction
W5> F5	0	No particular interaction
W5> F6	+1	Water and harmful substances retention
W5> L1	0	No particular interaction
W5> L2	0	No particular interaction
W5> L3	+3	small water cycle support, depression cone of groundwater
W5> L4	0	No particular interaction
W5> L5	+1	small water cycle support, depression cone of groundwater
W5> L6	+2	Decrease of the area of arable land to the exclusion of flooding areas
W5> L7	+3	State should purchase non-productive land
W5> L8	0	No particular interaction
W5> L9	0	No particular interaction
W5> L10	+2	Support of landscape heterogeneity
W5> L11	+1	Support of landscape heterogeneity
W5> L12	+2	Increase of landscape ecosystem value
W5> L13	0	No particular interaction
W5> W1	+3	Direct relation
W5> W2	+3	Direct relation
W5> W3	+3	Long-term water retention in landscape, depression cone of groundwater
W5> W4	+3	Direct relation, Long-term water retention in landscape
W5> W6	0	No particular interaction
W5> W7	+3	Positive change in land cover
W5> W8	+3	Direct relation, Long-term water retention in landscape, positive change in land cover
W5> W9	0	No particular interaction
W5> W10	0	No particular interaction
W5> W11	0	No particular interaction
W5> W12	+3	Return of water into landscape
W5> C1	+3	Direct relation, Long-term water retention in landscape
W5> C2	+3	Direct relation, Long-term water retention in landscape
W5> C3	0	No particular interaction
W6> E1	0	No particular interaction
W6> F1	+1	Support of landscape hydrological regime
W6> F2	0	No particular interaction
W6> F3	0	No particular interaction
W6> F4	0	No particular interaction
W6> F5	0	No particular interaction
W6> F6	0	No particular interaction
W6> L1	0	No particular interaction
W6> L2	0	No particular interaction
W6> L3	+1	depression cone of groundwater
W6> L4	0	No particular interaction

W6> L5	+1	Irrigation causes soil compaction
W6> L6	0	No particular interaction
W6> L7	0	No particular interaction
W6> L8	0	No particular interaction
W6> L9	0	No particular interaction
W6> L10	+1	Landscape diversification
W6> L11	+1	Long-term water retention in landscape, dividing of large field blocks
W6> L12	0	No particular interaction
W6> L13	0	No particular interaction
W6> W1	0	No particular interaction
W6> W2	0	No particular interaction
W6> W3	0	No particular interaction
W6> W4	+3	Direct relation, Long-term water retention in landscape
W6> W5	0	No particular interaction
W6> W7	+1	Local effect
W6> W8	+1	Local effect
W6> W9	0	No particular interaction
W6> W10	0	No particular interaction
W6> W11	0	No particular interaction
W6> W12	+3	Direct relation, Long-term water retention in landscape
W6> C1	+3	Direct relation, Long-term water retention in landscape
W6> C2	+3	Direct relation, Long-term water retention in landscape
W6> C3	0	No particular interaction
W7> E1	-1	Worsening of soil cultivation conditions
W7> F1	-1	Worsening of soil cultivation conditions
W7> F2	+2	Improving soil properties and soil retention capacity of water and nutrients
W7> F3	0	No particular interaction
W7> F4	+2	Improving soil properties and soil retention capacity of water and nutrients
W7> F5	+1	Direct relation, Long-term water retention in landscape
W7> F6	+2	Mitigation of adverse agricultural impacts
W7> L1	+3	Direct relation, Long-term water retention in landscape
W7> L2	+3	Direct relation, Long-term water retention in landscape
W7> L3	+3	Direct relation, Long-term water retention in landscape
W7> L4	+3	Direct relation, Long-term water retention in landscape
W7> L5	+3	Direct relation, Long-term water retention in landscape
W7> L6	+1	More difficult building conditions
W7> L7	+1	strategic areas for climate protection
W7> L8	0	No particular interaction
W7> L9	0	No particular interaction
W7> L10	0	No particular interaction
W7> L11	+2	Water retention in landscape
W7> L12	0	No particular interaction
W7> L13	+3	Change of soil quality
W7> W1	0	No particular interaction
W7> W2	0	No particular interaction
W7> W3	0	No particular interaction
W7> W4	0	No particular interaction
W7> W5	0	No particular interaction
W7> W6	0	No particular interaction

W7> W8	0	No particular interaction
W7> W9	0	No particular interaction
W7> W10	0	No particular interaction
W7> W11	0	No particular interaction
W7> W12	+3	Direct relation, Long-term water retention in landscape
W7> C1	+3	Direct relation, Long-term water retention in landscape
W7> C2	+3	Direct relation, Long-term water retention in landscape
W7> C3	0	No particular interaction
W8> E1	-3	Change of sowing processes
W8> F1	-3	Change of sowing processes
W8> F2	+2	Improving soil properties and soil retention capacity of water and nutrients, direct influence on the basis of the implemented measure
W8> F3	0	No particular interaction
W8> F4	+2	Landscape diversification, direct relation
W8> F5	+3	Improving soil properties and soil retention capacity of water and nutrients, direct relation, finer landscape structure
W8> F6	+2	Diverse landscape management decrease harm impact of conventional farming on landscape
W8> L1	+3	Direct relation
W8> L2	+3	Direct relation, soil quality improvement, heterogeneous landscape
W8> L3	+3	Change of land cover, finer landscape structure
W8> L4	+3	Decrease of soil compaction
W8> L5	+3	Change of land cover, finer landscape structure
W8> L6	+1	Harder condition for taking out of arable land from the agriculture land fund and consequently for land purchase
W8> L7	0	No particular interaction
W8> L8	0	No particular interaction
W8> L9	0	No particular interaction
W8> L10	+3	Landscape diversification, direct relation
W8> L11	+3	Direct relation, change of the perspective on landscape functioning
W8> L12	0	No particular interaction
W8> L13	+3	Direct relation, total change in sowing processes
W8> W1	+3	Direct relation
W8> W2	+3	Direct relation
W8> W3	+3	Direct relation
W8> W4	+3	Direct relation
W8> W5	+1	Soil quality improvement, mainly the ability to retain water and nutrients, direct relation
W8> W6	0	No particular interaction
W8> W7	+3	Direct relation
W8> W9	0	No particular interaction
W8> W10	+1	good agriculture practice as a model for landscape planning
W8> W11	0	No particular interaction
W8> W12	+3	Direct relation
W8> C1	+3	Direct relation
W8> C2	+3	Direct relation
W8> C3	0	No particular interaction
W9> E1	0	No particular interaction

W9> F1	0	No particular interaction
W9> F2	0	No particular interaction
W9> F3	0	No particular interaction
W9> F4	0	No particular interaction
W9> F5	0	No particular interaction
W9> F6	0	No particular interaction
W9> L1	+1/-1	Depending on the landowner - the small farmer naturally behaves differently(supposing sustainable land management) than a large company
W9> L2	+1/-1	Depending on the landowner - the small farmer naturally behaves differently(supposing sustainable land management) than a large company
W9> L3	+1/-1	Depending on the landowner - the small farmer naturally behaves differently(supposing sustainable land management) than a large company
W9> L4	+1/-1	Depending on the landowner - the small farmer naturally behaves differently(supposing sustainable land management) than a large company
W9> L5	+1/-1	Depending on the landowner - the small farmer naturally behaves differently(supposing sustainable land management) than a large company
W9> L6	+1/-1	Depending on the landowner - the small farmer naturally behaves differently(supposing sustainable land management) than a large company
W9> L7	+3	For strategical planning is essential to have some land as state property
W9> L8	+1	The subjects farming their own land are supposed to use sustainable management practices – good relation to soil
W9> L9	0/+1	No particular interaction
W9> L10	0/+1	No particular interaction
W9> L11	+1	For strategical planning is essential to have some land as state property
W9> L12	0	No particular interaction
W9> L13	0	No particular interaction
W9> W1	+2	Direct relation, easier landscaping in case of state land property
W9> W2	+2	Direct relation, easier landscaping in case of state land property
W9> W3	+2	Direct relation, easier landscaping in case of state land property
W9> W4	+2	Direct relation, easier landscaping in case of state land property
W9> W5	+2	Direct relation, easier landscaping in case of state land property
W9> W6	0	No particular interaction
W9> W7	+2	Direct relation, easier landscaping in case of state land property
W9> W8	0	No particular interaction
W9> W10	+2	Direct relation, easier landscaping in case of state land property
W9> W11	0	No particular interaction
W9> W12	+2	Direct relation, easier landscaping in case of state land property
W9> C1	+3	Direct relation, easier landscaping in case of state land property
W9> C2	+3	Direct relation, easier landscaping in case of state land property
W9> C3	0	No particular interaction
W10> E1	0	No particular interaction
W10> F1	0	No particular interaction
W10> F2	+1	Direct relation
W10> F3	0	No particular interaction
W10> F4	0	No particular interaction
W10> F5	0	No particular interaction
W10> F6	0	No particular interaction
W10> L1	+2	Direct relation, Long-term water retention in landscape
W10> L2	+2	Direct relation, Long-term water retention in landscape
W10> L3	+3	Direct relation, Long-term water retention in landscape

W10> L4	+1	Decrease of area cultivated by heavy agriculture machines
W10> L5	+1	Direct relation, Long-term water retention in landscape
W10> L6	0	No particular interaction
W10> L7	-1/+1	Easier landscaping in case of state land property
W10> L8	0	No particular interaction
W10> L9	+3	Easier landscaping in case of state land property
W10> L10	+3	Direct relation, easier landscaping in case of state land property
W10> L11	+2	Direct relation, , easier landscaping in case of state land property
W10> L12	0	No particular interaction
W10> L13	+2	Changes in landscape management and structure should be related to changes in sowing processes
W10> W1	+1	Direct relation
W10> W2	+1	Direct relation
W10> W3	+3	Direct relation
W10> W4	+3	Direct relation
W10> W5	+1	Direct relation
W10> W6	+1	Direct relation
W10> W7	0	No particular interaction
W10> W8	0	No particular interaction
W10> W9	0	No particular interaction
W10> W11	0	No particular interaction
W10> W12	+3	Well- structured landscape will mitigate drought
W10> C1	+3	Heterogeneous landscape with permanent vegetation will be functional in terms of water retention and local climate
W10> C2	+3	Heterogeneous landscape with permanent vegetation will be functional in terms of water retention and local climate
W10> C3	0	No particular interaction
W11> E1	0	No particular interaction
W11> F1	0	No particular interaction
W11> F2	0	No particular interaction
W11> F3	0	No particular interaction
W11> F4	0	No particular interaction
W11> F5	0	No particular interaction
W11> F6	0	No particular interaction
W11> L1	+3	Water retention in upper parts of catchment
W11> L2	+3	Is valid in case of forest and nearby land
W11> L3	+3	Direct relation
W11> L4	+1	Is valid in case of forest and nearby land
W11> L5	+1	Is valid in case of forest and nearby land
W11> L6	0	No particular interaction
W11> L7	0	No particular interaction
W11> L8	0	No particular interaction
W11> L9	0	No particular interaction
W11> L10	0	No particular interaction
W11> L11	+2	Support of small water cycle
W11> L12	+2	Water retention increase value of landscapes ecosystem services
W11> L13	0	No particular interaction
W11> W1	+3	Direct relation, Long-term water retention in landscape
W11> W2	+2	Direct relation, Long-term water retention in landscape

W11> W3	+3	Direct relation, Long-term water retention in landscape
W11> W4	+3	Direct relation, Long-term water retention in landscape
W11> W5	+3	Direct relation, Long-term water retention in landscape
W11> W6	0	No particular interaction
W11> W7	+3	Water retention in upper parts of catchment
W11> W8	0	No particular interaction
W11> W9	0	No particular interaction
W11> W10	0	No particular interaction
W11> W12	+3	Direct relation, Long-term water retention in landscape
W11> C1	+3	Direct relation, Long-term water retention in landscape
W11> C2	+3	Direct relation, Long-term water retention in landscape
W11> C3	0	No particular interaction
W12> E1	+1	Water retention is essential for all agriculture activities
W12> F1	+1	Water retention is essential for all agriculture activities
W12> F2	+3	Direct relation, Long-term water retention in landscape
W12> F3	0	No particular interaction
W12> F4	+2	Slowdown of the discharge of nutrients from the river basin
W12> F5	+2	Slowdown of the discharge of nutrients from the river basin
W12> F6	0	No particular interaction
W12> L1	+3	Direct relation, Long-term water retention in landscape
W12> L2	+3	Direct relation, Long-term water retention in landscape
W12> L3	+3	Direct relation, Long-term water retention in landscape
W12> L4	+3	Direct relation, Long-term water retention in landscape
W12> L5	+3	Direct relation, Long-term water retention in landscape
W12> L6	+1	Wet areas are not suitable for building
W12> L7	+1	Easier landscaping in case of state land property
W12> L8	0	No particular interaction
W12> L9	0	No particular interaction
W12> L10	+3	Landscape diversification, direct relation
W12> L11	+3	Continuing of landscape drying = not sustainable management ending by desert
W12> L12	+3	Water retention increase value of landscapes ecosystem services
W12> L13	+3	Direct relation
W12> W1	+3	Direct relation, water retention
W12> W2	+3	Direct relation, water retention
W12> W3	+3	Direct relation, water retention
W12> W4	+3	Direct relation, water retention
W12> W5	+3	Direct relation, water retention
W12> W6	+3	Direct relation, Long-term water retention in landscape
W12> W7	+3	Direct relation, Long-term water retention in landscape
W12> W8	+3	Direct relation, Long-term water retention in landscape Direct relation
W12> W9	+3	Direct relation, Depending on the landowner - the small farmer naturally behaves differently than a large company
W12> W10	0	No particular interaction
W12> W11	+3	Direct relation, Long-term water retention in landscape in upper catchments area
W12> C1	+3	Direct relation
W12> C2	+3	Direct relation
W12> C3	0	No particular interaction

Climate is affecting energy / food / land / water

C1> E1	-3/+3	Biofuels (biomass) production deteriorate water regime, soil quality, local climate = against mitigation / Biofuels = renewable resources; support climate change mitigation
C1> F1	-3/+3	Biomass (maize, rape) production deteriorate water regime, soil quality, local climate = against mitigation / Biofuels = renewable resources; support climate change mitigation
C1> F2	+3	Direct relation
C1> F3	0	No particular interaction
C1> F4	+3	Direct relation
C1> F5	+3	Direct relation
C1> F6	+3	Direct relation
C1> L1	+3	Direct relation
C1> L2	+3	Direct relation
C1> L3	+3	Direct relation
C1> L4	+3	Direct relation
C1> L5	+3	Direct relation
C1> L6	+3	Direct relation
C1> L7	0/+2	No particular interaction / May contribute to purchase of agriculture land by the state in order to realize spatial water retention measures in landscape
C1> L8	0	No particular interaction
C1> L9	+3	Direct relation
C1> L10	+3	Direct relation
C1> L11	+3	Direct relation
C1> L12	+3	Direct relation
C1> L13	+3	Direct relation
C1> W1	+3	Direct relation
C1> W2	+3	Direct relation
C1> W3	+3	Direct relation
C1> W4	+3	Direct relation
C1> W5	+3	Direct relation
C1> W6	+3	Direct relation
C1> W7	+3	Direct relation
C1> W8	+3	Direct relation
C1> W9	0	No particular interaction
C1> W10	+1	Direct relation
C1> W11	+3	Direct relation
C1> W12	+3	Direct relation
C1> C2	+3	Direct relation
C1> C3	-3/+3	Emissions trading is considered as useful for climate change mitigation; however in reality it is only business without any significant effect on climate change; climate change mitigation is related to sustainable landscape management that directly influence local climate and water regime
C1> C4	-3/+3	Greenhouse gasses reduction is considered as useful for climate change mitigation; however in reality it is only business without any significant effect on climate change; climate change mitigation is related to sustainable landscape management that directly influence local climate and water regime
C2> E1	-3/+3	Biofuels (biomass) production deteriorate water regime, soil quality, local climate = against adaptation / Biofuels = renewable resources; support climate change adaptation
C2> F1	-3/+3	Biomass (maize, rape) production deteriorate water regime, soil quality, local

		climate = against adaptation / Biofuels = renewable resources; support climate change adaptation
C2> F2	+3	Direct relation
C2> F3	0	No particular interaction
C2> F4	+3	Direct relation
C2> F5	+3	Direct relation
C2> F6	+3	Direct relation
C2> L1	+3	Direct relation
C2> L2	+3	Direct relation
C2> L3	+3	Direct relation
C2> L4	+3	Direct relation
C2> L5	+3	Direct relation
C2> L6	+3	Direct relation
C2> L7	0/+2	No particular interaction / May contribute to purchase of agriculture land by the state in order to realize spatial water retention measures in landscape
C2> L8	0	No particular interaction
C2> L9	+3	Direct relation
C2> L10	+3	Direct relation
C2> L11	+3	Direct relation
C2> L12	+3	Direct relation
C2> L13	+3	Direct relation
C2> W1	+3	Direct relation
C2> W2	+3	Direct relation
C2> W3	+3	Direct relation
C2> W4	+3	Direct relation
C2> W5	+3	Direct relation
C2> W6	+3	Direct relation
C2> W7	+3	Direct relation
C2> W8	+3	Direct relation
C2> W9	0	No particular interaction
C2> W10	+1	Direct relation
C2> W11	+3	Direct relation
C2> W12	+3	Direct relation
C2> C1	+3	Direct relation
C2> C3	-3/+3	Greenhouse gasses reduction is considered as useful for climate change; however in reality it is only business without any significant effect on climate change; climate change mitigation is related to sustainable landscape management that directly influence local climate and water regime; we should prefer mitigation to adaptation
C3> E1	+3	Direct relation
C3> F1	+3	Direct relation
C3> F2	-2	Support of maize, rape for biofuels in order to reduce GHGS is counteracting NPFA
C3> F3	0	No particular interaction
C3> F4	-2	GHGS reduction is considered as the best way how to mitigate climate change; there is no enough awareness that landscape management is mainly responsible for local climate, hydrology, soil quality etc. therefore there is preference of emissions trading, low carbon management activities across sectors; Preference should, however, be on the development of sustainable farming and development of such landscape management leading to …F4….that will contribute to climate change mitigation.
C3> F5	-3	GHGS reduction is considered as the best way how to mitigate climate change;

		there is no enough awareness that landscape management is mainly responsible for local climate, hydrology, soil quality etc. therefore there is preference of emissions trading, low carbon management activities across sectors; Preference should, however, be on the development of sustainable farming and development of such landscape management leading to …F5….that will contribute to climate change mitigation.
C3> F6	0	No particular interaction
C3> L1	-3	GHGS reduction is considered as the best way how to mitigate climate change; there is no enough awareness that landscape management is mainly responsible for local climate, hydrology, soil quality etc. therefore there is preference of emissions trading, low carbon management activities across sectors; Preference should, however, be on the development of sustainable farming and development of such landscape management leading to …L1….that will contribute to climate change mitigation.
C3> L2	-3	GHGS reduction is considered as the best way how to mitigate climate change; there is no enough awareness that landscape management is mainly responsible for local climate, hydrology, soil quality etc. therefore there is preference of emissions trading, low carbon management activities across sectors; Preference should, however, be on the development of sustainable farming and development of such landscape management leading to …L2….that will contribute to climate change mitigation.
C3> L3	-3	GHGS reduction is considered as the best way how to mitigate climate change; there is no enough awareness that landscape management is mainly responsible for local climate, hydrology, soil quality etc. therefore there is preference of emissions trading, low carbon management activities across sectors; Preference should, however, be on the development of sustainable farming and development of such landscape management leading to …L3….that will contribute to climate change mitigation.
C3> L4	0	No particular interaction
C3> L5	-3	GHGS reduction is considered as the best way how to mitigate climate change; there is no enough awareness that landscape management is mainly responsible for local climate, hydrology, soil quality etc. therefore there is preference of emissions trading, low carbon management activities across sectors; Preference should, however, be on the development of sustainable farming and development of such landscape management leading to …L5….that will contribute to climate change mitigation.
C3> L6	0	No particular interaction
C3> L7	0	No particular interaction
C3> L8	0	No particular interaction
C3> L9	0	No particular interaction
C3> L10	-3	GHGS reduction is considered as the best way how to mitigate climate change; there is no enough awareness that landscape management is mainly responsible for local climate, hydrology, soil quality etc. therefore there is preference of emissions trading, low carbon management activities across sectors; Preference should, however, be on the development of sustainable farming and development of such landscape management leading to …L10, L11….that will contribute to climate change mitigation.
C3> L11	-2	
C3> L12	0	No particular interaction
C3> L13	-3	GHGS reduction is considered as the best way how to mitigate climate change; there is no enough awareness that landscape management is mainly responsible for local climate, hydrology, soil quality etc. therefore there is preference of emissions trading, low carbon management activities across sectors; Preference should,
C3> W1	-3	
C3> W2	-3	
C3> W3	-3	

C3> W4	-3	however, be on the development of sustainable farming and development of such landscape management leading to …L13, W1 – W5….that will contribute to climate change mitigation.
C3> W5	-3	
C3> W6	0	No particular interaction
C3> W7	-3	GHGS reduction is considered as the best way how to mitigate climate change; there is no enough awareness that landscape management is mainly responsible for local climate, hydrology, soil quality etc. therefore there is preference of emissions trading, low carbon management activities across sectors; Preference should, however, be on the development of sustainable farming and development of such landscape management leading to …W7, W8….that will contribute to climate change mitigation.
C3> W8	-3	
C3> W9	0	No particular interaction
C3> W10	0	No particular interaction
C3> W11	-2	GHGS reduction is considered as the best way how to mitigate climate change; there is no enough awareness that landscape management is mainly responsible for local climate, hydrology, soil quality etc. therefore there is preference of emissions trading, low carbon management activities across sectors; Preference should, however, be on the development of sustainable farming and development of such landscape management leading to …W11, W12….that will contribute to climate change mitigation.
C3> W12	-3	
C3> C1	-3	Low carbon economy and strict orientation on GHGS reduction conceals the real way of climate change mitigation, which is sustainable land management
C3> C2	-3	Low carbon economy and strict orientation on GHGS reduction conceals the real way of climate change adaptation, which is sustainable landscape management

Appendix II. - Justification of the scores assigned to interactions among instruments and objectives

Energy instruments influencing food/agriculture, land/soil, water, climate objectives

Interaction	Score	Justification
EA> E1	+3	Supports maize and rape planting
EA> F1	+3	Supports maize and rape planting, grass for biogas
EA> F2	-2/+2	Maize, rape planting – negative effect on soil and water / grassing is in accordance with NPFA
EA> F3	0	No particular interaction
EA> F4	-1	Is inconsistent with AECM
EA> F5	-1	Is inconsistent with agriculture favourable climate procedures
EA> F6	0	No particular interaction
EA> L1	-2	Planting maize, rape supports erosion
EA> L2	-2	Maize, rape exhaust soil
EA> L3	-2	Deteriorate soil water infiltration
EA> L4	+1	Planting maize and rape = good business, no motivation to sell arable land for industrial and urban purposes
EA> L5	-2	Contributes to soil compaction
EA> L6	+1	Planting maize and rape = good business, no motivation to sell arable land for industrial and urban purposes
EA> L7	0	No particular interaction
EA> L8	0	No particular interaction
EA> L9	0	No particular interaction
EA> L10	-3	M and R are planted on large field blocks, as large as possible – landscape homogeneity
EA> L11	-3	Planting M and R is not from the soil quality and water regime long-term sustainable
EA> L12	0	No particular interaction
EA> L13	-3	Maize and rape = monoculture; Preference of maize and rape completely destroys crops diversity and sowing procedures
EA> W1	-3	Greening is not desired in large maize and rape field blocks
EA> W2	-3	Management on field as large as possible, with low respect to watercourses buffers (one meter buffer is not sufficient)
EA> W3	-3	Deteriorate soil water infiltration
EA> W4	-3	High erosion, soil compaction, low organics, high runoff, unfavourable microclimate = Deterioration of water regime
EA> W5	0	No particular interaction
EA> W6	0	No particular interaction
EA> W7	-3	High erosion, soil compaction, low organics, high runoff, unfavourable microclimate = Deterioration of water regime
EA> W8	-1	Planting maize and rape is not consistent with GAEC
EA> W9	0	No particular interaction
EA> W10	0	No particular interaction
EA> W11	0	No particular interaction
EA> W12	-3	High erosion, soil compaction, low organics, high runoff, unfavourable microclimate = Deterioration of water regime = drought enhancement
EA> C1	-3	Deterioration of water regime and climate = climate change support
EA> C2	-3	Deterioration of water regime and climate is not climate change adaptation measure
EA> C3	0	Theoretically: Biofuels = renewable resources = decrease of greenhouse gasses ; practically its only business

EB> E1	+1	Prefer grassland to maize and rape
EB> F1	+3	Prefers grassland usable for biogas stations
EB> F2	+3	Is in accordance with NPFA
EB> F3	0	No particular interaction
EB> F4	+1	Grassing = agriculture climate favourable procedure
EB> F5	+3	Grassing = agriculture climate favourable procedure
EB> F6	+3	Grassing = decrease in N-NO3- concentrations in surface water.
EB> L1	+3	Grassing = Most effective measure to decrease soil erosion
EB> L2	+2	Direct relation
EB> L3	+3	Direct relation
EB> L4	+3	Direct relation
EB> L5	+3	Direct relation
EB> L6	+2	Direct relation, grassing = new chance for agriculture land
EB> L7	0	No particular interaction
EB> L8	0	No particular interaction
EB> L9	+1	Grassing planning = need of land consolidation
EB> L10	+3	Contributes to landscape heterogeneity
EB> L11	+3	Support sustainable land management
EB> L12	0	No particular interaction
EB> L13	+3	Support traditional sowing procedures, mainly in mountain and less favourable areas
EB> W1	+3	Direct relation
EB> W2	+3	Grassing along watercourses = water quality improvement
EB> W3	+3	Direct relation
EB> W4	+3	Improves landscape water regime - Increases soil retention capacity, increases interception, increases evapotranspiration, slows surface drainage, transforms surface runoff to groundwater, resp. hypodermic.
EB> W5	+2	Grassing = buffer zones
EB> W6	0	No particular interaction
EB> W7	+3	Significant direct relation
EB> W8	+3	Is in accordance with GAEC 1,3,as well as 4,5
EB> W9	0	No particular interaction
EB> W10	0	No particular interaction
EB> W11	0	No particular interaction
EB> W12	+3	Landscape water regime improvement = drought mitigation
EB> C1	+3	Landscape water regime improvement = climate change mitigation
EB> C2	+3	Landscape water regime improvement = climate change adaptation
EB> C3	0	No particular interaction
EC> E1	-1/0	New crops preference to maize and rape; however depends on subsidies level
EC> F1	+3	new opportunity for landscape and agriculture
EC> F2	+3	NPFA = new energy crops
EC> F3	0	No particular interaction
EC> F4	+1	Crops improving soil and water regime = accordance with AECM
EC> F5	+1	Crops improving soil and water regime = support for agriculture climate procedures
EC> F6	+1	New crops as buffer zones along water courses = fast growing woody plants?
EC> L1	+1	Direct relation
EC> L2	+1	Direct relation
EC> L3	+1	Direct relation

EC> L4	+1	Direct relation
EC> L5	+1	Promise of not contributing to the worsening the soil
EC> L6	+1	New crops = new chance for agriculture
EC> L7	0	No particular interaction
EC> L8	0	No particular interaction
EC> L9	+1	New crops in plans of common facilities as new agrotechnical measures
EC> L10	+2	Diversity of crops, diversity of landscape
EC> L11	+2	New crops for soil and water regime improvement, planting in less favourable areas on less fertile soils = sustainable management
EC> L12	0	No particular interaction
EC> L13	+3	contributes to crops diversification
EC> W1	+1	New crops = new greening possibilities
EC> W2	+1	New crops as buffer zones along water courses = fast growing woody plants?
EC> W3	+1	Soil improvement = better water infiltration
EC> W4	+1	Soil improvement = better water infiltration = water regime improvement
EC> W5	+1	New crops as buffer zones along water courses = fast growing woody plants?
EC> W6	0	No particular interaction
EC> W7	+1	Soil improvement by new crops = runoff reduction
EC> W8	+1	Direct relation
EC> W9	0	No particular interaction
EC> W10	0	No particular interaction
EC> W11	0	No particular interaction
EC> W12	+2	Soil improvement = better water infiltration = water regime improvement = drought mitigation
EC> C1	+1	Soil improvement = better water infiltration = water regime improvement = climate change mitigation
EC> C2	+1	Soil improvement = better water infiltration = water regime improvement = climate change adaptation
EC> C3	0	No particular interaction

Food/agriculture instruments influencing energy, land/soil, climate objectives

Interaction	Score	Justification
FA> E1	0	All interactions were assigned 0 – despite one category (of three) of statutory management requirements (SMR) is called "Environment, climate change, good agriculture and environmental soil conditions" practically does not have any significant effect on soil condition, landscape heterogeneity, water retention, etc.; SMR deals mainly with biodiversity and pollution from point sources and contamination
to		
FA> C3	0	
FB> E1	0	No particular interaction
FB> F1	0	No particular interaction
FB> F2	-1	Crops are preferred to non-production functions in order to maximize SAPS – direct payments
FB> F3	0	No particular interaction
FB> F4	-1	Crop are maximization without respect to environment, GAEC and cross compliance – no controls, weak enforceability
FB> F5	-1	Crop are maximization without respect to environment, GAEC and cross compliance – no controls, weak enforceability
FB> F6	-1	To maximize direct payments – floodplains are often ploughed up
FB> L1	-1	Crop are maximization without respect to environment, GAEC and cross compliance – no controls, weak enforceability

FB> L2	-1	Crop are maximization without respect to environment, GAEC and cross compliance – no controls, weak enforceability
FB> L3	-1	Crop are maximization without respect to environment, GAEC and cross compliance – no controls, weak enforceability
FB> L4	-1	Crop are maximization without respect to environment, GAEC and cross compliance – no controls, weak enforceability
FB> L5	-1	Crop are maximization without respect to environment, GAEC and cross compliance – no controls, weak enforceability
FB> L6	+1	Direct payments are motivation for arable land protection
FB> L7	0	No particular interaction
FB> L8	0	No particular interaction
FB> L9	0	No particular interaction
FB> L10	-2	Large fields area = convenient for farming and subsidies
FB> L11	0	No particular interaction
FB> L12	0	No particular interaction
FB> L13	-1	Direct payments = No motivation for changing sowing procedures and crops diversity
FB> W1	-1	No motivation for payments for green areas as compensation for decrease of the crops area
FB> W2	-1	To maximize direct payments – floodplains are often ploughed up, insufficient buffer zones
FB> W3	-1	No financial motivation for farmers to promote natural retention in a comparison with direct payments -SAPS
FB> W4	-1	No financial motivation for farmers to restore water regime in a comparison with direct payments -SAPS
FB> W5	0	No particular interaction
FB> W6	0	No particular interaction
FB> W7	-1	No financial motivation for farmers to reduce runoff in a comparison with direct payments -SAPS
FB> W8	0	No particular interaction
FB> W9	0	No particular interaction
FB> W10	0	No particular interaction
FB> W11	0	No particular interaction
FB> W12	-1	No financial motivation for farmers to sustainable land management in terms of water retention and drought mitigation in a comparison with direct payments - SAPS
FB> C1	0	No particular interaction
FB> C2	0	No particular interaction
FB> C3	0	No particular interaction
FC> E1	0	No particular interaction
FC> F1	+1	Grass for biofuels = decrease of soil erosion, increase organics, water retention (GAEC 4,5,6)
FC> F2	+1	By greening - GAEC 4,5,6
FC> F3	0	No particular interaction
FC> F4	+1	GAEC 4,5,6
FC> F5	+1	GAEC 4,5,6
FC> F6	+1	GAEC 1
FC> L1	+1	GAEC 4, 5 however quite ineffective
FC> L2	+1	GAEC 6
FC> L3	+1	Organics in soil can improve water capacity of soil (GAEC 6), as well as minimizing

		erosion (GAEC 5) and sufficient land cover (GAEC 4)
FC> L4	0	No particular interaction
FC> L5	0	No particular interaction
FC> L6	0	No particular interaction
FC> L7	0	No particular interaction
FC> L8	0	No particular interaction
FC> L9	0	No particular interaction
FC> L10	+1	GAEC 7 – protection of landscape features (balks, terraces, green valley lines, individual and group of woody plants, alleys, wetlands, fishponds); however do not support new ones for increasing landscape heterogeneity
FC> L11	+1	All GAEC standards are targeted on sustainable landscape management
FC> L12	0	No particular interaction
FC> L13	+1	Partly influenced by GAEC 4 – using winter crops, multiannual crops, intercrops and leaving stubble on fields
FC> W1	+1	Greening in catchment may be considered as retention of landscape feature (GAEC 7)
FC> W2	+1	Protected by GAEC 1
FC> W3	+1	Can be supported by: Organics in soil can improve water capacity of soil (GAEC 6), as well as minimizing erosion (GAEC 5) and sufficient land cover (GAEC 4), retention of landscape features as wetlands (GAEC 7)
FC> W4	+1	Can be supported by: Organics in soil can improve water capacity of soil (GAEC 6), as well as minimizing erosion (GAEC 5) and sufficient land cover (GAEC 4), retention of landscape features as wetlands, fishponds (GAEC 7)
FC> W5	+1	Partly influenced by GAEC 1 – buffer zones along water courses
FC> W6	+1	Support for irrigation by GAEC 2
FC> W7	+1	Can be supported by: Organics in soil can improve water capacity of soil (GAEC 6), as well as minimizing erosion (GAEC 5) and sufficient land cover (GAEC 4), retention of landscape features as wetlands, fishponds (GAEC 7)
FC> W8	0	No particular interaction
FC> W9	0	No particular interaction
FC> W10	0	No particular interaction
FC> W11	0	No particular interaction
FC> W12	+1	Can be supported by: buffer zones along watercourses (GAEC 1), organics in soil can improve water capacity of soil (GAEC 6), as well as minimizing erosion (GAEC 5) and sufficient land cover (GAEC 4), retention of landscape features as wetlands, fishponds (GAEC 7)
FC> C1	+1	All GAEC standards are considered as tools for climate change mitigation
FC> C2	+1	All GAEC standards are considered as tools for climate change adaptation
FC> C3	0	No particular interaction
FD> E1	-1	Greening reduce the land area where biofuels crops may grow
FD> F1	+1	Grass for biogas stations
FD> F2	+1	Greening is consider as non-productive function of agriculture
FD> F3	0	No particular interaction
FD> F4	+1	Greening – better water retention
FD> F5	+1	Is complementary
FD> F6	+1	Greening along water courses – buffer for pollutants
FD> L1	+3	Greening mitigate erosion
FD> L2	+1	Increase organic content
FD> L3	+1	Improves water retention ability of soil
FD> L4	+1	Where is greening, there is no concreate

FD> L5	+1	Better soil aeration by grassland
FD> L6	0	No particular interaction
FD> L7	0	No particular interaction
FD> L8	0	No particular interaction
FD> L9	+1	Land consolidation can modify landscape structure by greening
FD> L10	+3	Creates heterogeneous landscape structure
FD> L11	+1	Greening with all consequences on soil, water, land = part of sustainable landscape management
FD> L12	0	No particular interaction
FD> L13	+3	Helps crops diversification, rotation
FD> W1	+3	Regulates evapotranspiration, improves water cycle, better water retention
FD> W2	+3	Greening along water courses improves water quality
FD> W3	+3	Improves water retention ability of soil
FD> W4	+3	Regulates evapotranspiration, improves water cycle, better water retention
FD> W5	+3	Improves water retention ability of soil in floodplain
FD> W6	0	No particular interaction
FD> W7	+3	Direct relation
FD> W8	+1	Greening can be considered as good agriculture and environmental condition
FD> W9	0	No particular interaction
FD> W10	0	No particular interaction
FD> W11	0	No particular interaction
FD> W12	+3	Greening as a tool for soil improvement, water retention is directly related to drought mitigation
FD> C1	+3	Greening as a tool for soil improvement, water retention is directly related to climate change mitigation
FD> C2	+3	Greening as a tool for soil improvement, water retention is directly related to climate change adaptation
FD> C3	0	No particular interaction
FE> E1	0	No particular interaction
FE> F1	0	No particular interaction
FE> F2	+2	Measure M10 supports some NPFA – grassing arable land, biobelts, grassing of runoff corridors
FE> F3	+3	The measures can be in soil blocks evidence
FE> F4	0	No particular interaction
FE> F5	+1	All AECM are aimed as climate friendly
FE> F6	+1	Using biobelts, grassing of arable land
FE> L1	+1	By grassing of arable land
FE> L2	+1	By grassing of arable land
FE> L3	+1	By grassing of arable land
FE> L4	+1	By grassing of arable land
FE> L5	+1	By grassing of arable land
FE> L6	0	By grassing of arable land
FE> L7	0	No particular interaction
FE> L8	0	No particular interaction
FE> L9	0	No particular interaction
FE> L10	+1	By grassing of arable land, biobelts, grassing of runoff corridors
FE> L11	0	No particular interaction
FE> L12	0	No particular interaction
FE> L13	0	No particular interaction

FE> W1	+1	By grassing of arable land, biobelts, grassing of runoff corridors
FE> W2	+1	By grassing of arable land in floodplains
FE> W3	+1	By grassing of arable land, biobelts, grassing of runoff corridors
FE> W4	+1	By grassing of arable land, biobelts, grassing of runoff corridors
FE> W5	+1	By grassing of arable land, biobelts, grassing of runoff corridors
FE> W6	0	No particular interaction
FE> W7	+1	By grassing of arable land, biobelts, grassing of runoff corridors
FE> W8	+1	By grassing of arable land, biobelts, grassing of runoff corridors
FE> W9	0	No particular interaction
FE> W10	0	No particular interaction
FE> W11	0	No particular interaction
FE> W12	+1	By grassing of arable land, biobelts, grassing of runoff corridors
FE> C1	+1	Is targeted to climate change mitigation
FE> C2	+1	Creates measures for climate change adaptation
FE> C3	0	No particular interaction
FF> E1	0	No particular interaction
FF> F1	0	No particular interaction
FF> F2	+1	It should be the nature of ecological and organic farming
FF> F3	0	No particular interaction
FF> F4	0	No particular interaction
FF> F5	+1	It should be the nature of ecological and organic farming
FF> F6	+1	It should be the nature of ecological and organic farming
FF> L1	+1	It should be the nature of ecological and organic farming
FF> L2	+1	It should be the nature of ecological and organic farming
FF> L3	+1	It should be the nature of ecological and organic farming
FF> L4	+1	It should be the nature of ecological and organic farming
FF> L5	+1	It should be the nature of ecological and organic farming
FF> L6	0	No particular interaction
FF> L7	0	No particular interaction
FF> L8	+1	It should be the nature of ecological and organic farming
FF> L9	+1	It should be the nature of ecological and organic farming
FF> L10	+1	It should be the nature of ecological and organic farming
FF> L11	+1	It should be the nature of ecological and organic farming
FF> L12	0	No particular interaction
FF> L13	+1	It should be the nature of ecological and organic farming
FF> W1	+1	It should be the nature of ecological and organic farming
FF> W2	+1	It should be the nature of ecological and organic farming
FF> W3	+1	It should be the nature of ecological and organic farming
FF> W4	+1	It should be the nature of ecological and organic farming
FF> W5	0	No particular interaction
FF> W6	+1	It should be the nature of ecological and organic farming
FF> W7	+1	It should be the nature of ecological and organic farming
FF> W8	+1	It should be the nature of ecological and organic farming
FF> W9	0	No particular interaction
FF> W10	0	No particular interaction
FF> W11	+1	It should be the nature of ecological and organic farming
FF> W12	+1	It should be the nature of ecological and organic farming
FF> C1	+1	It should be the interest of ecological and organic farming
FF> C2	+1	It should be the interest of ecological and organic farming

FF> C3	0	No particular interaction
FG> E1	-1	Less arable land for biofuels production
FG> F1	0	No particular interaction
FG> F2	0	No particular interaction
FG> F3	0	No particular interaction
FG> F4	0	No particular interaction
FG> F5	0	No particular interaction
FG> F6	0	No particular interaction
FG> L1	+3	Reforestation, good forest health = decrease erosion
FG> L2	0	No particular interaction
FG> L3	+3	Forest restoration is crucial for water retention in soils – root system
FG> L4	0	No particular interaction
FG> L5	0	No particular interaction
FG> L6	-1	Reforestation means decrease of arable land area
FG> L7	0	No particular interaction
FG> L8	0	No particular interaction
FG> L9	+1	Reforestation = part of land consolidation process
FG> L10	+3	Contributes to heterogeneous landscape
FG> L11	+1	Forest development is essential part of sustainable land management in terms of small water cycle recovery and water retention
FG> L12	+1	Forests damage were the first case of using ecosystem services
FG> L13	0	No particular interaction
FG> W1	0	No particular interaction
FG> W2	0	No particular interaction
FG> W3	+3	Forest restoration is crucial for water retention in soils – root system
FG> W4	+3	Forest restoration is crucial for small water cycle restoration and climate
FG> W5	0	No particular interaction
FG> W6	+1	Construction of small reservoirs in forests
FG> W7	+3	Forest reduce runoff
FG> W8	0	No particular interaction
FG> W9	0	No particular interaction
FG> W10	0	No particular interaction
FG> W11	+3	Direct relation
FG> W12	+3	Forests attract precipitation, functional small water cycle, drought mitigation
FG> C1	+3	Forest directly mitigate climate change
FG> C2	+3	Influence local climate - adaptation
FG> C3	+3	Carbon sequestration
FH> E1	0	No particular interaction
FH> F1	0	No particular interaction
FH> F2	0	No particular interaction
FH> F3	0	No particular interaction
FH> F4	0	No particular interaction
FH> F5	0	No particular interaction
FH> F6	0	No particular interaction
FH> L1	-2	Compacted soil can increase erosion
FH> L2	0	No particular interaction
FH> L3	-3	The compacted soil absorbs less water, thereby accelerating its surface runoff, increasing the risk of floods and flooding.

FH> L4	0	No particular interaction
FH> L5	-3	Heavy machines are the main cause of soil compaction
FH> L6	0	No particular interaction
FH> L7	0	No particular interaction
FH> L8	0	No particular interaction
FH> L9	0	No particular interaction
FH> L10	-1	Heavy machines need large field blocks, homogenous landscape structure
FH> L11	0	No particular interaction
FH> L12	0	No particular interaction
FH> L13	0	No particular interaction
FH> W1	0	No particular interaction
FH> W2	0	No particular interaction
FH> W3	-1	Soil compaction by heavy machines = worsening water infiltration
FH> W4	-1	Soil compaction by heavy machines = worsening water infiltration
FH> W5	-1	Soil compaction by heavy machines in floodplains = worsening water infiltration
FH> W6	0	No particular interaction
FH> W7	-1	Soil compaction by heavy machines = increase runoff
FH> W8	0	No particular interaction
FH> W9	0	No particular interaction
FH> W10	0	No particular interaction
FH> W11	0	No particular interaction
FH> W12	-1	Soil compaction by heavy machines – worsening of water infiltration into soil = drought support
FH> C1	-1	Because of deterioration of soil characteristics and thus water retention, does not contribute to climate change mitigation
FH> C2	-1	Worsening of soil characteristics does not contribute to climate change adaptation
FH> C3	-1	Using heavy machines – no reduction of greenhouse gasses emission
FI> E1	0	No particular interaction
FI> F1	0	No particular interaction
FI> F2	0/+1	Small farms should interest in NPFA because of sustainable land management
FI> F3	0	No particular interaction
FI> F4	0/+1	Small farms should interest in F4 because of sustainable land management
FI> F5	0/+1	Small farms should interest in F5 because of sustainable land management
FI> F6	0/+1	Small farms should interest in F6 because of sustainable land management
FI> L1	0/+1	Small farms should interest in L1 because of sustainable land management
FI> L2	0/+1	Small farms should interest in L2 because of sustainable land management
FI> L3	0/+1	Small farms should interest in L3 because of sustainable land management
FI> L4	0	No particular interaction
FI> L5	0/+1	Small farms should interest in L5 because of sustainable land management
FI> L6	+1	Small farms should interest in L6 because of sustainable land management
FI> L7	-1	Small farms = private land property
FI> L8	+1	Small farms = private land property
FI> L9	+1	Establishing of small farms cannot be without land consolidation
FI> L10	+1	Small farms = landscape heterogeneity
FI> L11	0/+1	Small farms should interest in sustainable land management
FI> L12	0	No particular interaction
FI> L13	0/+1	Small farms should interest in L13 because of sustainable land management
FI> W1	0/+1	Small farms should interest in W1 because of sustainable land management
FI> W2	0/+1	Small farms should interest in W2 because of sustainable land management

FI> W3	0/+1	Small farms should interest in W3 because of sustainable land management
FI> W4	0/+1	Small farms should interest in W4 because of sustainable land management
FI> W5	0/+1	Small farms should interest in W5 because of sustainable land management
FI> W6	0/+1	Small farms should interest in W6 because of sustainable land management
FI> W7	0/+1	Small farms should interest in W7 because of sustainable land management
FI> W8	0/+1	Small farms should interest in W8 because of sustainable land management
FI> W9	-1/+1	Small farms should have an interest in water retention measures, however may be not willing to provide land in terms of public interest
FI> W10	0	No particular interaction
FI> W11	0/+1	Small farms should interest in W11 because of sustainable land management
FI> W12	0/+1	Small farms should interest in W12 because of sustainable land management
FI> C1	0/+1	Small farms should interest in climate change mitigation
FI> C2	0/+1	Small farms should interest in measures to climate change adaptation
FI> C3	0	No particular interaction
FJ> E1	0	No particular interaction
FJ> F1	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> F2	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> F3	0	No particular interaction
FJ> F4	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> F5	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> F6	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> L1	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> L2	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> L3	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> L4	0	No particular interaction
FJ> L5	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> L6	+1	It is supposed young farmers will be keen on keeping agriculture land
FJ> L7	-1	It is supposed young farmers will manage their own land
FJ> L8	+1	It is supposed young farmers will manage their own land
FJ> L9	+1	Small farms and young farmers will need to use land consolidation in order to modify land ownership and establish sustainable management measures in landscape
FJ> L10	+1	Young farmers = small farms = landscape heterogeneity
FJ> L11	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> L12	0	No particular interaction
FJ> L13	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> W1	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> W2	0/+1	It is supposed young farmers will be keen on best managing land practices leading

		to sustainable land management / or not??
FJ> W3	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> W4	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> W5	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> W6	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> W7	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> W8	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> W9	-1/+1	Young farmers should have an interest in water retention measures, however may be not willing to provide land in terms of public interest
FJ> W10	0	No particular interaction
FJ> W11	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> W12	0/+1	It is supposed young farmers will be keen on best managing land practices leading to sustainable land management / or not??
FJ> C1	0/+1	Young farmers should interest in climate change mitigation
FJ> C2	0/+1	Young farmers should interest in measures to climate change adaptation
FJ> C3	0	No particular interaction
FK> E1 To FK> C2 Except following:	0/+1	Training programme for farmers aimed at implementation of measures to mitigate negative impacts of drought and water scarcity may have some effect only if the farmers manage their own land, i.e. they are involved in sustainable management and interested in soil quality and water regime; Additionally, it can be successful only in case that compensations / subsidies for negative effects of climate or their poor farming will be substantially reduced; in practice the financial compensations usually prevails the effort for sustainable land management; otherwise there is no effect
FK> F3	0	No particular interaction
FK> L7	0	No particular interaction
FK> L12	0	No particular interaction
FK> W10	0	No particular interaction
FK> C3	0	No particular interaction

Land/soil instruments influencing energy, food/agriculture, land/soil, climate objectives

Interaction	Score	Justification
LA> E1	-1/+1	Decrease of arable land for biofuels production
LA> F1	+1	Decrease of arable land for biomass production / grassing
LA> F2	0	No particular interaction
LA> F3	0	No particular interaction
LA> F4	0	No particular interaction
LA> F5	0	No particular interaction
LA> F6	0	No particular interaction
LA> L1	0/+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective L1 is directly related with
LA> L2	0/+1	State land reserve should serve as a possibility to own land on which technical and

		natural measures for improvement landscape water regime should be realized and objective L2 is directly related with
LA> L3	0/+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective L3 is directly related with
LA> L4	+1	State will not sell arable land for industrial development (hopefully)
LA> L5	0/+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective L5 is directly related with
LA> L6	+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized will not have interest in L6
LA> L7	+3	Direct relation
LA> L8	-3	Decrease private land ownership
LA> L9	+1	Changing land ownership needs land consolidation
LA> L10	0/+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective L10 is directly related with
LA> L11	0/+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective L11 is directly related with
LA> L12	0	No particular interaction
LA> L13	0	No particular interaction
LA> W1	+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective W1 is directly related with
LA> W2	+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective W2 is directly related with
LA> W3	+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective W3 is directly related with
LA> W4	+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective W4 is directly related with
LA> W5	+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective W5 is directly related with
LA> W6	+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective W6 is directly related with
LA> W7	+1	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective W7 is directly related with
LA> W8	0	No particular interaction
LA> W9	+3	Direct relation
LA> W10	0	No particular interaction
LA> W11	0	No particular interaction
LA> W12	+3	State land reserve should serve as a possibility to own land on which technical and natural measures for improvement landscape water regime should be realized and objective W12 is directly related with

LA> C1	+1	State land property = realization of water retention measures = climate change mitigation
LA> C2	+1	State land property = realization of water retention measures = climate change adaptation
LA> C3	0	No particular interaction
LB> E1	0	No particular interaction
LB> F1	0	No particular interaction
LB> F2	+1	Can design landscape structure in accordance with NPFA
LB> F3	+1	Needs information from the soil blocks evidence
LB> F4	+1	Plan of common facilities can involve agrotechnical measures
LB> F5	+1	Can design landscape structure and measures in accordance with agricultural climate favourable procedures
LB> F6	+1	Can involve measures for control of land management in floodplains in order to minimize floods, increase water retention
LB> L1	+3	Can design measures to decrease erosion
LB> L2	0	No particular interaction
LB> L3	+3	Design measures for water retention in soil
LB> L4	+3	design land use and its changes
LB> L5	0	No particular interaction
LB> L6	+3	Design land use changes
LB> L7	-1/+1	Rearrange land ownership
LB> L8	-1/+1	Rearrange land ownership
LB> L9	+1	Direct relation
LB> L10	+3	Design landscape structure
LB> L11	+3	Design landscape structure, soil and water protection measures, however is not responsible for management
LB> L12	+1	When designing new landscape – ecosystem services assessment can be taken into consideration
LB> L13	+1	Plan of common facilities can involve agrotechnical measures
LB> W1	+3	Can design measures of greening with respect to runoff, erosion, etc.
LB> W2	+3	Design buffer zones
LB> W3	+3	Through land consolidation etc. technical and natural measures for water retention may be realized
LB> W4	+3	Through land consolidation etc. technical and natural measures for water retention may be realized, including land ownership
LB> W5	+3	Through land consolidation etc. technical and natural measures for water retention may be realized, including land ownership
LB> W6	+1	Through land consolidation reservoirs and irrigation systems may be realized, including land ownership
LB> W7	+3	Key instrument for runoff decrease through landscape structure adaptation
LB> W8	0	No particular interaction
LB> W9	+2	Is a tool for land ownership arrangements
LB> W10	+1	Direct relation
LB> W11	+3	Key instrument for water retention measures design
LB> W12	+3	Key instrument for landscape structure adaptation and measures for drought mitigation
LB> C1	+1	instrument for climate change mitigation measures
LB> C2	+1	instrument for climate change adaptation measures
LB> C3	0	No particular interaction

LC> E1	0	No particular interaction
LC> F1	0	No particular interaction
LC> F2	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management
LC> F3	0	No particular interaction
LC> F4	0	No particular interaction
LC> F5	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management
LC> F6	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management
LC> L1	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management
LC> L2	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management
LC> L3	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management
LC> L4	+1	farming on own land supposes not selling it (unless its necessary) for industrial development
LC> L5	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management
LC> L6	+1	farming on own land supposes not selling it (unless its necessary) for industrial development
LC> L7	-3	Private land = no state land
LC> L8	+3	Direct relation
LC> L9	+2	Changing ownership solves land consolidation
LC> L10	+2	It is supposed that farming on own land = better relation to land, its quality and its sustainable management and an effort for landscape heterogeneity; suppose = more small farms = increased landscape heterogeneity
LC> L11	+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management
LC> L12	0	No particular interaction
LC> L13	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management, crops diversification, restoration of sowing procedures
LC> W1	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management; thus is establishing greening areas in field blocks
LC> W2	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management; respecting buffer zones along watercourses
LC> W3	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management thus is soil water retention improvement
LC> W4	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management thus is restoration of water regime
LC> W5	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management; thus is proper floodplains management
LC> W6	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management; thus is construction of small reservoirs if needed
LC> W7	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management; thus is reduction of surface runoff of water
LC> W8	+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management and following the rules of GAEC and cross compliance
LC> W9	-1/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable water management; reluctance to construct technical measures of

		public interest for water retention on private land
LC> W10	0	No particular interaction
LC> W11	0/+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable water management
LC> W12	+3	It is supposed that farming on own land = better relation to land, its quality and its sustainable water management; drought mitigation should be priority
LC> C1	+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management = climate change mitigation
LC> C2	+1	It is supposed that farming on own land = better relation to land, its quality and its sustainable management = climate change adaptation
LC> C3	0	No particular interaction
LD> E1	-1	Planting biofuels does not protect soil
LD> F1	-1/+1	Planting maize and rape does not protect soil / grassing for biofuels is soil protection
LD> F2	+1	NPFA should contribute to soil protection
LD> F3	+1	Is supported by the act
LD> F4	+1	It is in compliance with the act; is a requirement imposed by this act
LD> F5	+1	It is in compliance with the act; is a requirement imposed by this act
LD> F6	+1	It is in compliance with the act; is a requirement imposed by this act
LD> L1	+3	It is in compliance with the act; is a requirement imposed by this act
LD> L2	+3	It is in compliance with the act; is a requirement imposed by this act
LD> L3	+3	It is in compliance with the act; is a requirement imposed by this act
LD> L4	+3	It is in compliance with the act; is a requirement imposed by this act
LD> L5	+3	It is in compliance with the act; is a requirement imposed by this act
LD> L6	+3	It is in compliance with the act; is a requirement imposed by this act
LD> L7	0	No particular interaction
LD> L8	0	No particular interaction
LD> L9	+1	Land consolidation should respect the act
LD> L10	+1	The act touches landscape features, agriculture land fund and its changes
LD> L11	+1	It is in compliance with the act; is a requirement imposed by this act
LD> L12	0	No particular interaction
LD> L13	0	No particular interaction
LD> W1	0/+1	Minimize disruption of the organization of agricultural land fund, hydrological and drainage conditions in the area
LD> W2	0/+1	Minimize disruption of the organization of agricultural land fund, hydrological and drainage conditions in the area
LD> W3	0/+1	Minimize disruption of the organization of agricultural land fund, hydrological and drainage conditions in the area
LD> W4	0/+1	Minimize disruption of the organization of agricultural land fund, hydrological and drainage conditions in the area
LD> W5	0/+1	The removal of land from the agricultural land fund may occur for the restoration of natural and technical restoration of watercourses
LD> W6	+1	Fishponds = agriculture land fund
LD> W7	0/+1	Minimize disruption of the organization of agricultural land fund, hydrological and drainage conditions in the area
LD> W8	+1	It is in compliance with the act
LD> W9	0	No particular interaction
LD> W10	0	No particular interaction
LD> W11	0	No particular interaction
LD> W12	0/+1	Minimize disruption of the organization of agricultural land fund, hydrological and

		drainage conditions in the area
LD> C1	0	No particular interaction
LD> C2	0	No particular interaction
LD> C3	0	No particular interaction
LE> E1	0	No particular interaction
LE> F1	0	No particular interaction
LE> F2	+2	Support greening, soil protection measures etc. = NPFA
LE> F3	0	No particular interaction
LE> F4	+1	Supports greening, soil protection
LE> F5	+1	Supports greening, soil protection
LE> F6	+1	Supports greening, soil protection, restoration of shore stands, floodplains revitalization
LE> L1	+3	Soil protection measures, greening
LE> L2	+1	Soil protection measures, greening, …
LE> L3	+1	Soil protection measures, greening, …
LE> L4	0	No particular interaction
LE> L5	+1	Soil protection measures
LE> L6	0	No particular interaction
LE> L7	0	No particular interaction
LE> L8	0	No particular interaction
LE> L9	+3	The measures from the programme are solved/designed by land consolidation
LE> L10	+3	Landscape heterogeneity measures are subsidies from the programme
LE> L11	+3	The programme realizes sustainable landscape measures
LE> L12	+1	Support of natural landscape functions can be justified by ecosystem functions
LE> L13	0	No particular interaction
LE> W1	+3	Direct support from the programmes
LE> W2	+3	Direct support from the programmes
LE> W3	+3	Direct support from the programmes
LE> W4	+3	Direct support from the programmes
LE> W5	+3	Direct support from the programmes
LE> W6	0	No particular interaction
LE> W7	+3	Direct support from the programmes
LE> W8	+2	Direct support from the programmes
LE> W9	0	No particular interaction
LE> W10	+1	The measures from the programmes are solved/designed by land consolidation
LE> W11	+1	Partly supported with the programmes
LE> W12	+3	Measures for drought mitigation – greening, restoration of shore stands, soil improvement, runoff reduction, etc. is supported by the programmes
LE> C1	+3	All actions subsidies from these programmes are aimed at climate change mitigation
LE> C2	+3	All actions subsidies from these programmes are aimed as climate change adaptation
LE> C3	0	No particular interaction
LF> E1	0	No particular interaction
LF> F1	0	No particular interaction
LF> F2	+1	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention

LF> F3	+1	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention
LF> F4	0	
LF> F5	+1	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention
LF> F6	+1	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention
LF> L1	+1	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention
LF> L2	0	No particular interaction
LF> L3	+1	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention
LF> L4	0	No particular interaction
LF> L5	0	No particular interaction
LF> L6	+1	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; arable land should be preserved in order to perform non-productive functions
LF> L7	0	No particular interaction
LF> L8	0	No particular interaction
LF> L9	+2	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; data = data support for land consolidation
LF> L10	+3	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; HD = valuable tool for landscape reconstruction
LF> L11	+1	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention
LF> L12	+1	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; high ecosystem services value of wet areas
LF> L13	+1	Not planting crops on originally wet areas = landscape has a good memory
LF> W1	+3	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; data = for landscape restoration in order to improve

		water retention
LF> W2	+3	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; data = for landscape restoration in order to improve water retention
LF> W3	+1	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; data = for landscape restoration in order to improve water retention
LF> W4	+3	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; data = for landscape restoration in order to improve water retention
LF> W5	+2	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; data = for landscape restoration in order to improve water retention
LF> W6	+3	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; data = for landscape restoration in order to improve water retention
LF> W7	+3	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; data = for landscape restoration in order to improve water retention
LF> W8	0	No particular interaction
LF> W9	0	No particular interaction
LF> W10	0	No particular interaction
LF> W11	+3	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; data = for landscape restoration in order to improve water retention
LF> W12	+3	Historical data (HD) can support greening and wet meadows, etc. From the data is apparent which areas were grassland, wet meadows, stream areas, etc. our ancestors respected these non productive features as protection against erosion, natural water retention; data = for landscape restoration in order to improve water retention
LF> C1	+1	Data = for landscape restoration in terms of climate mitigation = water retention
LF> C2	+1	Data = for landscape restoration in terms of climate adaptation = water retention
LF> C3	0	No particular interaction

Water instruments influencing energy, food/agriculture, land/soil, climate objectives

Interaction	Score	Justification
WA> E1	-3	Define wide-rows crops as a thread for good water quality and retention

WA> F1	+1	Grassing (e.g. grass for biogas stations) supports good water quality and retention
WA> F2	0	No particular interaction
WA> F3	0	No particular interaction
WA> F4	+1	Need to keep AECM in agriculture
WA> F5	0	No particular interaction
WA> F6	+3	Water courses protection against pollution (mainly point not spatial from agriculture); spatial pollution should be regulated by Common agriculture policy
WA> L1	+1	Establishing of antierosion measures on agriculture land, spatial pollution
WA> L2	+1	Increase organics in soil = decrease of erosion, spatial pollution
WA> L3	+1	Defined objective in river basin plan
WA> L4	+1	Improves water retention = Defined objective in river basin plan
WA> L5	+1	Improves water retention = Defined objective in river basin plan
WA> L6	0	No particular interaction
WA> L7	+3	For the optimization of the landscape water regime is the main obstacle ownership relations, ie the lack of land owned by the state
WA> L8	-3	For the optimization of the landscape water regime is the main obstacle ownership relations, ie the lack of land owned by the state
WA> L9	+3	Land consolidation modify land ownership and may design measures for landscape water retention improvement
WA> L10	+3	Define landscape heterogeneity as important for water retention
WA> L11	+1	Agriculture and thus sustainable land management is crucial for minimizing spatial pollution and water retention
WA> L12	0	No particular interaction
WA> L13	+3	Agriculture is responsible for spatial pollution, crops as a tool for decrease erosion
WA> W1	+3	Water resources protection, minimize spatial pollution
WA> W2	+3	Water resources protection, minimize spatial pollution
WA> W3	+3	Mentioned as an target needed to be reached
WA> W4	+3	Mentioned as an target needed to be reached
WA> W5	+3	Mentioned as an target needed to be reached
WA> W6	0	No particular interaction
WA> W7	+3	Defined objective in river basin plan
WA> W8	+3	Strict application of GAEC and cross compliance as crucial for decrease of spatial pollution and water retention
WA> W9	+3	Defined as important objective in the river basin plan
WA> W10	+3	Defined as important objective in the river basin plan
WA> W11	+1	Essential for water retention and measures
WA> W12	+1	As one objective for drought mitigation in the river basin plan
WA> C1	+1	Climate change mitigation is essential to mention all documents; drought and floods mitigation
WA> C2	+1	Climate change adaptation is essential to mention all documents; drought and floods adaptation, measures
WA> C3	0	No particular interaction
WB> E1	0	No particular interaction
WB> F1	0	No particular interaction
WB> F2	0	No particular interaction
WB> F3	0	No particular interaction
WB> F4	+1	AECM as a measure supporting grassing of eroded arable land, including grassland cultivation
WB> F5	+1	Accordance with AECM
WB> F6	+1	Flood protection consists in good condition of floodplains and its natural retention

		capacity
WB> L1	+1	Decreasing erosion = flood protection
WB> L2	+1	Increasing organics in soil = flood protection
WB> L3	+1	Improving soil retention ability and infiltration = flood protection
WB> L4	+1	Large proportion of urban areas in river basins = negative effect on floods; as a flood protection = an effort to decrease soil sealing at least in floodplains
WB> L5	+1	Soil compaction = main cause of floods
WB> L6	-1	Flood protection measures on agriculture land
WB> L7	+1	Lack of state land reserves for the implementation of complex land consolidation and flood protection measures = interest in increasing state land property
WB> L8	-1	Lack of state land reserves for the implementation of complex land consolidation and flood protection measures = interest in increasing state land property
WB> L9	+1	Part of the land consolidation proposals are plans of common facilities, which include, among other, water management and anti-erosion measures. Support for land consolidation
WB> L10	+1	Heterogeneous landscape = more retention ability = floods protection
WB> L11	+1	Need of sustainable land management as a tool for flood protection
WB> L12	+1	Role of floodplains in water retention is supported by ecosystem services
WB> L13	+1	Planting crops with respecting soil characteristics in order to mitigate floods
WB> W1	+1	Flood mitigation measure
WB> W2	+1	Flood mitigation measure
WB> W3	+1	Soil water retention = floods protection
WB> W4	+1	Restoration of retention ability of landscape = floods protection
WB> W5	+1	Flood mitigation measure
WB> W6	+3	Small water reservoirs are considered as flood protection
WB> W7	+2	Runoff reduction = floods prevention
WB> W8	+2	The Cross Compliance System and GAEC 5 contribute to tackling the problem of soil erosion and thus indirectly to preventing floods.
WB> W9	0	No particular interaction
WB> W10	+2	Part of the land consolidation proposals are plans of common facilities, which include, among other, water management and anti-erosion measures. Support for land consolidation
WB> W11	+2	Support for water retention in forests
WB> W12	0	Unfortunately no particular interaction; drought and flood mitigation should be solved together
WB> C1	+1	Flood mitigation = climate change mitigation
WB> C2	+1	Flood mitigation = climate change adaptation
WB> C3	0	No particular interaction
WC> E1	0	No particular interaction
WC> F1	0	No particular interaction
WC> F2	0	No particular interaction
WC> F3	0	No particular interaction
WC> F4	0	No particular interaction
WC> F5	0	No particular interaction
WC> F6	+1	Mitigate unfavourable effects of agriculture on water
WC> L1	0	No particular interaction – Statement that: Restrictions and inadequate enforcement of changes in farmland management in catchment areas to enhance rainfall retention, slowing down of runoff, and soil erosion.
WC> L2	0	
WC> L3	0	
WC> L4	0	
WC> L5	0	

WC> L6	0	
WC> L7	0	
WC> L8	0	
WC> L9	0	
WC> L10	0	
WC> L11	0	
WC> L12	0	
WC> L13	0	
WC> W1	0	
WC> W2	0	
WC> W3	+1	Realization through extending and strengthening the application GAEC standards to the benefit of water management of catchments
WC> W4	+1	Realization through extending and strengthening the application GAEC standards to the benefit of water management of catchments
WC> W5	+1	Support revitalization of watercourses
WC> W6	+1	to support the development of a network of small water reservoirs (including fishponds) that have a positive impact on many aspects of water in the landscape (flood protection, irrigation, groundwater stabilization, microclimate impact, new habitats)
WC> W7	+1	Defined target in conception
WC> W8	+1	GAEC and cross compliance requirements are going to be implied by Ministry of Agriculture in water politics
WC> W9	0	No particular interaction - Land property as a barrier for flood protection
WC> W10	0	No particular interaction
WC> W11	0	No particular interaction
WC> W12	0	No particular interaction – only statement the drought problem should be solved in future
WC> C1	+1	Climate change mitigation in terms of floods protection, drought mitigation will be developed
WC> C2	+1	Statement: It is necessary take into consideration adaptation measures in water policy
WC> C3	0	No particular interaction
WD> E1	0	No particular interaction
WD> F1	0	No particular interaction
WD> F2	0	No particular interaction
WD> F3	0	No particular interaction
WD> F4	0	No particular interaction
WD> F5	0	No particular interaction
WD> F6	+1	Landowners are obliged, unless otherwise provided by special legal regulation, to provide such management so as not to worsen the water conditions.
WD> L1	+1	Landowners are obliged, unless otherwise provided by special legal regulation, to provide such management so as not to worsen the water conditions. In particular, they are required to ensure that the drainage conditions are not deteriorating, the soil is not discharged by erosive water activities
WD> L2	0	No particular interaction
WD> L3	0	No particular interaction
WD> L4	0	No particular interaction
WD> L5	0/+1	Landowners are obliged, unless otherwise provided by special legal regulation, to provide such management so as not to worsen the water conditions. In particular, they are required to ensure that the drainage conditions are not deteriorating, the

		soil is not discharged by erosive water activities
WD> L6	0	No particular interaction
WD> L7	0	No particular interaction
WD> L8	0	No particular interaction
WD> L9	+1	In terms of flood protection
WD> L10	0	No particular interaction
WD> L11	+1	Sustainable land management is not against water act
WD> L12	0	No particular interaction
WD> L13	0	No particular interaction
WD> W1	0	No particular interaction
WD> W2	+1	In terms of flood protection
WD> W3	+1	Flood risk management plans may also include support for sustainable land use, soil water retention
WD> W4	0	No particular interaction
WD> W5	+1	Increase retention ability of floodplains to mitigate floods
WD> W6	+1	As flood protection
WD> W7	+1	As a flood protection
WD> W8	0	No particular interaction
WD> W9	0	No particular interaction
WD> W10	0	No particular interaction
WD> W11	0	No particular interaction
WD> W12	+3	The amendment of water act is targeted on drought mitigation and protection measures.
WD> C1	+1	Floods mitigation = climate change mitigation
WD> C2	+1	Floods mitigation = climate change adaptation
WD> C3	0	No particular interaction
WE> E1	0	No particular interaction
WE> F1	0	No particular interaction
WE> F2	+2	Green infrastructure support as a part of 1.pillar of CAP – areas of ecological interest
WE> F3	0	No particular interaction
WE> F4	+1	Green infrastructure support as a part of 1.pillar of CAP – areas of ecological interest
WE> F5	+1	Green infrastructure support as a part of 1.pillar of CAP – areas of ecological interest
WE> F6	+3	Support green infrastructure along watercourses
WE> L1	+2	Support of green infrastructure will mitigate erosion
WE> L2	0	No particular interaction
WE> L3	0	No particular interaction
WE> L4	0	No particular interaction
WE> L5	0	No particular interaction
WE> L6	0	No particular interaction
WE> L7	0	No particular interaction
WE> L8	0	No particular interaction
WE> L9	0	No particular interaction
WE> L10	+3	Green infrastructure and wetlands contributes to landscape heterogeneity
WE> L11	0	No particular interaction
WE> L12	+1	Green infrastructure can help ensure providing of ecosystem services in line with the EU biodiversity strategy
WE> L13	0	No particular interaction

WE> W1	+3	Green infrastructure as a main pillar for water retention and its quality improvement - areas of ecological interest (1. CAP pillar)
WE> W2	+3	Support of buffer zones to protect biodiversity, improve water quality, mitigate floods and drought - areas of ecological interest (1. CAP pillar)
WE> W3	0	No particular interaction
WE> W4	+3	Natural water retention in landscape by green infrastructure = ecological 1. pillar of the CAP to support measures for natural water retention (through areas used in ecological interest). Green infrastructure, wetlands and restoration of naturally flooded areas for water retention.
WE> W5	+3	Water resources protection is realized through watercourses and floodplains restoration
WE> W6	+3	Fishponds = water accumulation and retention in landscape, floods and erosion prevention; improve irrigation effectivity
WE> W7	+3	Green infrastructure reduces runoff
WE> W8	0	No particular interaction
WE> W9	0	No particular interaction
WE> W10	0	No particular interaction
WE> W11	0	No particular interaction
WE> W12	+3	Green infrastructure, wetlands and restoration of naturally flooded areas for water retention and drought mitigation
WE> C1	+1	Is in accordance with climate change mitigation measures
WE> C2	+1	Is in accordance with climate change adaptation measures
WE> C3	+1	Industrial Emissions directive: ensure that issued emissions permits set emission limits that correspond with best available techniques and take into account relevant water policy objectives.
WF> E1	-1	Support for sustainable landscape management not biofuels production
WF> F1	-1	Support for sustainable landscape management not biofuels production
WF> F2	+1	Support greening, operating of technical water measurements (management of water management works used to belong under the State agricultural administration)
WF> F3	0	No particular interaction
WF> F4	0	No particular interaction AECM are voluntary and quite ineffective in drought mitigation
WF> F5	+1	Agriculture procedures favourable to climate cannot be harmful, however concerning drought mitigation, not too effective
WF> F6	+1	Floodplains should not be ploughed up
WF> L1	+3	All objectives are directly related to drought mitigation; however their realization in landscape is a question
WF> L2	+3	
WF> L3	+3	
WF> L4	+3	
WF> L5	+3	
WF> L6	+3	
WF> L7	+3	
WF> L8	+3	
WF> L9	+3	Support rather technical water retention measures than only landscape structure adaptation (new unpaved roads construction etc.)
WF> L10	+3	Support rather technical water retention measures than only landscape structure adaptation; mosaic of technical and biological (greening) measures) From the point of complex solution, using technical and semi-technical measures in the area of the river basin (eg decentralized rainfall in the site of impact) and

		organizational and ecosystem measures (eg restoration of landscape features, revitalization and renaturation of watercourses and floodplain forests, spring areas and other wetlands)
WF> L11	+1	Sustainable landscape management = drought prevention
WF> L12	0	No particular interaction
WF> L13	+1	Respecting ecological niche of crops may help to mitigate drought, prevent erosion, improve soil quality, retain more water
WF> W1	+3	All objectives are directly related to drought mitigation; however their realization in landscape is a question
WF> W2	+3	
WF> W3	+3	
WF> W4	+3	
WF> W5	+3	
WF> W6	+1	
WF> W7	+3	
WF> W8	0	No particular interaction AECM are voluntary and quite ineffective in drought mitigation
WF> W9	+2	Land ownership will be necessary for drought mitigation measures – task for land consolidation
WF> W10	+2	Land ownership will be necessary for drought mitigation measures – task for land consolidation
WF> W11	+3	Crucial for drought mitigation
WF> W12	+3	The concept design landscape measures in order to mitigate drought
WF> C1	+3	Drought mitigation = climate change mitigation
WF> C2	+3	Drought mitigation = climate change adaptation
WF> C3	0	No particular interaction
WG> E1	0	No particular interaction
WG> F1	0	No particular interaction
WG> F2	+2	NPFA = water retention by combination of biotic (greening, etc.) and technical measurement on agriculture land
WG> F3	+1	Technical and natural measures will need evidence
WG> F4	0	No particular interaction
WG> F5	0	No particular interaction
WG> F6	+1	Floodplains without intensive farming
WG> L1	+3	By technical and natural measures
WG> L2	+1	Natural measure for landscape water retention
WG> L3	+1	Natural measure for landscape water retention
WG> L4	0	No particular interaction
WG> L5	+3	Natural measure for landscape water retention
WG> L6	0	No particular interaction
WG> L7	+3	Necessary to realize the measures; define water retention in landscape as public interest
WG> L8	-1	Private land makes difficult to realize technical measures on arable land
WG> L9	+3	Land consolidation is needed to implement the technical measures
WG> L10	+3	Heterogeneous structure in terms of technical measures (trenches, polders, small ponds, balks…)
WG> L11	+1	Is necessary to complement technical measures
WG> L12	0	No particular interaction
WG> L13	0	No particular interaction
WG> W1	+3	Greening as biological measure supporting technical ones
WG> W2	+3	Direct relation

WG> W3	+3	Direct relation; difference between soil water retention of permanent grassland and arable land is 10 %
WG> W4	+3	Direct relation
WG> W5	+3	Direct relation
WG> W6	+1	Small ponds as technical measures
WG> W7	+3	Direct relation
WG> W8	0	No particular interaction
WG> W9	+3	Private land makes difficult to realize technical measures on arable land
WG> W10	+3	With an emphasis on water retention measures
WG> W11	+3	Direct relation
WG> W12	+3	Direct relation
WG> C1	+3	Technical and natural measures for water retention = climate change mitigation
WG> C2	+3	Technical and natural measures for water retention = climate change adaptation
WG> C3	0	No particular interaction
WH> E1	0	No particular interaction
WH> F1	0	No particular interaction
WH> F2	+2	Subsidies for NPFA = restoration of extinct ponds, wetlands, biological water retention measures
WH> F3	0	No particular interaction
WH> F4	0	No particular interaction
WH> F5	0	No particular interaction
WH> F6	+1	Payments for greening floodplains – no intensive agriculture
WH> L1	+1	Subsidies for effective antierosion measures (GAEC efficiency is approx. 10 %)
WH> L2	+1	Subsidies for strengthening retention capacity of the soil – increase organics and deepen soil profile
WH> L3	+1	Subsidies for strengthening retention capacity of the soil – increase organics and deepen soil profile
WH> L4	0	No particular interaction
WH> L5	+1	Subsidies for strengthening retention capacity of the soil = decrease of soil compaction
WH> L6	0	No particular interaction
WH> L7	+1	To allocate part of state budget for increase land state reserves
WH> L8	0	No particular interaction
WH> L9	0	No particular interaction
WH> L10	0	No particular interaction
WH> L11	0	No particular interaction
WH> L12	0	No particular interaction
WH> L13	0	No particular interaction
WH> W1	+1	Support for complex water retention measures – greening with technical measures
WH> W2	+1	Payments for greening floodplains – no intensive agriculture
WH> W3	+3	Subsidies for strengthening retention capacity of the soil – increase organics and deepen soil profile
WH> W4	+3	Subsidies for complex water retention measurements
WH> W5	+3	Subsidies for revitalization of water courses
WH> W6	+3	Increase wetlands and small water reservoirs on agriculture land by private investments
WH> W7	+3	Financial support for measures targeted on runoff reduction
WH> W8	0	No particular interaction
WH> W9	+1	Support private investments in water retention measures

WH> W10	0	No particular interaction
WH> W11	+1	Subsidies for forest water regime improvement and restoration
WH> W12	+1	Subsidies for water retention measures = drought mitigation
WH> C1	+1	Water retention = climate change mitigation
WH> C2	+1	Water retention = climate change adaptation
WH> C3	0	No particular interaction

Climate instruments influencing energy, food/agriculture, land/soil, water objectives

Interaction	Score	Justification
CA> E1 to CA> W12	0	No particular interaction
CA> C1	-3/+3	Emissions trading is considered as significant tool for greenhouse gasses reduction and thus climate change mitigation and GHGS are considered as the main factor responsible for climate change / For this reason, the direct influence of vegetation and the retention of water in the landscape on the climate is neglected.
CA> C2	0	No particular interaction
CA> C3	+3	instrument supporting greenhouse gasses reduction/redistribution
CB> E1 to CB> W12	0	No particular interaction
CB> C1	-3/+3	Greenhouse gasses reduction = climate change mitigation / neglect of direct effect of vegetation and water on climate; the priorities are in GHGS reduction and not in sustainable landscape management that significantly influence the climate change
CB> C2	0	No particular interaction
CB> C3	+3	Direct relation
CC> E1	0	No particular interaction
CC> F1	0	No particular interaction
CC> F2	+1	Nitrogen retention through greening
CC> F3	0	No particular interaction
CC> F4	+1	Carbon sequestration in soil, nitrogen retention by grassland
CC> F5	+1	Carbon sequestration in soil, nitrogen retention by grassland
CC> F6	-1/+1	High carbon accumulation in wetland soils, by draining and intensive cultivation carbon is released
CC> L1	+1	Decrease erosion, mineralization, decomposition = carbon accumulation
CC> L2	+1	Increasing organics = higher carbon storage, nitrogen
CC> L3	+1	Wet soil accumulate more carbon
CC> L4	0	No particular interaction
CC> L5	0	No particular interaction
CC> L6	0	No particular interaction
CC> L7	0	No particular interaction
CC> L8	0	No particular interaction
CC> L9	0	No particular interaction
CC> L10	0	No particular interaction
CC> L11	+1	Sustainable land management of meadows – different management practices influence carbon storage and nitrogen
CC> L12	0	No particular interaction
CC> L13	0	No particular interaction / maybe crop management practices (rotation) influence C storage

CC> W1	+1	Greening = nitrogen retention, carbon storage in biomass
CC> W2	+1	Wetlands = carbon storage, nitrogen buffer; floodplain forest = carbon storage, its damage = C release
CC> W3	0	No particular interaction
CC> W4	0	No particular interaction
CC> W5	+1	Wetlands = carbon storage, nitrogen buffer; floodplain forest = carbon storage, its damage = C release
CC> W6	+1	Fishponds as nitrogen and carbon storage = depend on its mesotrophy/hypertrophy
CC> W7	0	No particular interaction
CC> W8	+1	Controlled grazing, minimum grass coverage, less agriculture intensification
CC> W9	0	No particular interaction
CC> W10	0	No particular interaction
CC> W11	+1	Waterlogged forests = carbon storage
CC> W12	0	No particular interaction
CC> C1	+1	Carbon sequestration = main (rather ineffective) tool for climate change mitigation (when compared to water retention)
CC> C2	+1	Carbon sequestration = (rather ineffective) adaptation measure (when compared to water retention)
CC> C3	+3	Carbon sequestration = greenhouse gasses reduction

DE-CZ-SK Transboundary Case Study
Policy analysis
Blocks 1 + 2, German part

AUTHORS: Chris Hodel, Tobias Conradt, PIK

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Document version: finalized block 1 + 2 results

Executive summary

The German part of the transboundary case study contains the federal states formerly part of the German Democratic Republic which are still the economically weakest in Germany and suffer e.g. under the age structure of their population (DESTATIS 2017).

Relevant stakeholders include policy-making bodies of the EU and Germany, state authorities, NGOs, corporations and social groups like farmer or forest owners. The policy makers are the target of influencing efforts by the other stakeholders, to further their own objectives. The influence and power of specific stakeholders depends i.a. on their economic resources (e.g. energy providers) or the ability to gather support (NGOs). Influence and power can be compromised by insufficient organization or fragmentation (citizens), which can hinder the usage of opportunities.

The Nexus critical objectives (NCOs), as well as the respective Nexus critical instruments (NCIs), often compliment and support the advancement of each other. This is mostly the case for the environment and sustainability related NCOs e.g. promotion of renewable energies, reduction of water pollution and forest protection. The achievement of one of those NCOs also promotes the other and is often even an indispensable part of another objective. So is the reduction of emissions and water pollution necessary to reach sustainability. The importance of awareness can't be highlighted enough.

But there are also those NCOs, that are not compatible in any way, e.g. mining and sustainability. Especially the NCOs regarding food production have a difficult relationship with the NCO "reduction of water pollution", since fertilizers are one of the main reasons for surface and groundwater pollution. The promotion of biofuels also strains the production to a certain degree.

Some NCIs constrain the achievement of certain objectives, so are farmers pressed by the desire to reduce the negative impact on the environment and are often the bereaved when new policies are implemented. Expropriations for e.g. mining purposes can lead to social problems and damaging impact on the environment. Regulations and standards are necessary to achieve the NCOs. At the same time is monitoring adherence to these standards inevitable, since regulations that are not controlled could as well be non-existent. There must be consequences for breaching these regulations since controlling alone isn't effective. Every NCI raises awareness about matters concerning the respective sector and the environment, since people and corporations need to concern themselves with the consequences.

Policies with relevance for the case study are made and implemented on several scales of government: EU – National – Federal state – Municipality. While the delegation of policies to a lower level should increase the accuracy with which they can be implemented, its often instead a source of problems, especially in Germany. Reason for this is the relative distinct amount of independence for the federal states regarding policy-making. While mostly similar, federal states still have their own laws and regulations. New national laws need to be implemented on federal state level, which increases the time needed to react to new developments. There is shared responsibility in many areas, which results in difficulties e.g. related to project funding. Both, Germany and the respective federal states, sometimes try to avoid paying for projects, hoping the other will do it instead. Policies with the same objective can hinder each other, if they are not sufficiently coordinated and the different levels of government are unable to work together. The implementation of policies is often slowed down or incomplete to uphold interests of the economy instead, which are often held in higher regard than the achievement of policy objectives.

Formal practices and rules mostly consist of councils and meetings of authorities, whose objective is the coordination of policies and the support of decision-making. Informal practices and arrangements are mostly done by small groups of individuals with common (economical) interests and trust in each other e.g. farmers and forest owners.

The success of policies is much more likely, if all involved parties profit from the adherence to the regulations and objectives. Failing policies are often a consequence of lacking willingness to fully commit to a policy change, sometimes out of concerns for the economy. Interests of the economy are often held in higher regard than the achievement of e.g. sustainability and other environment related objectives. This lead e.g. to many exceptions in regulations. Policies can be considered a failure even if they achieved their objective, if the objectives and the measures taken to achieve them, were inadequate to begin with.

1. Introduction

This chapter includes the following elements:

- case study description
- problem description
- nexus sectors investigated
- key research questions

Case study description

The German part of the transboundary case study covers the German federal states Mecklenburg-Western Pomerania, Saxony Anhalt, Brandenburg, Thuringia, and Saxony that were formed within the Soviet power sector after 1945 and constituted the German Democratic Republic (GDR) in 1949. It also covers the City of Berlin that had been divided, formally remaining under control of the World War allies in its entirety, until 1990. Except for West Berlin, this territory shares both the history of socialist rule and the transformation process to nowadays market-driven economy and governance with the other countries in this case study.

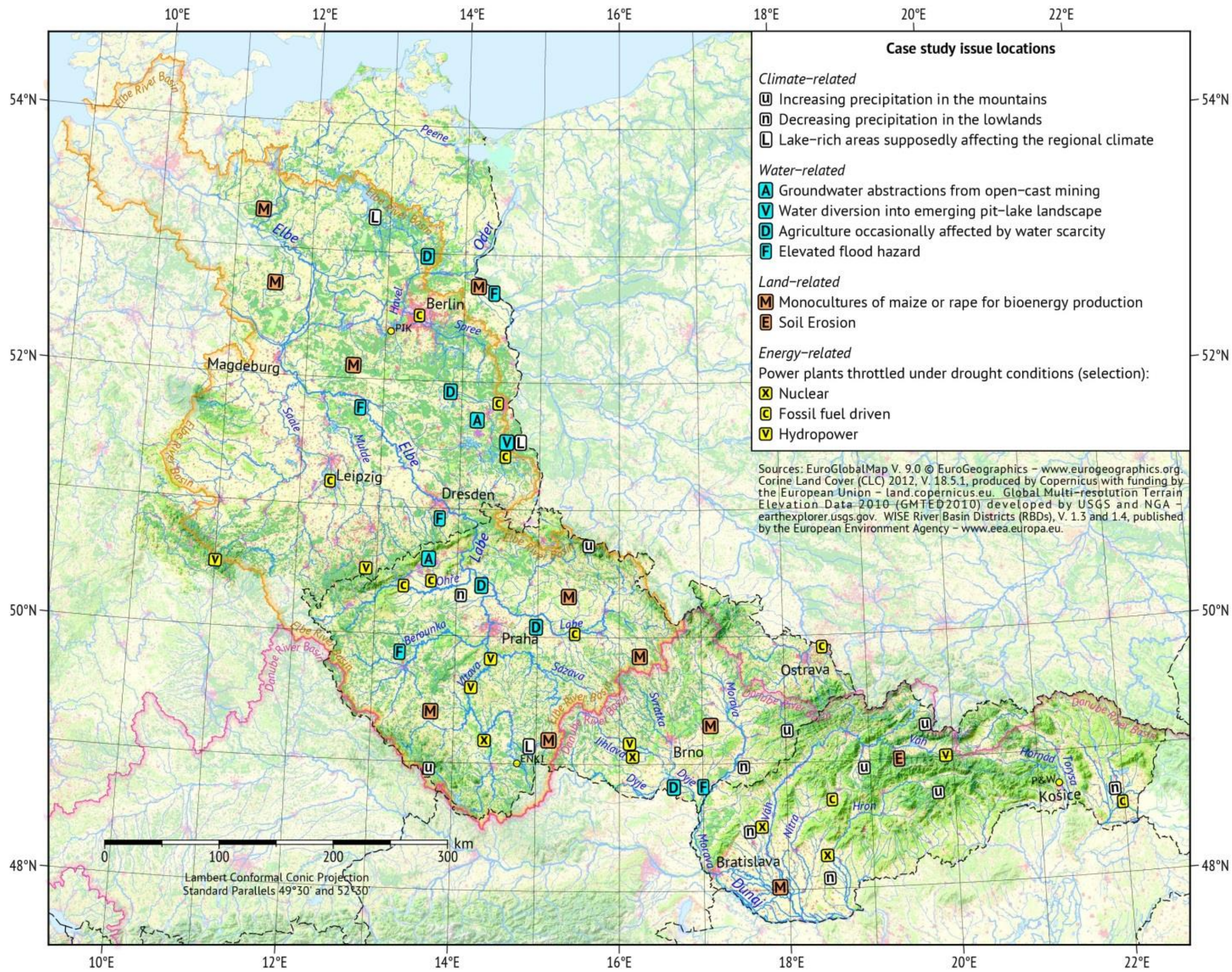
Despite small differences to the former GDR territory, we use the current (end of 2015) federal states' boundaries in defining our case study region. This means an area extent of 108 862 km² and a population of 16.1 million inhabitants for the German part (Statistisches Jahrbuch 2017). For comparison: Czech Republic: 78 868 km², 10.6 million inhabitants; Slovakia: 49 035 km², 5.4 million inhabitants (Eurostat 2017).

Much of the German case study part belongs to the North German Lowlands with typical elevations below 200 m amsl. However, this landscape is not flat but has been differentiated through the past glaciations, so there is a broad variety of micro-reliefs and soil types. The highest elevations are older mountain ranges on the western and southern boundaries, namely the Harz mountains reaching 1141 m amsl and the Ore mountains towards the Czech part, reaching 1215 m amsl within Germany.
The climate of the German part is humid-continental. The 2 m air temperature in the lowlands varies typically between monthly averages of 0°C in January and 20°C in July, but severe frosts may drop below -15°C in rare occasions while the summer heat may exceed 30°C on a few days of the year. The average precipitation is 700 mm/a and rather evenly distributed about the year.

There is however a significant difference in water availability between the lowlands parts of which receive only 500 mm/a on average facing comparable evapotranspiration depths and the mountainous areas with precipitation averages of more than 1500 mm/a in a comparably cooler environment. Extreme events, especially drought conditions and extreme precipitation are likely to occur more frequently due to climate change. The German part of the Elbe River area covers 73% of the German part of the case study area. This river is the second-largest stream in Germany and has important tributaries within the domain, namely the Mulde, Saale, and Havel Rivers. The remaining German parts of the case study area are drained through many smaller rivers and rivulets, and it must be noted that the eastern boundary of the area is marked by the Oder River whose basin is located for the most part in Poland. The lowlands are dominated by non-irrigated agriculture while the mountains are largely forested. The map in Fig. 1 gives an overview of the physical geography of the area.

The energy sector of the German part of the case study domain is characterised by some still active lignite mining areas. In 2014, 721 PJ of lignite were used as primary energy source about half of which amount was used for electric power generation within the area. And about half of the area's 149 TWh gross electricity production, 75 TWh, are generated from lignite. However, there are no nuclear power plants, and 43 TWh were generated from renewable sources: 22 TWh from wind, 8 TWh from photovoltaics, and 13 TWh from biomass. Although Berlin and Thuringia had been sinks for electrical energy the entire area made a net export of about 46 TWh, one third of its production (LAE 2017).

Figure 1 Map of the case study area (saturated land use colours) with major river basin boundaries and locations of selected nexus issues



Problem description

The map in Fig. 1 locates also most of the nexus-related problems we are addressing with our study. For the German part, some climate characteristics may cause problems, especially under climate change. These include losses in agricultural yields, especially in the northern parts where sandy soils cannot store enough water to compensate extended periods of dry weather and increasing evapotranspiration has a strong negative effect on plant growth. Already under current climatic conditions interannual yield

variabilities are respectively high in this region (Gornott et al. 2016). Another climatic pressure exists through probably generally decreasing water availability while extremes seem to become more frequent.
There are also effects directed towards the climate – without taking the greenhouse gas emissions of the case study region into account – distinct effects on local convection are caused by landscape patterns. For example, the artificial lake landscape developing from the former open-cast mining pits in Lusatia (Brandenburg–Saxonian boundary region) seems to trigger more thunderstorms in the summer season (Conradt et al. 2007).

Water-related problems are mostly quantitative (floods and droughts), because the water quality of the region increased substantially since the breakdown of the socialist economies (ICPER 2010), although there are still some problems related to nutrient pollution from agricultural areas (e.g. LUNG 2015). The latter are however closely monitored and managed based on the EU Water Framework Directive.
After many decades without significant flood events an extreme flood was observed along the Oder River in 1997, and two centennial floods hit large parts of the Elbe River basin in the years 2002 and 2013 (Conradt et al. 2013, Belz et al. 2014). Given the evidence for increasing frequencies of precipitation extremes (Kirtman et al. 2013), elevated flood risks must be carefully considered in policy making. This is however hardly a transboundary issue between Germany and the Czech Republic: The Elbe River is the only noteworthy connection, because most of the national boundary is practically identical to major water divides. And the discharge from the Czech Republic into Germany is managed for many decades according to the needs of navigation according to bilateral agreements; this means additional water releases during summer droughts and some flood protection from the Czech cascade of dams in the Vltava River.

Typical drought phases occur either in the transition from spring to summer, the most important season for crop growth, or in late summer, often in combination with prolonged heat waves. Less obviously affected than agriculture but nevertheless confronted with production shutdowns are thermal power plants relying on cooling water; studies suggest increasing problems due to climate change within the next decades (Koch & Vögele 2009, Koch et al. 2012, 2014). The history of lignite mining and still ongoing mining activities in two sub-regions have strong impacts on the hydrology of the region: Once, groundwater was pumped into the rivers to keep the pits dry, nowadays most pits has been disused and are being re-filled with water to create an artificial lake-landscape aiming at tourism. The overall groundwater deficits reached 13 billion m³ in the end of the 1980s, now it is sometimes hard to maintain a minimum discharge of 2 m³/s in the Spree river at Berlin. The other, much more visible effect of the lignite mining activities is the destruction of a historical rural landscape with thousand-year-old villages. Even if there will be a new, water-rich landscape someday, this prospect cannot compensate the loss of homeland for the removed residents. This landscape-waste plus the climate change implications of the adhering to coal spark enough conflict potential in need for sustainable and job-preserving political solutions.

Nexus sectors investigated

In the German part, the water, land, and energy sectors seem to be most important for nexus-related policy research and stakeholder interaction, because that is where the major conflict lines are and where climate change will probably have the strongest impact. The relevant links into climate and food will of course always be considered.

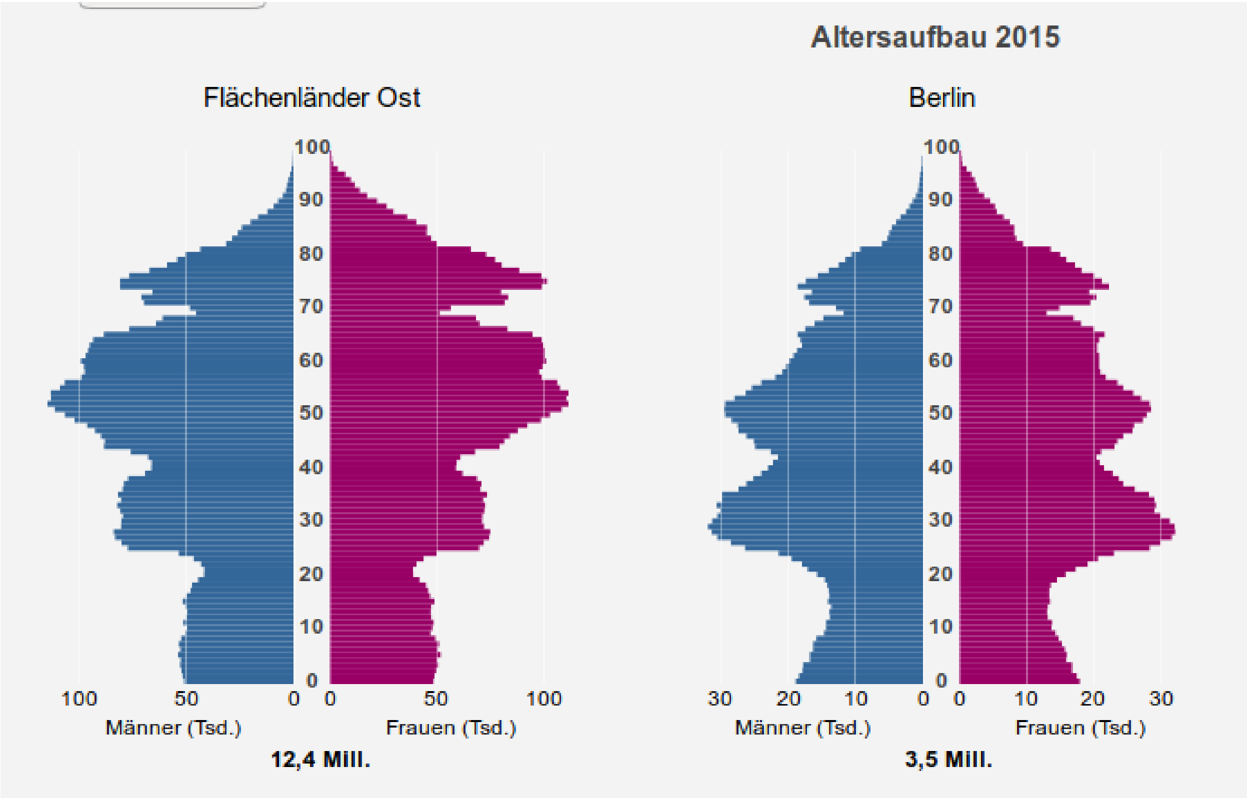
Key research questions

How threatened is the electricity supply in the area given the increasing amount of unstable renewable sources under climate change?
What would be the consequences of an immediate shutdown of the lignite mining activities in Lusatia?
How much food production is and will be sacrificed to biomass generation? What are the environmental consequences of this “green” energy in the area, especially regarding the water balance?

2. Socio-economic context

There are big differences in the socio-economic conditions between Berlin, other bigger cities (especially Dresden), and the countryside. Let's start with a look on the age distributions in Fig. 2.

Figure 2 Age distributions of the population living in the five larger federal states around Berlin (left) and the citizens of Berlin (right)



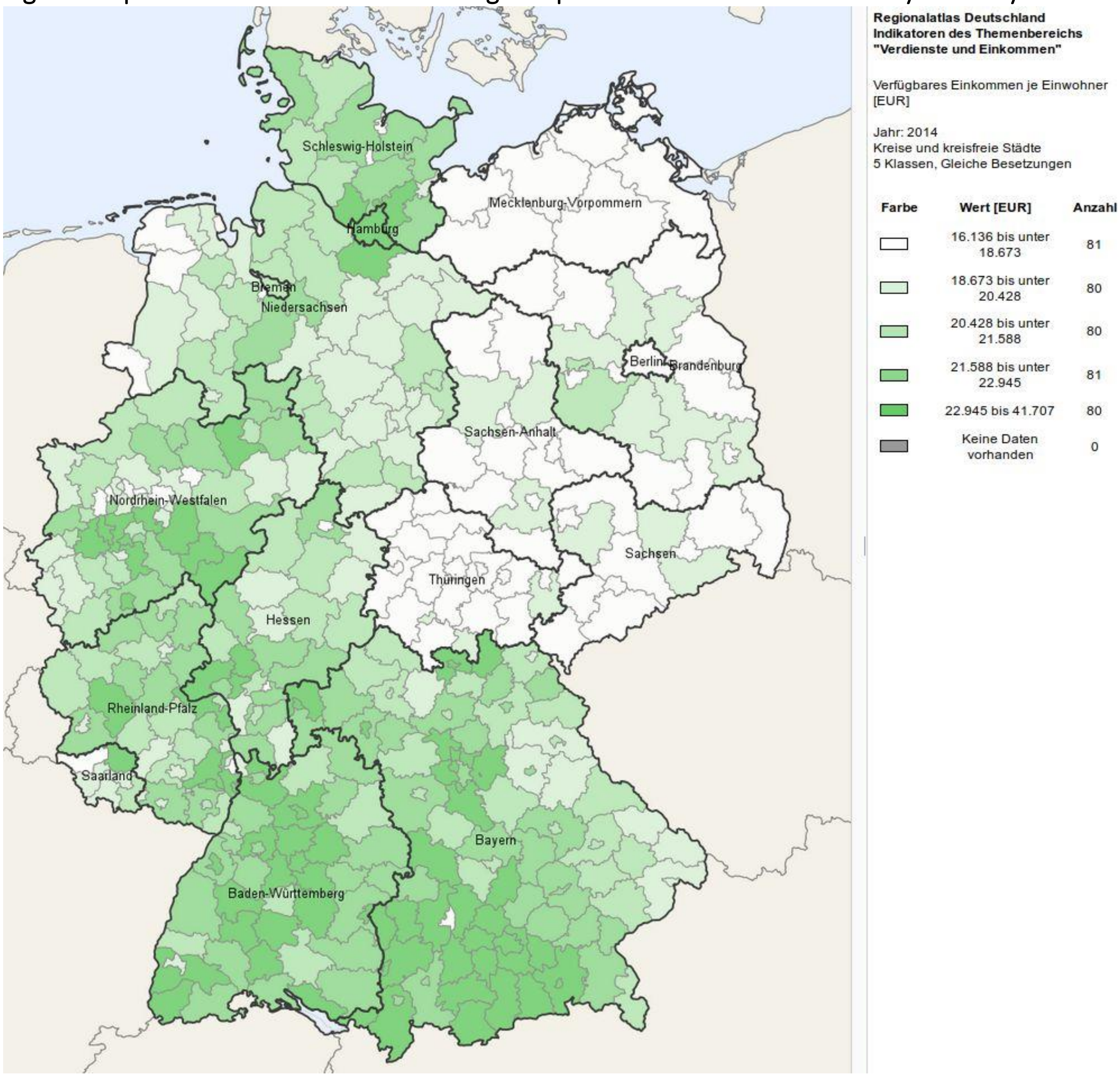
Source: DESTATIS, URL: https://service.destatis.de/laenderpyramiden/ – accessed in November 2017.

Both age "pyramids" expose distinct notches: At ages of 70, caused by the disruptions of the Second World War and its immediate aftermath, 40, caused by the availability of the birth control pill, and 20, owing to both the first-generation effect of the pill and the changed conditions after the breakdown of the socialist economy.

It is easy to spot that the population outside the capital is rather old. Young people see their future in the cities and leave the countryside. The low birth rate of only 1.5 children per woman contributes to this development. This causes already problems in rural areas where a lot of older people do not have easy access to medical services and lack the presence of younger family members to care for them.

The capital has got a healthier age distribution albeit the second drop in birth rates about 25 years ago was of similar size. But birth rates are currently increasing again here, probably accelerated through the higher share of migrants with higher fertility.

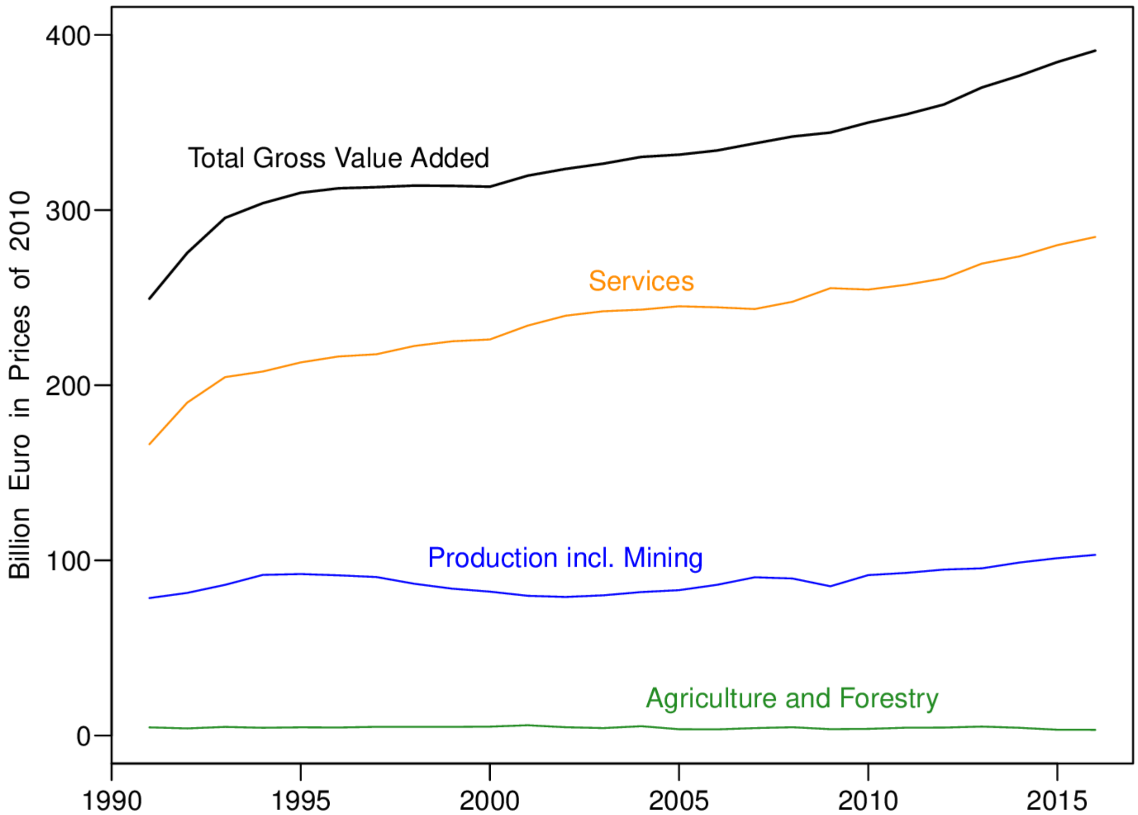
Figure 3 Spatial distribution of the average disposable income over Germany in the year 2014



Source: DESTATIS, Regionalatlas Deutschland. URL: https://www.destatis.de/regionalatlas - last accessed in November 2017

From Fig. 3 it is easy to see that the case study area is the poorest part of Germany with average disposable incomes of typically well below 20 000 € per year and inhabitant. Despite of many high-level jobs in the federal government and other institutions, Berlin ranges within the lowermost quantile. This can be explained by the high share of welfare-dependent residents (16.5%), contributing to the specific urban culture of the capital.

Figure 4 Visualisation of time series of Gross Value Added for the six federal states including Berlin: Principal sectors.



Data source: Statistical Offices of Germany and the federal states. URL: http://www.statistik-portal.de/Statistik-Portal/ – last accessed in November 2017.

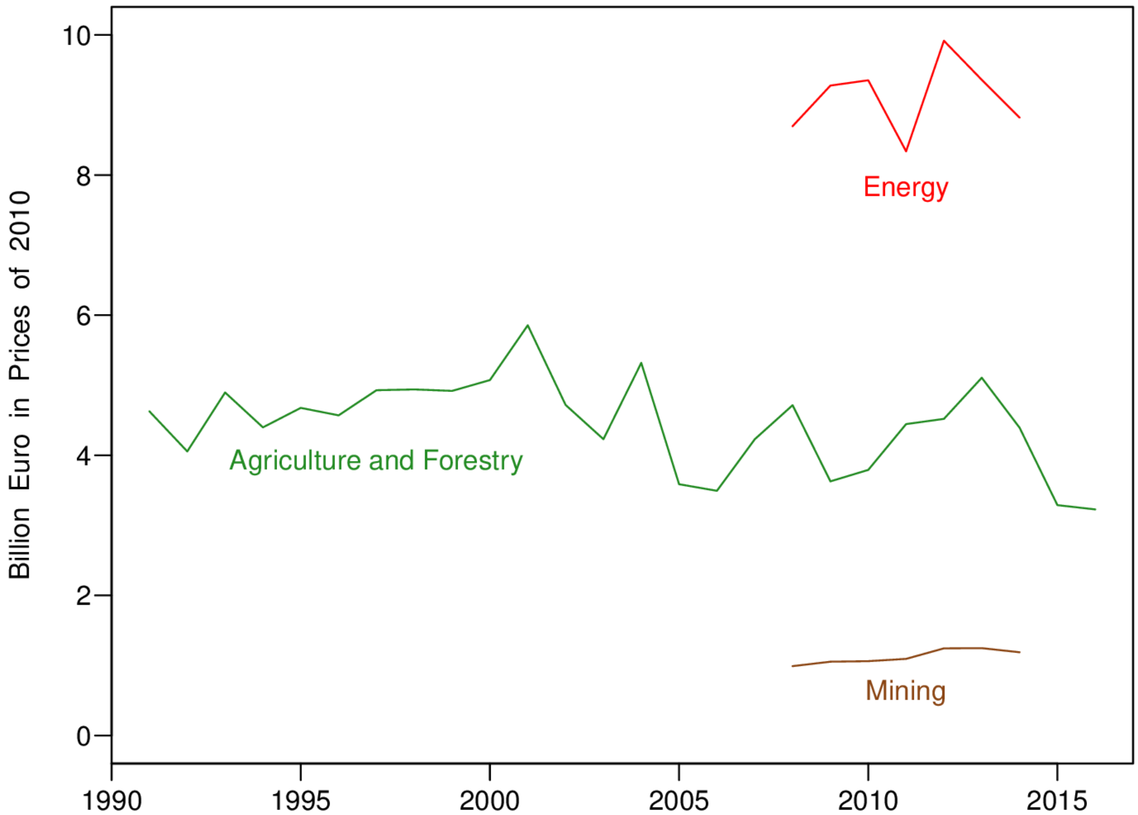
On the other hand, the economy in the German part of the case study area developed very well over the last two decades; Fig. 4 shows the increases in Gross Value Added[1] for the entire economy and its principal sectors. The general increase is largely due to the increases in the service sector, but also production values increased slightly in recent years. From this perspective, Agriculture and Forestry are of minor importance to the economy.

With approximately 400 billion Euros, the economical output of the area is about an eighth of entire Germany's GDP (ranging about 3.2 trillion Euro). Note that the population of 16.2 million equals a fifth of the population of entire Germany (82 million), so there is still a notable productivity gap compared to the western parts of the country.

The difference between Gross Domestic Product (GDP) and Gross Value Added (GVA) is the consideration of taxes and subventions on goods and services: GDP = GVA plus taxes minus subventions. GDP is closer to market prices while GVA highlights the effective production costs. The reason for reporting only GVA here was data availability.

1

Figure 5 Visualisation of time series of Gross Value Added for the six federal states including Berlin: Agriculture and Forestry, Energy, and Mining

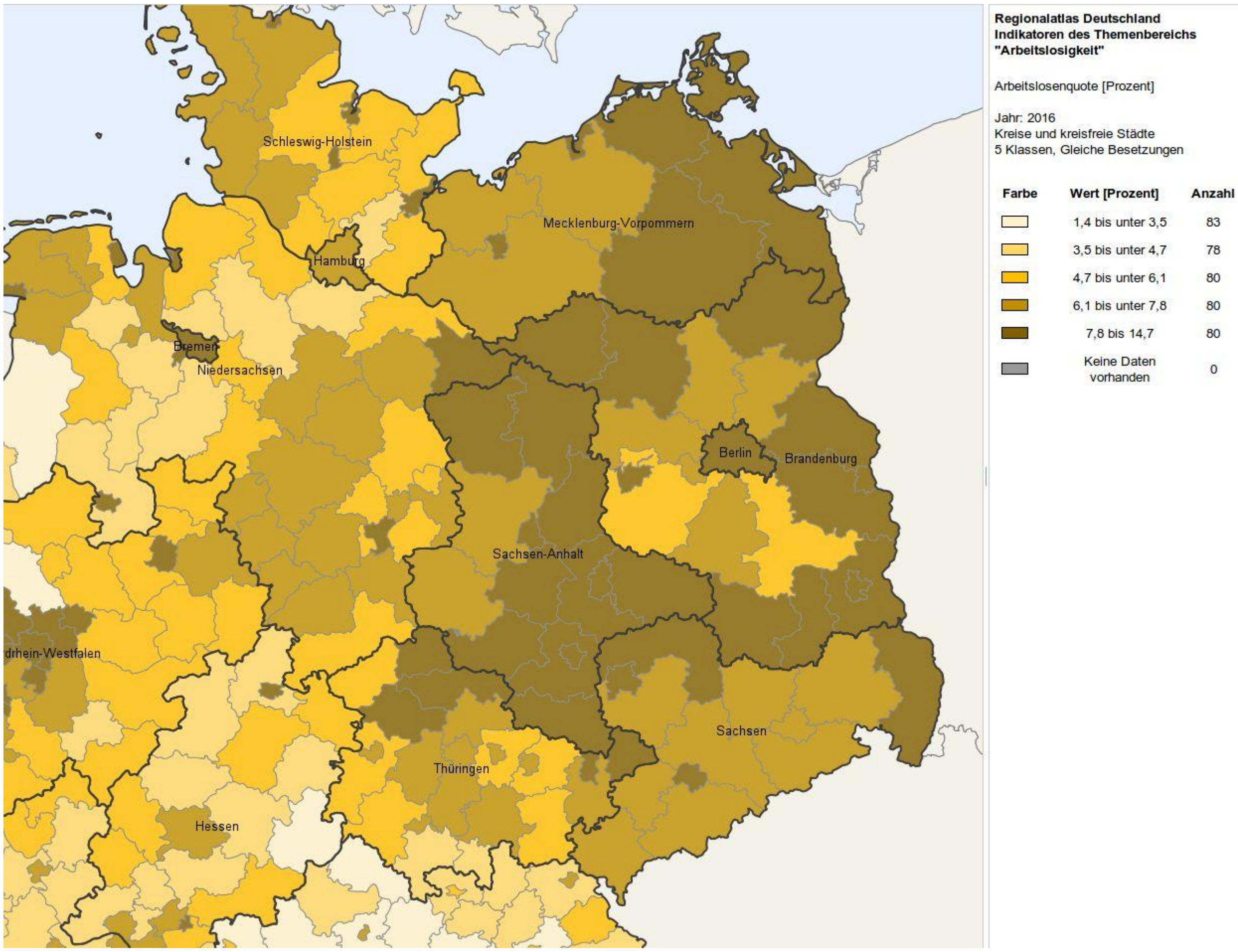


Data source: Statistical Offices of Germany and the federal states. URL: http://www.statistik-portal.de/Statistik-Portal/ – last accessed in November 2017.

However, Agriculture and Forestry do contribute to the economy with a volume of about four billion Euro per year as the upscaled view of Fig. 5 shows. Energy and Mining are also separately depicted over the few years of data that were available. The jagged graphs of Energy and Agriculture are caused by the ups and downs in yields; both plant growth and renewable power generation are highly dependent on weather situations.

The importance of both the agricultural and the energy sector should not be considered based on this metric alone. If the energy sector would shut down, what about the rest of the economy which is more often than not totally electricity-dependent? And how about an economy without food? Food could perhaps more easily be imported than energy, but the recent production numbers of the agricultural sector of the study domain are impressive: On average, more than 9 million tons of wheat, about 2 million tons of rye, 3.5 million tons of barley, and 1.7 million tons of potatoes are harvested each year in this area. Alltogether, more than 1 metric ton of cereals is harvested per inhabitant and year (DESTATIS 2017). Plus, more than 400 kg of sugar beets – equivalent to an annual sugar production of 65 kg per inhabitant (cf. Appel 2016). Currently, both cereals and electrical energy are net-exported from the area.

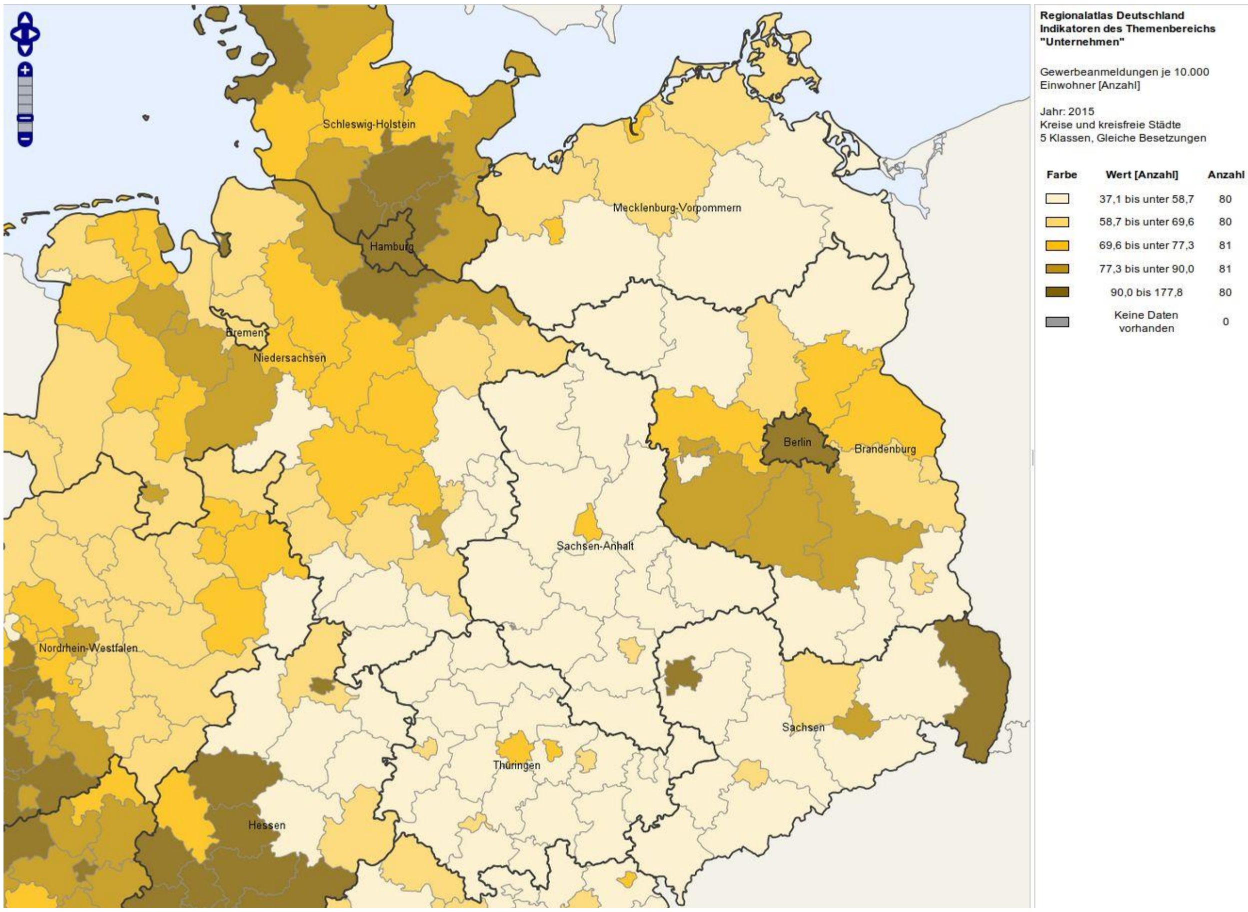
Figure 6: Regional percentages of unemployment in the Year 2016.



Source: DESTATIS, Regionalatlas Deutschland. URL: https://www.destatis.de/regionalatlas – last accessed in November 2017.

Although the number of people registered unemployed is well below the EU average in Germany and decreased to near full employment in the recent years, East Germany is still confronted with higher shares of joblessness, typically about 10%, see Fig. 6.

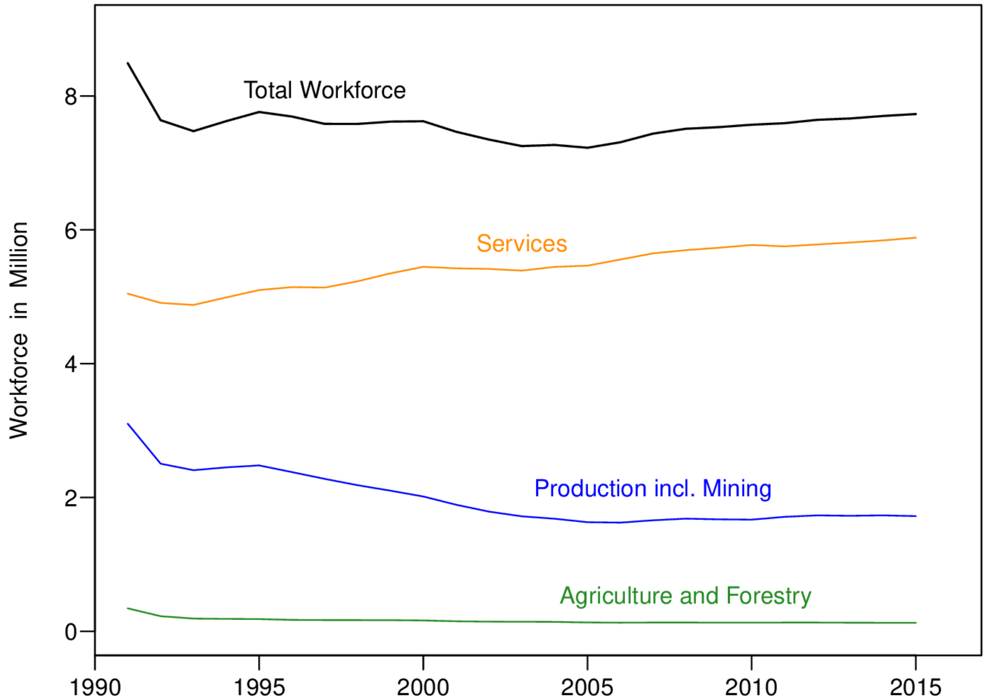
Figure 7 Regional business starts per 10 000 inhabitants in the Year 2015



Source: DESTATIS, Regionalatlas Deutschland. URL: https://www.destatis.de/regionalatlas – last accessed in November 2017.

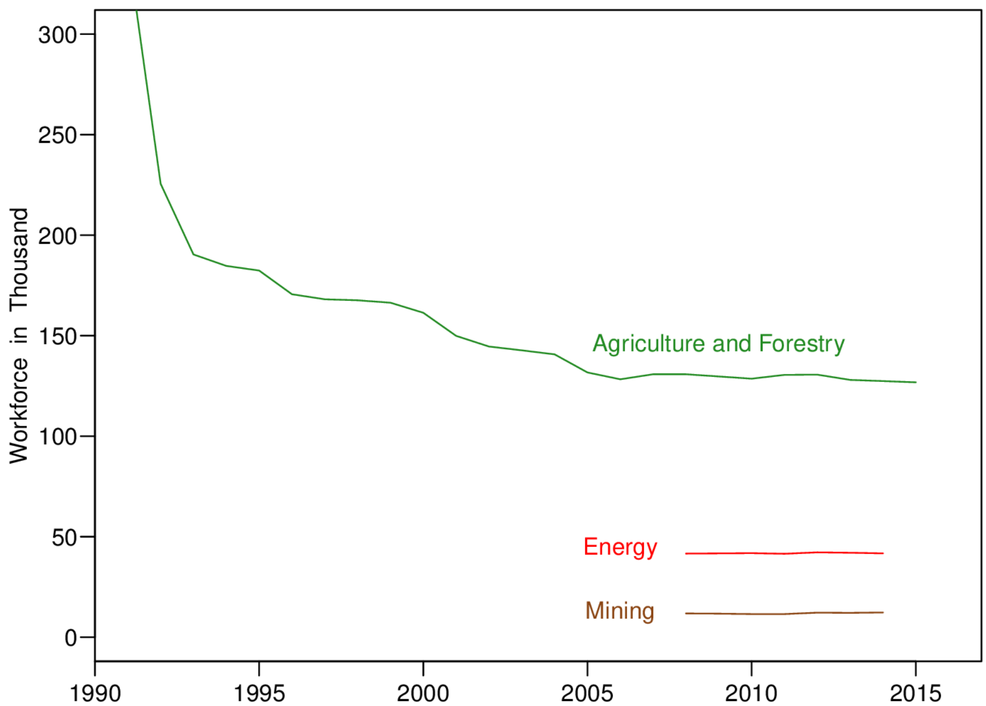
Apart from Berlin and its surroundings (plus a few outlier cities) the inhabitants of the case study region do not compensate higher unemployment by starting their own enterprises. The aversion may however also be explainable by the age distribution (see above); the older people were socialised in a society without private entrepreneurship. Missing start capital might be an issue, too. The capital region is in sharp contrast to that with Berlin being famous for a lively start-up scene.

Figure 8 Development of the Workforce over time for the six federal states including Berlin: Principal sectors



Data source: Statistical Offices of Germany and the federal states. URL: http://www.statistik-portal.de/Statistik-Portal/ – last accessed in November 2017.

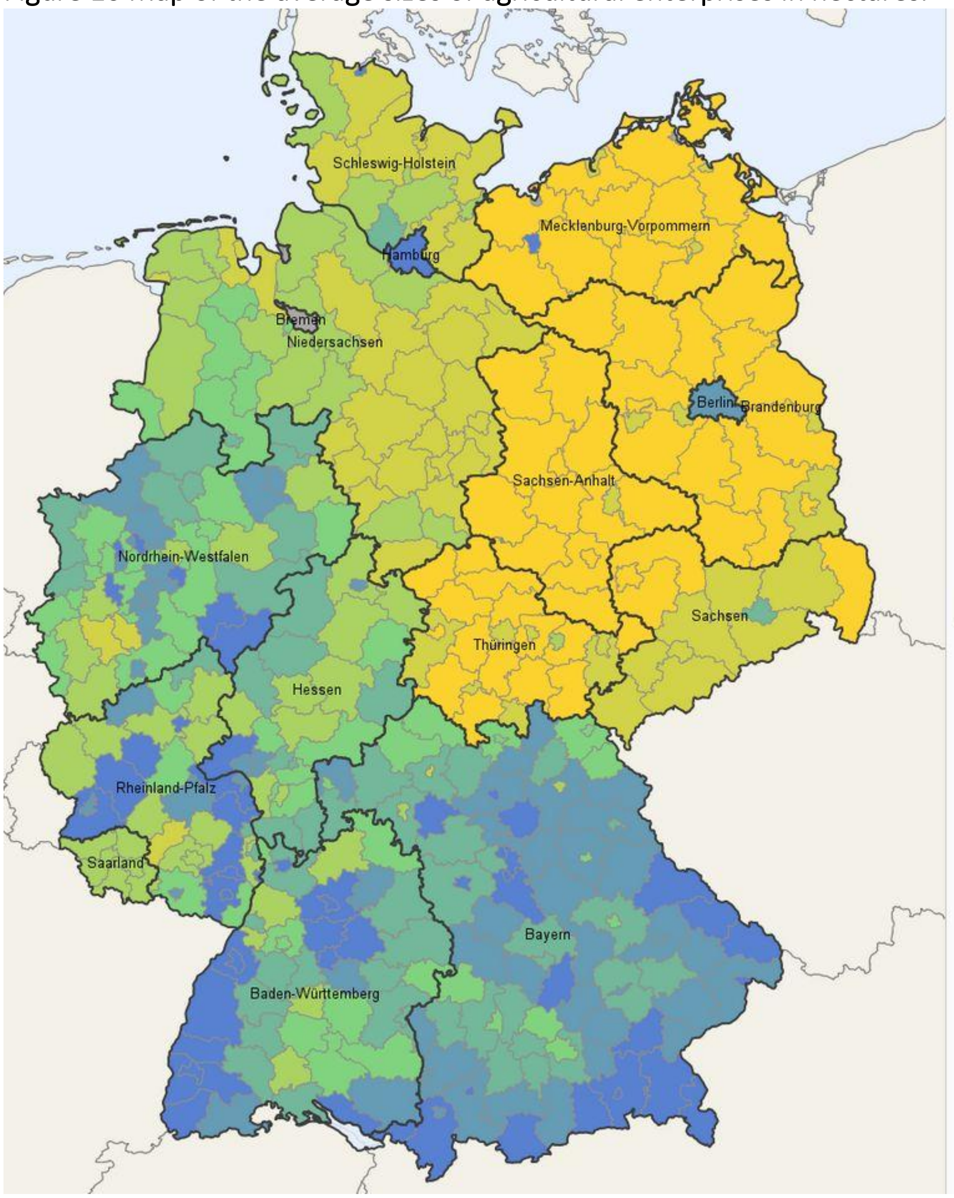
Figure 9 Development of the Workforce over time for the six federal states including Berlin: Agriculture and Forestry, Energy, and Mining.



Data source: Statistical Offices of Germany and the federal states. URL: http://www.statistik-portal.de/Statistik-Portal/ – last accessed in November 2017.

The workforce in the area had been relatively stable over the last two decades as can be seen from Figs. 8 and 9. There is some shift from the secondary into the tertiary sector, it is in fact the service sector that produced the job growth in the most recent years. The agricultural sector experienced the most severe losses in relative terms but seems to stabilise now at about 130 000 farmers and farm employees.

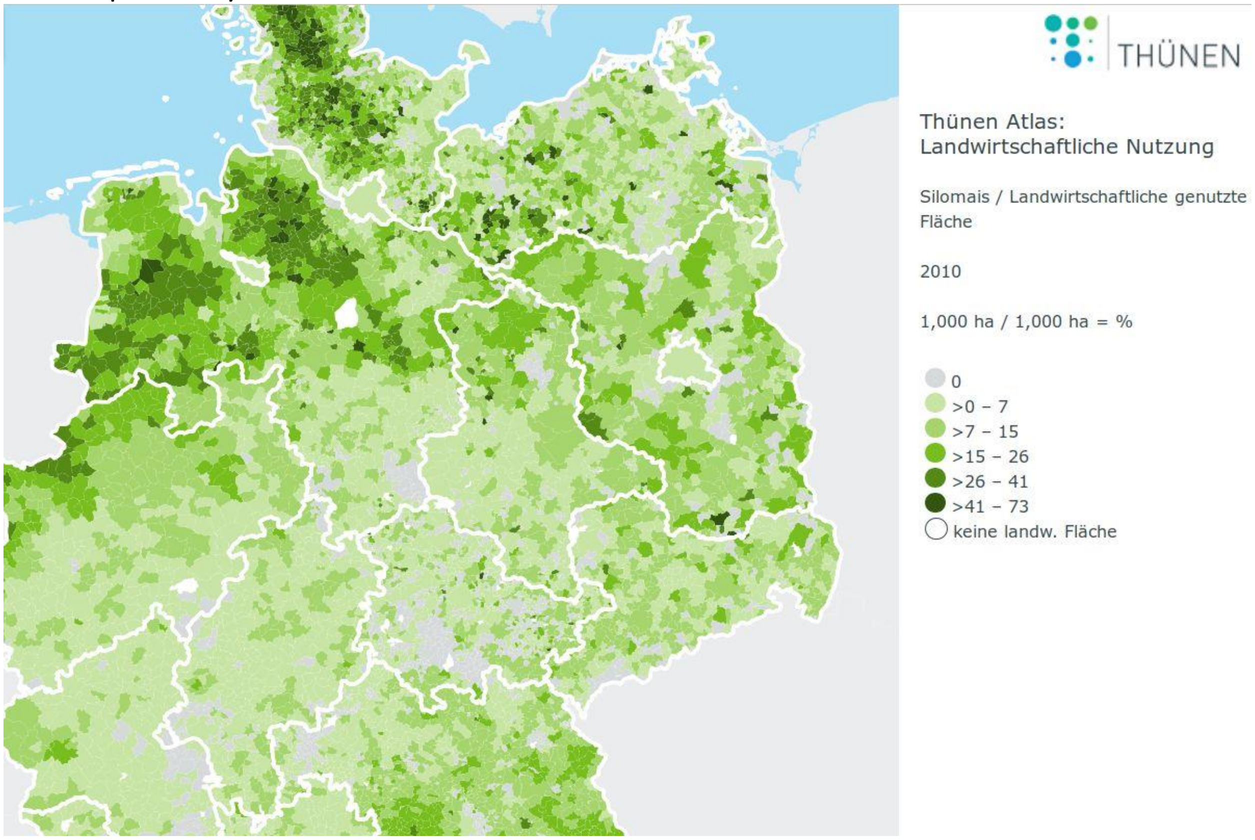
Figure 10 Map of the average sizes of agricultural enterprises in hectares.



Source: DESTATIS, Regionalatlas Deutschland. URL: https://www.destatis.de/regionalatlas – last accessed in November 2017.

Another specific point about the farm structure are their sizes measured by the associated land areas. In Germany, typical values in the case study region are 250–300 ha which is five to ten times of what is common for single farms in the other parts of Germany.

Figure 11 Percentages of silage maize plantation areas in the total agricultural area. Community level map for the year 2010



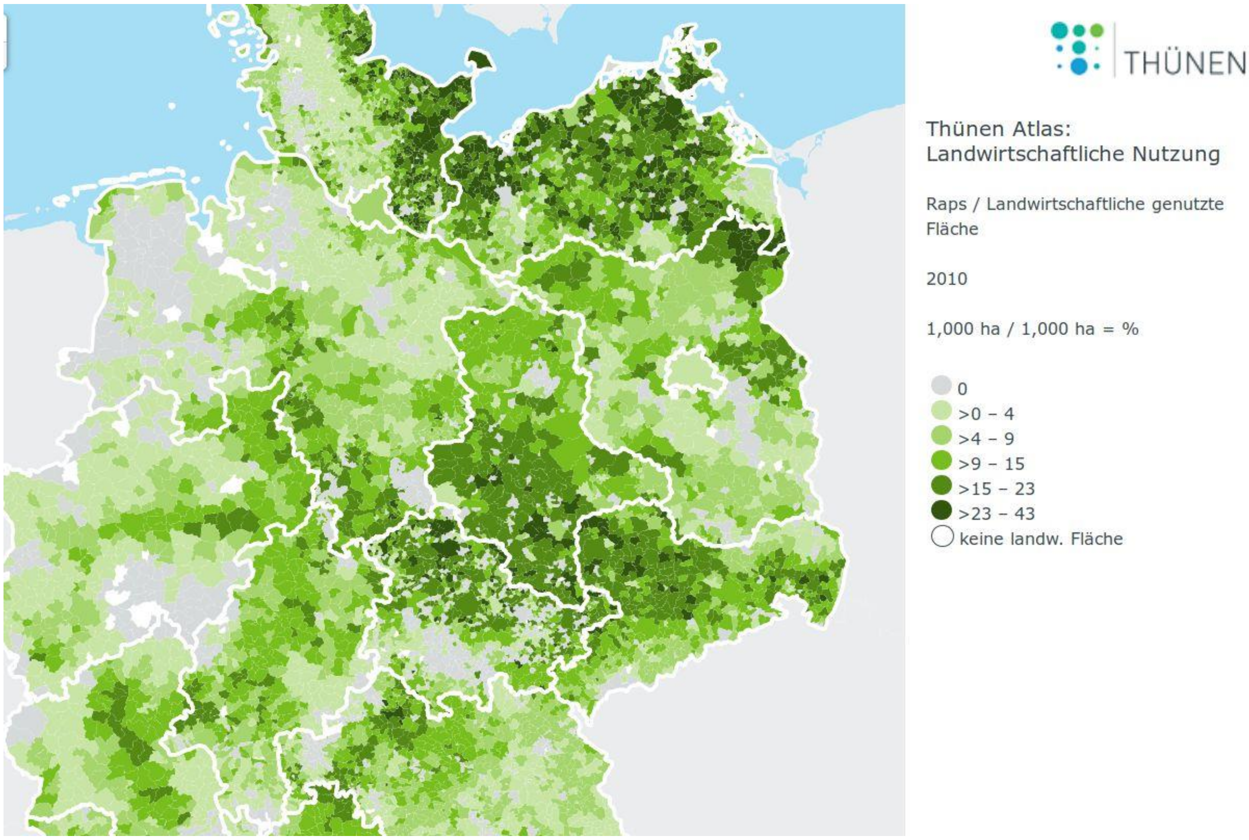
Thünen-Atlas by Johann Heinrich von Thünen Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries. URL: https://www.thuenen.de/en/infrastructure/thuenen-geo-information/thuenen-atlas/ – last accessed in November 2017.

Figure 11 shows the spatial distribution and relative share of silage maize plantations over Northern Germany. Although there are some livestock breeding and biogas power plants in the project area, silage maize cultivation is only dominant in a few communities. Contiguous areas with spatial shares of more than one third of the agricultural areas are a bigger concern in the north western stretches of Germany characterised by high intensities of cattle breeding and pig fattening.

When looking at monoculture, grape might be a more important crop to discuss for the German part of the study area as can be seen from Fig. 12: Especially the federal states of Mecklenburg-Western Pomerania, Saxony-Anhalt, and Saxony are seas of bright yellow in early summer. The ecological impact of extensive grape cropping may however be less problematic than that of maize, because grape is a better shelter plant regarding erosion and needs less water and nutrients to grow compared to maize.

The overall shares of maize and grape have nearly doubled since the 1990s (DESTATIS 2017).

Figure 12 Percentages of grape plantation areas in the total agricultural area. Community level map for the year 2010



Thünen-Atlas by Johann Heinrich von Thünen Institute, Federal Research Institute for Rural Areas, Forestry and Fisheries. URL: https://www.thuenen.de/en/infrastructure/thuenen-geo-information/thuenen-atlas/ – last accessed in November 2017.

3. Mapping of stakeholders

This chapter includes the following elements:

- Description of stakeholders, their role, power and interest structure per each relevant policy sector
- Map of relevant stakeholders and relationships
- Power/interest grid

Description of stakeholders

All sectors

Policy-making bodies of the European Union (Council and Commission)	
Role	Public, responsible for common policies and law-making amongst the EU
Formal power	Making directives and regulations which are either immediately binding and to be executed by member states, need to be coded into their national laws, or are guidelines and suggestions for national policy making
Informal power	Influence on political strategies and agenda setting through steady interchange of personnel, public relations, and targeted allocation of funds
Source of power	Treaties between the national governments of the member states and respective funding from some of the national budgets.
Interests	Creating an area of freedom, security, and justice with a common market, maintaining economic prosperity, and a healthy environment

Federal Government of Germany	
Role	Public, responsible for policy making in Germany
Formal power	Formulating laws (which need to get approved by parliament) and ministerial directives (which are immediate binding regulations)
Informal power	Agenda setting, public relations, and informal communication
Source of power	Chancellor's election by parliament, ministers are then chosen by the chancellor (Inaugurations by the president are merely a formal act)
Interests	Implementation of coalition agreements between the political parties involved and, if once elected, staying at the levers of power. This should naturally imply maintaining the established living standards in Germany, but the definition of well-being and the development of respectively targeted strategies depends largely on the party programmes.

German Federal Parliament	
Role	Public, responsible for national law making in Germany
Formal power	Working on laws and voting laws into effect based on drafts from the government, the federal states, or the political groups of its own members; election of the chancellor; decisions on federal taxes and the federal budget
Informal power	Opinion shaping through debates and occasional resolutions
Source of power	Direct, free, and equal elections of its members every four years; agenda-setting processes within the political parties represented in parliament
Interests	Generally, no common interests between members belonging to the governing parties and opposition members; there is also a separation between MPs who really try to make the best for their voters and those who are just longing for another extension of their (well-paid) office.

NB: The federal states are represented with another chamber in the national law-making process, this is however of minor importance and therefore not considered in this analysis.

Climate sector

Climate mitigation policies are principally made on the EU and national level (see stakeholders listed above) while adaptation measures are decided more on the federal states' level (e.g. rules for climate-proof urban planning and construction) and by individual private stakeholders (e.g. farmers adapting to prolonged growing seasons). The relevant actors are listed under the other sectors below.

Water sector

Navigation (ship owners)	
Role	Private: offering transport of mass goods along Elbe, Oder, and a few designated canals
Formal power	Standard citizen rights (vote in general elections)
Informal power	Lobbying political decision bodies, especially the ministry of transport
Source of power	Own engagement, constitutional laws
Interests	Rivers and canals should be well-maintained for navigation. This includes water level regulation through reservoirs and earthworks along river banks, digging deeper pathways for bigger ships, and building/maintaining other infrastructure e.g. locks, and harbours.

Federal authorities for navigation (ministry of transport, waterways authorities)	
Role	Public: Keeping rivers and canals well-maintained for navigation with a focus on safety
Formal power	As Germany owns the federal waterways, nearly arbitrary regulations and management decisions about these can be made and effectively implemented by the federal authorities. This power is only limited by international agreements, e.g. the right for all Czech vessels to navigate the Elbe River freely towards the open sea, and by the extent of the federal waterways: Smaller rivers belong to the federal states and are managed by the respective state authorities.
Informal power	Very limited, perhaps some internal influencing of higher decision makers and politicians from lower levels aside the official communication.
Source of power	National law on federal waterways and ministerial decisions
Interests	Maintaining Germany's waterways safe and of high transport capacity

Environmental authorities of the federal states (ministries, state and municipal authorities)	
Role	Monitoring the state of the environment and taking measures to improve it. For the water sector, this is largely governed by implementing the EU Water Framework Directive (WFD) and Floods Directive.
Formal power	Running the monitoring programmes and developing the management plans. Taking effective action is often hampered by conflicting rights: For instance, the restoration of a natural river bed might not be possible due to property rights or adjoining national traffic routes which cannot be easily removed.
Informal power	Influencing decisions in other policy areas in favour of environmental concerns, Opinion-shaping by PR campaigns
Source of power	State laws partly based on WFD designations.
Interests	Achieving the good ecological status of all water bodies as promoted by the WFD and maintain a healthy environment in general

Stakeholders in river floodplains (e.g. farmers, residents)	
Role	Driving business or living in floodplain areas
Formal power	Standard citizen rights (vote in general elections)
Informal power	Lobbying political decision makers
Source of power	Own engagement, constitutional rights
Interests	Well maintained dikes that protect them safely from all the floods in the nearby river

The antagonist stakeholder to these people appreciating constructive flood protection are the environmental NGOs engaged for the deconstruction of dikes and restoration of natural, i.e. occasionally flooded, riparian forests. They are listed under Energy.

Users of drinking water (everyone)	
Role	Private, human being
Formal power	Standard citizen rights (vote in general elections)
Informal power	Very limited, because there is no organisation
Source of power	Individual engagement, constitutional rights
Interests	Always having potable tap water – as defined by the EU directive on drinking water– at their disposal

Municipalities and Communities with their water works	
Role	Public, organise drinking water supply and central sewage treatment
Formal power	Entitled to order and install the technical infrastructure and to charge money for connection and usage of the drinking water supply and sewage collection systems. Usually they oblige their citizens to connect to the system.
Informal power	Nudging people to a responsible use of water (water saving, no unnecessary pollution) through information campaigns via classical PR media and local open-door events
Source of power	State laws, local Elections, and the service fees charged
Interests	To supply their customers high-quality drinking water and efficiently treat the waste water at cost-covering prices, therefore also interested in a high quality of surface waters and groundwater

Recreational users of surface water bodies	
Role	Private, inhabitants and tourists enjoying water bodies in numerous ways (swimming, boating, fishing, hiking ashore)
Formal power	Standard citizen rights (vote in general elections)
Informal power	May influence their policy makers, can inform state water authorities of problems and rule breaks to trigger desired actions
Source of power	Own engagement, constitutional rights
Interests	High water quality, open access to water bodies, beautiful environment

Energy sector

LEAG, owner of the large coal plants and the remaining lignite pits of Eastern Germany	
Role	Private, principal supplier of electricity for the region
Formal power	Can set the price per kWh of electricity and trade both coal and electricity
Informal power	Big player in the region, lobbies both the national government and the EU commission together with the other big electricity suppliers
Source of power	The huge capital (assets) of the company which is owned by Czech holdings (EPH and PPF) which in turn belong to practically only three people
Interests	Getting out as much money from the coal power system as long as possible and keep their position in the energy market afterwards. Access to cooling water for the thermal power plants

Smaller electricity providers using renewables	
Role	Private, small players in the electricity market
Formal power	Persons: standard citizen rights (vote in general elections), companies: practically none (they sell their electricity at prescribed prices).
Informal power	PR in favour of renewable energies
Source of power	Own engagement, constitutional rights
Interests	Earning money, some probably also in promoting green energy. Biogas plant drivers like to have access to cheap biomass, e.g. silage maize

Citizens and enterprises	
Role	Private, end-users of electricity
Formal power	Citizens: Standard citizen rights (vote in general elections)
Informal power	Choice of energy provider, taking part in demonstrations for green energy
Source of power	Own engagement, constitutional rights
Interests	Continuous and reliable supply of electricity while keeping the prices low. A sub-group would like to shut down the coal power plants in favour of green energy, even if this means somewhat higher prices

Environmentally oriented NGOs	
Role	Private, opinion and lobby groups
Formal power	None
Informal power	Opinion building and influence on politics e.g. though organisation of demonstrations and lobbying in favour of green energy, restoration of natural river floodplains, and organic farming
Source of power	Own engagement, constitutional rights
Interests	Building a green, sustainable society. In our case study area, they strive for shutdown of lignite mining and coal power plants, destruction of dikes or rebuilding of dike lines in greater distance to the rivers, and against the use of pesticides and genetically manipulated organisms in farming. In Brandenburg, there are also nature conservation groups working against the erection of wind generators; their main argument are probable dangers for birds

Land sector

Farmers	
Role	Private, producers of raw food and bioenergy fuels
Formal power	Citizen rights (participating in general elections)
Informal power	Lobbying politics through farmer's associations
Source of power	Own engagement, constitutional rights
Interests	Less regulations and setting higher market prices for agricultural products

Forest owners	
Role	Private, producers of wood and providers of game breeding areas
Formal power	Development of landscape character by harvesting and selecting tree species in plantation areas; this is usually passed to foresters. Citizen rights (participating in general elections)
Informal power	Hardly any
Source of power	Private property in forest areas, Own engagement, constitutional rights
Interests	Generating long-term income, maintaining safety for trespassers (who, according to state laws, cannot be prohibited walking through forests)

Citizens	
Role	Users of land for recreation purposes (hiking, skating, cycling)
Formal power	Citizen rights (participation in general elections)
Informal power	None, because group too large and diverse
Source of power	State laws (trespassing rights), own engagement, constitutional rights
Interests	A beautiful culture landscape rich of variation and species – no monocultures – with lots of well maintained ways free of car traffic

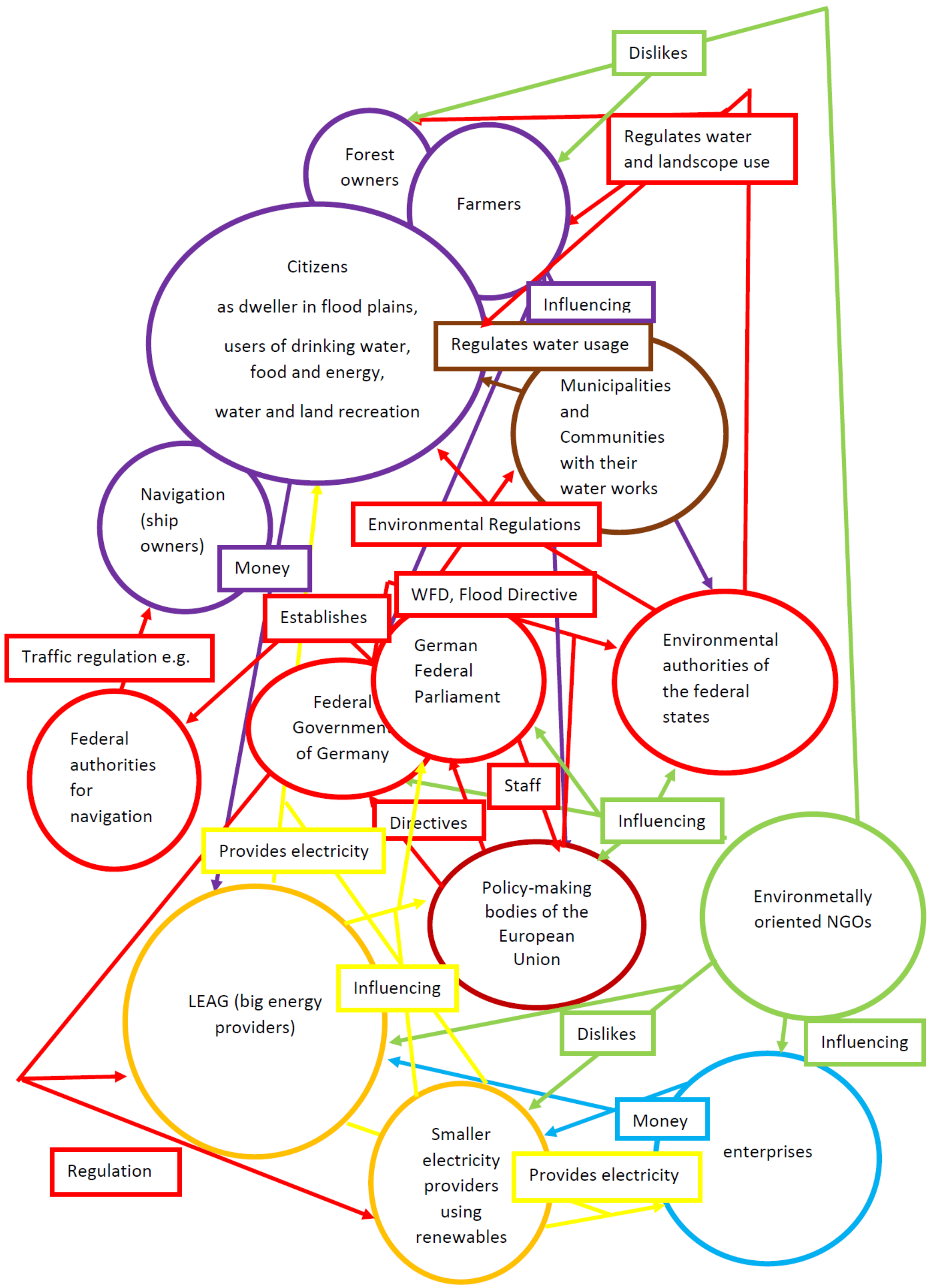
Food sector

All people who eat (practically everyone)	
Role	Consumers of food
Formal power	Ability to choose from a lot of different food offers. Citizen rights (participation in general elections).
Informal power	Big influence on structure and production conditions in the entire food sector through the choices made about which food to buy and eat
Source of power	Own engagement, constitutional rights
Interests	Eat to not get hungry – or to enjoy the meal, cooking – or having no hassle with preparing food, save money – or support organic farming, eat meat – or be vegetarian, stick to a certain diet – or whatever. Food consumption is a mine field of decisions to take which makes this a big lever for change.

Map of relevant stakeholders and relationships

The policy makers are the target of influencing efforts of varying degree, by basically all stakeholder groups. Objective of these efforts is the "manipulation" of new policies, to better suit the needs of the respective group. While "Citizens" are the biggest group by far, they still cannot effectively use their potential influence, since they are fragmented, mostly disorganized and want to achieve different objectives.

Figure 13 Map of relevant stakeholders and relationships


Dislikes
Forest owners
Farmers
Regulates water and landscope use
Citizens
as dweller in flood plains,
users of drinking water, food and energy,
water and land recreation
Influencing
Regulates water usage
Municipalities and Communities with their water works
Navigation (ship owners)
Money
Environmental Regulations
WFD, Flood Directive
Establishes
Traffic regulation e.g.
German Federal Parliament
Environmental authorities of the federal states
Federal Government of Germany
Federal authorities for navigation
Staff
Directives
Influencing
Provides electricity
Policy-making bodies of the European Union
Environmetally oriented NGOs
LEAG (big energy providers)
Influencing
Dislikes
Influencing
Money
enterprises
Smaller electricity providers using renewables
Provides electricity
Regulation

Power/interest grid

The most powerful and influential stakeholder are the policy-making bodies of the European Union and the Federal Government and Parliament. Power lies not only with the different policy-making bodies, but also with institutions and corporations. Their power and influence depend on their importance for the economy or the ability to gather support for their cause (relevant for e.g. NGOs). A high interest in issues of a certain sector does not necessarily mean, that they also hold a significant amount of power. Stakeholder groups with low unity can have problems regarding the usage of their opportunities and seem much more insignificant than they could be (e.g. citizens).

Figure 14 Power/interest of organizations on WATER ISSUES

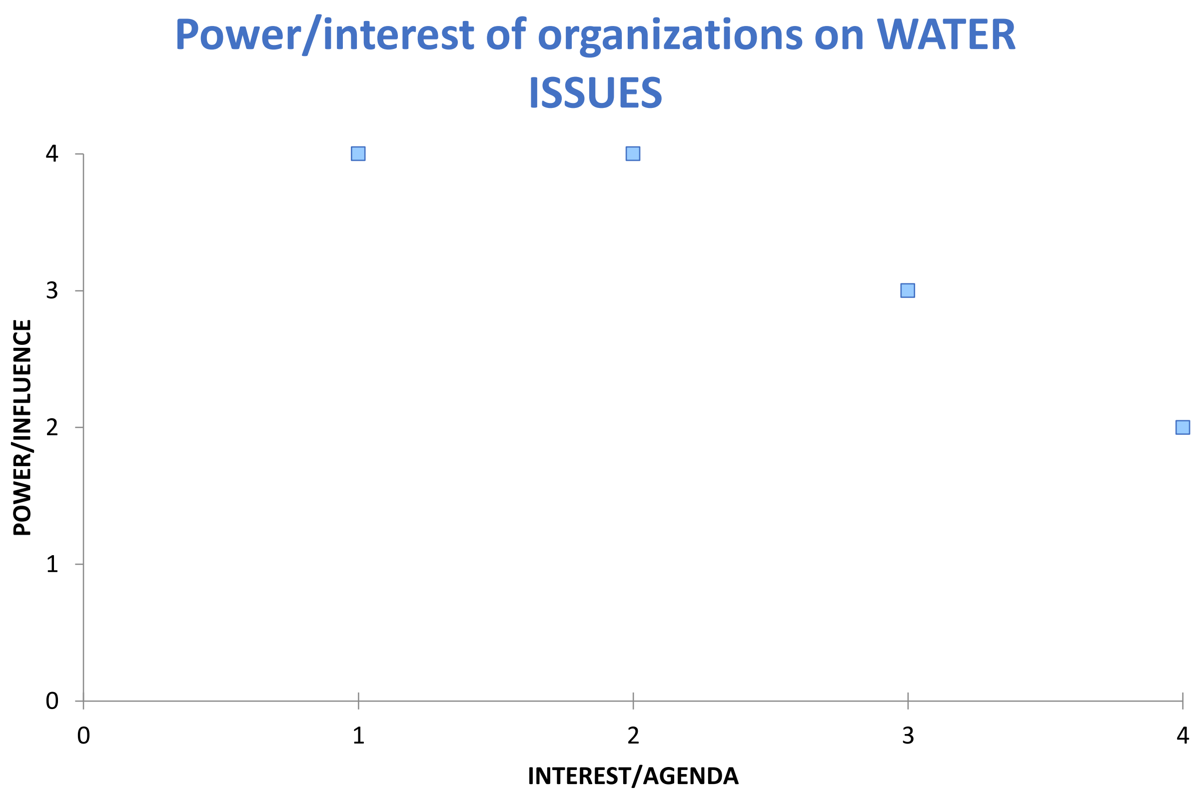


Figure 15: Power/interest of organizations on Energy Issues

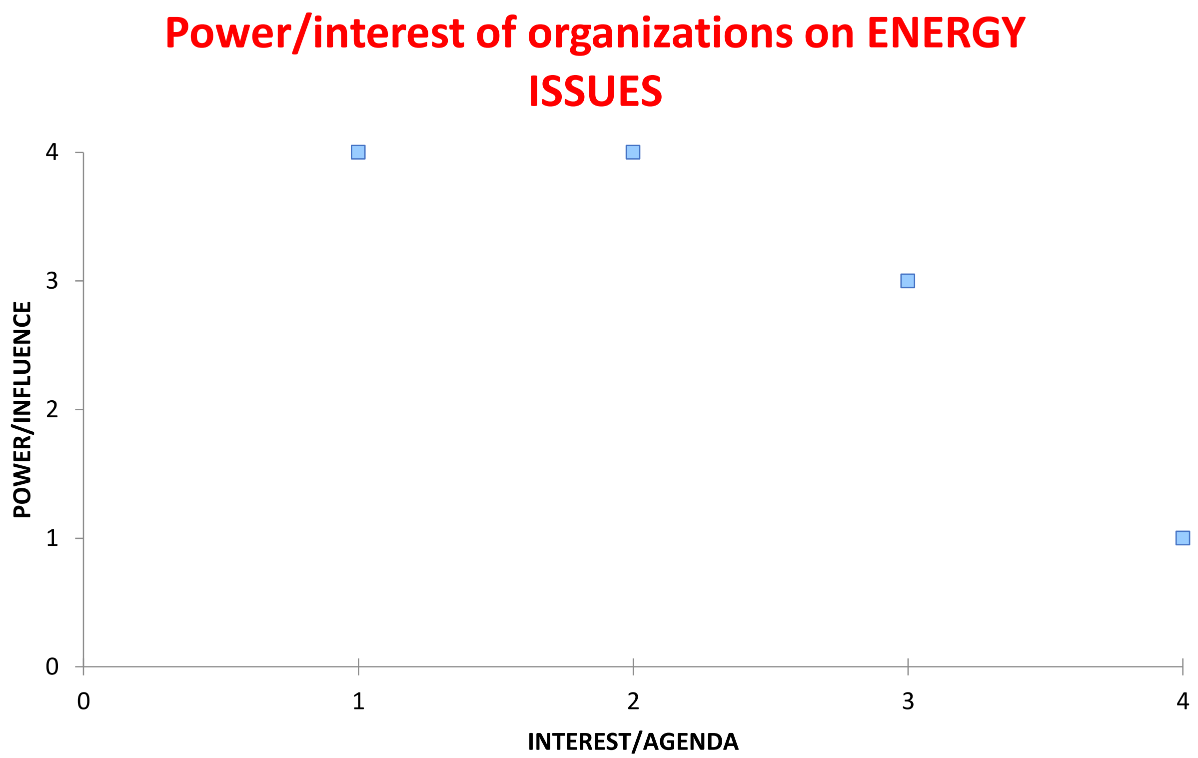


Figure 16 Power/interest of organizations on AGRICULTURE AND FOOD ISSUE

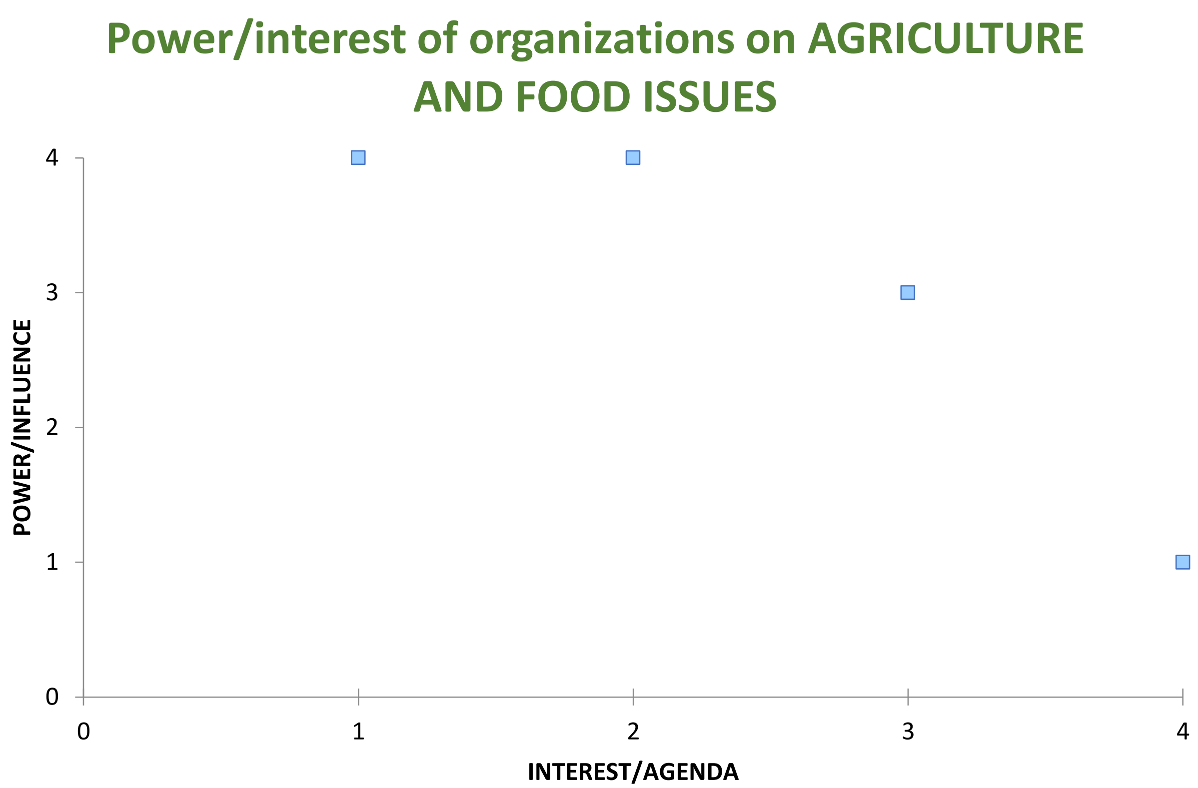


Figure 17 Power/interest of organizations on LAND USE ISSUES

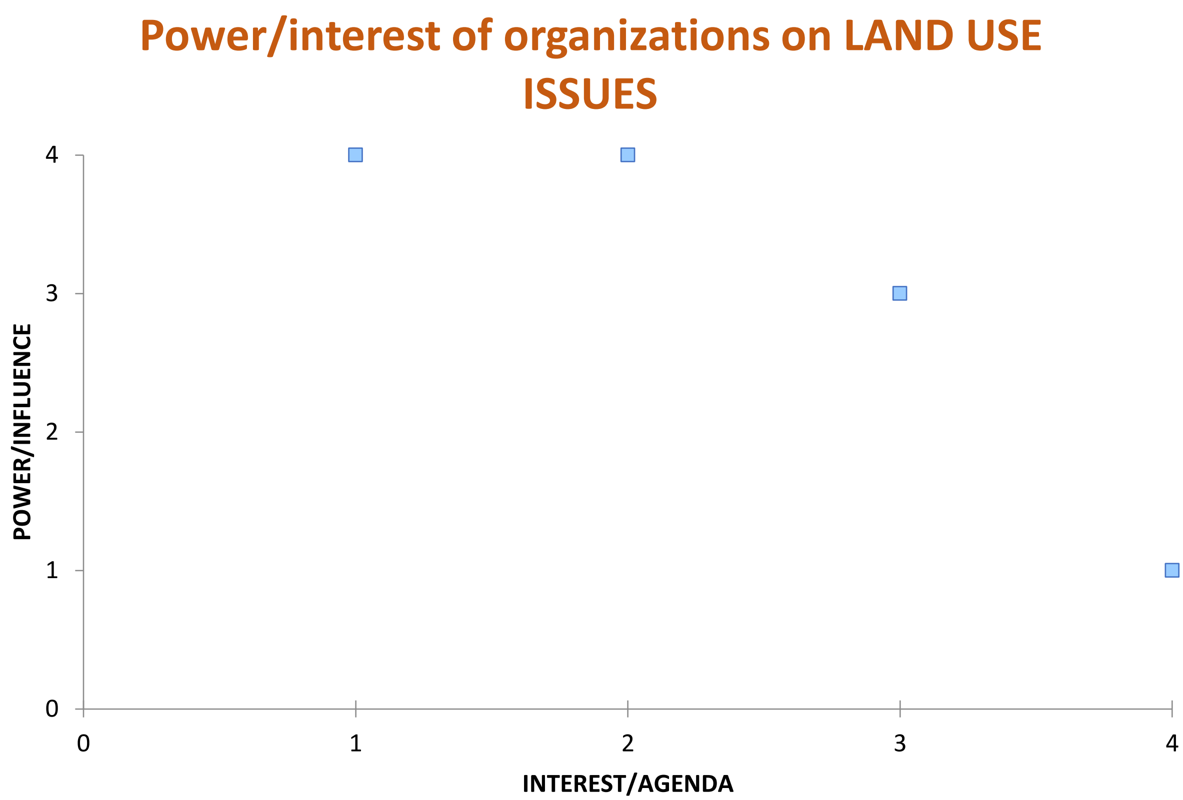
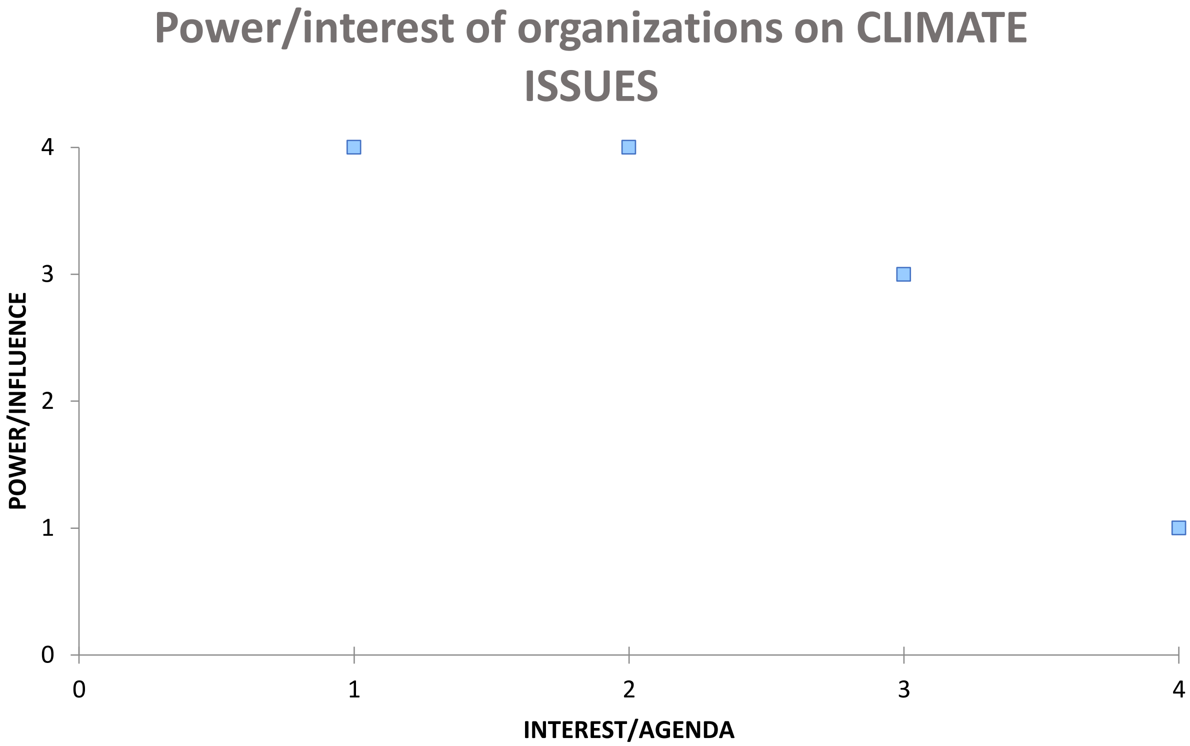


Figure 18 Power/interest of organizations on CLIMATE ISSUES


Power/interest of organizations on CLIMATE ISSUES
POWER/INFLUENCE
INTEREST/AGENDA
0
1
2
3
4

4. Mapping of policy goals and instruments

This chapter includes the following elements:

- Illustration of key policy objectives and instruments
- Inventory of policy documents
- Inventory of objectives of each relevant policy sector
- Inventory of instruments of each relevant policy sector

Illustration of key policy objectives and instruments

There exist many different policy objectives and instruments, but some are much more important than other. The key Nexus critical objectives (NCOs) and the respective Nexus critical instruments (NCIs) are listed below.

Key policy objective	Key policy instruments	Relevant for sector	Reference documents (selection)
Improvement of water quality	Pollution limits Monitoring Fees Standards Regulations	Water, Food and agriculture, Land use, Energy	Die Europäische Wasserrahmenrichtlinie (EU-WRRL) (EU Water Framework Directive) Abwasserabgabengesetz - AbwAG Abwasserverordnung - AbwV
Sustainable usage of water	Regulations for usage	Water, Food and agriculture, Land use, Energy	Die Europäische Wasserrahmenrichtlinie (EU-WRRL) Wasserhaushaltsgesetz - WHG
Flood control	Dikes and other flood control measures	Water, Land use, Food and agriculture	Die Europäische Wasserrahmenrichtlinie (EU-WRRL) (EU Water Framework Directive) Brandenburgisches Wassergesetz (BbgWG) Floods Directive
End of nuclear energy usage in Germany	Shutdown of atomic power plants	Energy, Climate, Land use	Atomgesetz - AtG
Promotion of renewable energy	Subsidies Biddings for e.g. solar plants	Energy, Water, Food and agriculture, Land use, Climate	Erneuerbare-Energien-Gesetz - EEG 2017 Erneuerbare-Energien-Verordnung – EEV
Improvement of the power network	Subsidies	Energy, Land use	Erneuerbare-Energien-Gesetz - EEG 2017 Erneuerbare-Energien-Verordnung – EEV Energieleitungsausbaugesetz – EnLAG

			Netzausbaubeschleu-nigungsgesetz Übertragungsnetz (NABEG)
Reduction of energy usage	Regulations for energy usage (taxation) Subsidies Fees	Energy, Climate	Energieeinsparungsgesetz – EnEG Energieeinsparverordnung – EnEV Berliner Energiewendegesetz (EWG Bln)
Ensuring food quality and production	Controlling ingredients Regulations, Standards Fees	Land use, Food and agriculture, Water	Ernährungssicherstellungs- und vorsorgegesetz – ESVG Gesetz zur Förderung der Einstellung der landwirtschaftlichen Erwerbstätigkeit Flurbereinigungsgesetz (FlurbG) Tierzuchtgesetz (TierZG)
Prevention of animal diseases and diseases in general	Regulations Standards	Food and agriculture	Tiergesundheitsgesetz - TierGesG Fischseuchenverordnung (FischSeuchV 2008)
Promotion of ecological cultivation	Subsidies	Land use, Food and agriculture	Direktzahlungen-Durchführungsgesetz - DirektZahlDurchfG Verordnung zur Durchführung des Öko-Landbaugesetzes (Öko-LandbauGDVO M-V
Protection of animals and biodiversity	Regulations	Land use, Food and agriculture	Verordnung über die Jagdzeiten (JagdzeitV 1977) Tierschutzgesetz (TierSchG)
Sustainable and environmental friendly use of land	Regulations Subsidies Fees	Energy, Water, Food and agriculture, Land use, Climate	Baugesetzbuch BauGB Bundes-Bodenschutzgesetz – BbodSchG
Preservation of forests and their biodiversity	Regulations	Land use, Climate, Food and agriculture	Bundesnaturschutzgesetz BNatSchG Flurbereinigungsgesetz (FlurbG) Verordnung über die Jagdzeiten (JagdzeitV 1977)
Reduction of emissions	Regulations Subsidies Standards	Energy, Climate	Klimaschutzplan 2050: Klimaschutzpolitische Grundsätze und Ziele der Bundesregierung Erneuerbare-Energien-Gesetz - EEG 2017

Promotion of awareness about the environment	Establishment and support of organizations	Climate	Umweltauditgesetz - UAG UAG-Erweiterungsverordnung - UAG-ErwV

Inventory of policy documents

Documents will be listed under the sector they have the most influence on.

Water

Type of document	Title of document	Short description of document content	Life span of policy
National law	Gesetz über Abgaben für das Einleiten von Abwasser in Gewässer (Abwasserabgabengesetz - AbwAG)	Implementation of the "polluter pays principle": The law regulates the fees to be charged by the federal states per amount of pollutants in waste water discharged into the water bodies.	1978– Last adjustment in 2016
National regulation	Verordnung über Anforderungen an das Einleiten von Abwasser in Gewässer (Abwasserverordnung - AbwV)	Detailed regulations on requirements for waste water discharges: everything to consider in driving waste water treatment plants from measurement methods to pollution limits. This regulation enforces numerous EU directives.	1997– Replacing older legislation; last adjustment in 2017
Federal state law	Brandenburgisches Wassergesetz (BbgWG)	Law on water in Brandenburg e.g. usage and protection of water bodies. Partly implementation of EU-Directives and national laws.	1994- Last adjustment in 2017
Regional management plan	Aktualisierung des Bewirtschaftungsplans nach § 83 WHG bzw. Artikel 13 der Richtlinie 2000/60/EG für den deutschen Teil der Flussgebietseinheit Elbe für den Zeitraum von 2016 bis 2021	Management Plan to achieve the objectives of the EU-Directive 2000/60/EC. Protection measures for ground and surface water in the river basin of the Elbe. Defines usage of certain water bodies and e.g. exceptions.	2016-2021 Updated version of the old management plan
Regional management plan	Aktualisierter Bewirtschaftungsplan nach Artikel 13 der Richtlinie 2000/60/EG bzw. § 83 WHG für den deutschen Teil	Management Plan to achieve the objectives of the EU-Directive 2000/60/EC. Protection measures for ground and surface	2016-2021 Updated version of the old management plan

	der IFGE Oder Bewirtschaftungszeitraum 2016 bis 2021	water in the river basin of the Oder. Defines usage of certain water bodies and e.g. exceptions.	
Regional management plan	Aktualisierung des Bewirtschaftungsplans nach § 83 WHG bzw. Artikel 13 der Richtlinie 2000/60/EG für die Flussgebietseinheit Warnow/Peene für den Zeitraum von 2016 bis 2021	Management Plan to achieve the objectives of the EU-Directive 2000/60/EC. Protection measures for ground and surface water in the river basin of Warnow and Peene. Defines usage of certain water bodies and e.g. exceptions.	2016-2021 Updated version of the old management plan
Bilateral agreement	Abkommen zwischen der Regierung der Bundesrepublik Deutschland und der Regierung der Tschechoslowakischen Sozialistischen Republik über den Binnenschiffsverkehr (BinSchAbk CSK)	Agreement on inland navigation between Germany and former Czechoslovakia, grants free passage along the Elbe River down to the sea.	1988–
National law	Gesetz zu dem Abkommen vom 26. Januar 1988 zwischen der Regierung der Bundesrepublik Deutschland und der Regierung der Tschechoslowakischen Sozialistischen Republik über den Binnenschiffsverkehr (BinSchAbkCSKG)	Law on the agreement from above.	1989- Last adjustment in 2016
National law	Gesetz über die Aufgaben des Bundes auf dem Gebiet der Binnenschiffahrt (Binnenschiffahrtsaufgabengesetz - BinSchAufgG)	This law regulates the tasks of the German state in relation to inland navigation. The objective is to prevent damage to the environment and people.	1956- Last adjustment in 2017
Federal state law	Berliner Wassergesetz (BWG)	Law on water in Berlin e.g. usage and protection of water bodies. Partly implementation of EU-Directives and national laws.	2005- Last adjustment in 2018
European directive	Die Europäische Wasserrahmenrichtlinie (EU-WRRL) (EU Water Framework Directive)	EU-directive. Objectives are e.g. the protection and quality improvement of surface waters, the sustainable usage of water and the reduction of groundwater pollution e.g. by fertilizer. Development of management plans for river basins.	2000-

National regulation	Verordnung über den Betrieb der Fähren auf Bundeswasserstraßen (Fährenbetriebsverordnung - FäV)	Regulates the ferry traffic on German waterways.	1995- Last adjustment in 2017
European directive	Floods directive	The improvement of flood control occurs in three steps. The first step was the assessment of flood risk under consideration of all affected sectors. Results will be used to identify regions with high flood risk and map different scenarios. The Last step is the development of Flood Risk Management Plans.	2007-
National regulation	Verordnung zum Schutz des Grundwassers (Grundwasserverordnung - GrwV)	Regulates the classification of groundwater and provides threshold values regarding the pollution with substances to secure the quality.	2010- Last adjustment in 2017
National regulation	Verordnung zur Regelung des Verfahrens bei Zulassung und Überwachung industrieller Abwasserbehandlungsanlagen und Gewässerbenutzungen (Industriekläranlagen-Zulassungs- und Überwachungsverordnung - IZÜV)	Regulates the observation and admission of industrial clarification plants and general industrial water usage. The public needs to be informed about admissions.	2013- Last adjustment in 2017
Federal state law	Wassergesetz des Landes Mecklenburg-Vorpommern (LWaG)	Law on water in Mecklenburg-Western Pomerania. Regulates usage and protection of water.	1992- Last adjustment in 2016
National regulation	Verordnung zum Schutz der Oberflächengewässer (Oberflächengewässerverordnung - OGewV)	Law on the protection of surface water. Legal framework for the categorization and usage of surface water. Another objective is the observation of water development.	2016-
Federal state law	Sächsisches Wassergesetz (SächsWG)	Law on the usage and protection of water in Saxony. Regulates measures regarding flood protection.	2013- Last adjustment in 2016
Federal state law	Thüringer Gesetz über die Errichtung eines Sondervermögens "Verbesserung wasserwirtschaftlicher Strukturen"	Law on the creation of fund assets to improve waterways and their infrastructure.	2002- Last adjustment in 2005

	(ThürSVwSG)		
National regulation	Verordnung zur Entlastung der nichtöffentlichen Betriebe, die Wasser gewinnen sowie Wasser oder Abwasser in Gewässer einleiten, von Berichtspflichten nach dem Umweltstatistikgesetz (UStatG2005BerPflEntlV)	Small nonpublic corporations are excluded from the obligation to do an environmental statistic.	2013-
National law	Bundeswasserstraßenausbaugesetz (WaStrAbG)	Law on the construction and reparation of national waterways. Includes the development of the Oder-Havel waterway.	2016-
National regulation	Bekanntmachung der Strompolizeiverordnung zum Schutz bundeseigener Betriebsanlagen an Bundeswasserstraßen (Wasserstraßen-Betriebsanlagenverordnung - WaStrBAV)	Regulates the usage of national constructions close to national waterways. Improper and needless use are prohibited to prevent damaging the constructions.	2016-
National law	Bundeswasserstraßengesetz (WaStrG)	Law on national waterways. Includes the definition of national waterways, the regulations for usage and the legal framework for the water police.	1968- Last adjustment in 2017
Federal state law	Wassergesetz für das Land Sachsen-Anhalt (WG LSA)	Law on water in Saxony-Anhalt e.g. usage and protection of water bodies. Partly implementation of EU-Directives and national laws.	2011- Last adjustment in 2017
National law	Gesetz zur Ordnung des Wasserhaushalts (Wasserhaushaltsgesetz - WHG)	Law on the usage of water. Negative influence on water e.g. rivers is prohibited and must be compensated. Implementation of EU-Directive 2000/60/EC.	2009- Last adjustment in 2017

Energy

Type of document	Title of document	Short description of document content	Life span of policy
National	Gesetz über die friedliche Verwendung der	The main purpose of this	1960–

law	Kernenergie und den Schutz gegen ihre Gefahren (Atomgesetz - AtG)	law is now the ordered phasing out of nuclear energy in Germany until 2022. Until then it regulates the safe operation of nuclear power plants and fuels.	Last adjustment in 2017
National regulation	Verordnung über die Erzeugung von Strom aus Biomasse (Biomasseverordnung - BiomasseV)	Regulation based on the law on renewable energies. Details what belongs to biomass (e.g. farm waste) and what not (e.g. peat) and specifies the qualified technical approaches.	2001– Last adjustment in 2016
National regulation	Verordnung über Anforderungen an eine nachhaltige Herstellung von flüssiger Biomasse zur Stromerzeugung (Biomassestrom-Nachhaltigkeitsverordnung - BioSt-NachV)	Implementation of Directive 2009/28/EC. Based on the law on renewable energies: Liquid biomass for electricity generation is subject to practically the same requirements for sustainable production as biofuels are.	2009– Last adjustment in 2016
National regulation	Verordnung zur Berechnung der durchschnittlichen Strompreise für die Besondere Ausgleichsregelung nach dem Erneuerbare-Energien-Gesetz (Besondere-Ausgleichsregelung-Durchschnittsstrompreis-Verordnung - DSPV)	Law on the calculation of average electricity prices for the special compensation scheme under the renewable energy sources act. Regulates how to calculate electricity prices for energy-intensive industries.	2016-
National law	Gesetz über Energiedienstleistungen und andere Energieeffizienzmaßnahmen (EDL-G)	Law on energy services and other energy efficiency measures. Goal is to reduce energy usage and promote energy-saving technologies and procedures. Incentives to participate will be established and the hindrance of the process, especially by energy	2010- Last adjustment in 2016

		providers, is prohibited.	
National regulation	Verordnung zur Ausführung der Erneuerbare-Energien-Verordnung (Erneuerbare-Energien-Ausführungsverordnung – EEAV)	Regulation implementing the Renewable Energy Ordinance. System operators can receive compensation, if they promote their renewable energy. Establishes the possibility of price influencing through the provider to avoid financel loss. Marketing efforts, profit and loss must be transparent and accessible detectable.	2010- Last adjustment in 2017
European directive	Energy Efficiency Directive (EED)	Objective is the yearly reduction of energy usage by 1.5 percent and the energy efficient renovation of at least 3 percent of the buildings owned or occupied by the respective goverment. The participation of corporations and the public should be encouraged and promoted.	2012-
National law	Gesetz für den Ausbau erneuerbarer Energien (Erneuerbare-Energien-Gesetz - EEG 2017)	Law on the development of renewable energies. Objective of the law is to raise the ratio of renewable energies to 40-45 percent in 2025, 55-60 percent in 2035 and at least 80 percent in 2050. Obligates network operators to improve the power supply system to better meet the requirements of renewable energies and the future energy landscape. Regulates subsidies for renewable energy constructions and	2014- Last adjustment in 2017

		limits them to a certain amount per year. A report will be made in 2018 in relation to the success of the development of renewable energies and the system expansion.	
National regulation	Verordnung zur Durchführung des Erneuerbare-Energien-Gesetzes und des Windenergie-auf-See-Gesetzes (Erneuerbare-Energien- Verordnung – EEV)	Regulation implementing the renewable energy act and the wind energy-at-sea law. Network operator need to provide a 5-year plan related to renewable energies. All specifications must be made separate for the different kinds of energy generation e.g. wind or solar.	2015- Last adjustment in 2017
National law	Gesetz zur Förderung Erneuerbarer Energien im Wärmebereich (Erneuerbare-Energien-Wärmegesetz – EEWärmeG)	Law on the promotion of renewable energies in the heating sector. Defines the sources of renewable energies, which are usable for heating or cooling. Sets requirements for the usage of renewable energies in the heating sector. There are exceptions for this requirement, especially if the cost of renovation would be unreasonably high.	2008- Last adjustment in 2015
Federal state law	Gesetz zur Durchführung des Erneuerbare-Energien-Wärmegesetzes im Land Berlin (EEWärmeG-DG Bln)	Regulates the implementation of a national law concerning renewable energies.	2011- Last adjustment in 2014
National regulation	Verordnung zur Durchführung des Treibhausgas- Emissionshandelsgesetzes in der Handelsperiode 2013 bis 2020 (Emissionshandelsverordnung 2020 - EHV 2020)	Ordinance on the Implementation of the Greenhouse Gas Emissions Trading Act in the trading period 2013 to 2020. Explains the emission factor for bio	2013- Last adjustment in 2016

		diesel in different environments and how to obtain emission credits.	
National regulation	Verordnung über die Versteigerung von Emissionsberechtigungen nach dem Zuteilungsgesetz 2012 (Emissionshandels-Versteigerungsverordnung 2012 - EHVV 2012)	Regulation on the auction of emission allowances according to the Allocation Act 2012. Explains the auction of emissions allowances at the stock market.	2009- Last adjustment in 2015
National regulation	Verordnung über das Verfahren zur Ermittlung des Wertes der von Eigenerzeugern selbst verbrauchten Elektrizität (Eigenverbrauchsverordnung – EigenVerbV)	Regulation on the procedure for determining the value of electricity consumed by producers themselves. The price of energy depends on the average price of the year two years ago.	1974- Last adjustment in 2015
National regulation	Verordnung über Vorausleistungen für die Einrichtung von Anlagen des Bundes zur Sicherstellung und zur Endlagerung radioaktiver Abfälle (Endlagervorausleistungsverordnung – EndlagerVlV)	Regulation on advance payments for the installation of federal facilities for the safekeeping and disposal of radioactive waste. Energy provider must pay for the disposal of radioactive waste. The share of expenses depends on the size of the provider and especially on how much radioactive waste is generated.	1982- Last adjustment in 1966
National law	Gesetz zur Einsparung von Energie in Gebäuden (Energieeinsparungsgesetz – EnEG)	Law on energy saving in buildings. Buildings must be constructed in a way that avoids unnecessary loss and usage of energy. This also affects existing buildings, but there are several exceptions e.g. for buildings without lasting human habitation.	1976- Last adjustment n i2013
National law	Energiesteuergesetz (EnergieStG)	Energy Tax Act. Regulates everything energy related	2006- Last

		e.g. potential users of energy, import and export of energy and the rules for the usage and taxation of natural gasoline and coal.	adjustment in 2017
National regulation	Verordnung zur Durchführung des Energiesteuergesetzes (Energiesteuer Durchführungsverordnung – EnergieStV)	By-law detailing the regulations of the above.	2006- Last adjustment n i2016
National regulation	Verordnung über energiesparenden Wärmeschutz und energiesparende Anlagentechnik bei Gebäuden (Energieeinsparverordnung – EnEV)	Law on energy-saving thermal insulation and energy-saving plant technology in buildings. Objective is to conserve energy in buildings and a carbon neutral building landscape in 2050. Explains energy performance certificates for buildings and what kind of information's they provide.	2007- Last adjustment in 2015
Federal state regulation	Verordnung zur Durchführung der Energieeinsparverordnung (EnEV-Durchführungsverordnung - EnEVDVO M-V)	Regulation on the implementation of a national law regarding the reduction of energy usage in Mecklenburg-Western Pomerania.	2010-
National law	Gesetz zum Ausbau von Energieleitungen (Energieleitungsausbaugesetz – EnLAG)	Law on the expansion of power lines. Names several projects in relation to the expansion of power lines and how this will happen. New power lines must be underground if e.g. the distance to a residential area is less than 400 meters.	2009- Last adjustment in 2016
National law	Gesetz zur Sicherung der Energieversorgung (Energiesicherungsgesetz 1975 - EnSiG 1975)	Act to secure the energy supply. This law has the task to provide the state with the option to limit the usage of fossil fuel	1974- Last adjustment in 2015

		and other energy sources in time of emergency. Compensation can be necessary.	
National regulation	Verordnung über das Verfahren zur Festsetzung von Entschädigung und Härteausgleich nach dem Energiesicherungsgesetz (EnSiGEntschV)	By-law detailing the regulations of the above.	1974- Last adjustment in 1986
National law	Energiestatistikgesetz (EnStatG)	Energy Statistics Act. All relevant information´s about energy usage and production will be used to improve the implementation of renewable energy and reduce the negative impact on the environment. The statistic will be used for reports.	2017-
National regulation	Verordnung zur Umsetzung unionsrechtlicher Veröffentlichungs-, Informations- und Transparenzpflichten im Energiesteuer- und im Stromsteuergesetz (Energiesteuer- und Stromsteuer-Transparenzverordnung – EnSTransV)	Regulation on the implementation of Union law disclosure, information and transparency obligations in the Energy Tax and Electricity Tax Act. Defines how the obligations must be met.	2016- Last adjustment in 2018
National law	Gesetz zur Errichtung eines Fonds zur Finanzierung der kerntechnischen Entsorgung (Entsorgungsfondsgesetz – EntsorgFondsG)	The purpose of the fund is to secure financial means, with which the costs for the safe disposal of the radioactive waste, resulting from the commercial use of nuclear energy for the generation of electricity in Germany, is paid.	2017-
National regulation	Verordnung zur Kennzeichnung von energieverbrauchsrelevanten Produkten mit Angaben über den Verbrauch an Energie und an anderen wichtigen Ressourcen (Energieverbrauchskennzeichnungsverordnung – EnVKV)	Regulation on labeling energy-related products with informations on the consumption of energy and other important resources.	1997- Last adjustment in 2016
National	Gesetz über die Elektrizitäts- und	Law on Electricity and Gas	2005-

law	Gasversorgung (Energiewirtschaftsgesetz – EnWG)	Supply. Defines everything in question to electricity and gas supply e.g. obligations of provider.	Last adjustment in 2017
National regulation	Verordnung über die Gebühren und Auslagen für Amtshandlungen der Bundesnetzagentur nach dem Energiewirtschaftsgesetz (Energiewirtschaftskostenverordnung – EnWGKostV)	Ordinance on the fees and expenses for official acts of the Federal Network Agency under the Energy Industry Act.	2006- Last adjustment in 2016
National law	Gesetz über die Bevorratung mit Erdöl und Erdölerzeugnissen (Erdölbevorratungsgesetz – ErdölBevG)	Law on the storage of oil and petroleum products. The reserves, which must be available, need to encompass enough oil to cover the demand of 90 days.	2012- Last adjustment in 2017
Federal state law	Berliner Energiewendegesetz (EWG Bln)	Law on the “energy revolution” in Berlin. Makes planes for the modernizing of public buildings and the advancement of renewable energies.	2016- Last adjustment in 2017
National regulation	Anordnung über Feuerungsanlagen, Anlagen zur Verteilung von Wärme und zur Warmwasserversorgung sowie Brennstofflagerung (Feuerungsanordnung - FeuAO)	Adapted regulation of the GDR. Regulates the usage of heat systems to ensure safety and low impact on the environment and people.	1990-
National regulation	Verordnung über Allgemeine Bedingungen für die Grundversorgung von Haushaltskunden und die Ersatzversorgung mit Gas aus dem Niederdrucknetz (Gasgrundversorgungsverordnung - GasGVV)	Regulates the relationship between gas supplier and customer, in this case private persons. The supplier can cut supply of gas if the customer violates the contract.	2006- Last adjustment in 2016
National regulation	Verordnung über Gashochdruckleitungen (Gashochdruckleitungsverordnung - GasHDrLtgV)	Regulates the construction and the conduct of high-pressure gas pipelines.	2011- Last adjustment in 2017
National regulation	Verordnung über die Sicherstellung der Gasversorgung (Gaslastverteilungs-Verordnung - GasLastV)	The state can force corporations and people to change existing	1976- Last adjustment in 2015

		contracts to secure the supply with gas.	
National regulation	Verordnung über den Zugang zu Gasversorgungsnetzen (Gasnetzzugangsverordnung - GasNZV)	Regulates the access to the gas distribution system.	2010- Last adjustment in 2017
National regulation	Verordnung zur Sicherung der Gasversorgung in einer Versorgungskrise (Gassicherungsverordnung – GasSV)	The state can force corporations and people to change existing contracts, to secure the supply with gas, in case of emergency.	1982- Last adjustment in 2005
National regulation	Verordnung zur grenzüberschreitenden Ausschreibung für Strom aus erneuerbaren Energien (Grenzüberschreitende-Erneuerbare-Energien-Verordnung - GEEV)	Regulates the transnational bidding related to energy projects. The improvement of cooperation and equal possibilities are the main objectives.	2017-
National regulation	Verordnung zu den gemeinsamen Ausschreibungen für Windenergieanlagen an Land und Solaranlagen (Verordnung zu den gemeinsamen Ausschreibungen – GemAV)	Details the process of collective biddings for solar and wind energy plants. Subsidies can be reduced, if the contract is breached by the operator.	2017-2021
National regulation	Durchführungsverordnung über Herkunfts- und Regionalnachweise für Strom aus erneuerbaren Energien (Herkunfts- und Regionalnachweis-Durchführungsverordnung - HkRNDV)	Regulates the certification of renewable energy in connection to the origin. Breaching the rules can lead to exclusion from further subsidies.	2012- Last adjustment in 2017
National regulation	Verordnung über Konzessionsabgaben für Strom und Gas (Konzessionsabgabenverordnung - KAV)	Regulates the license fee for the usage of public infrastructure by the provider of gas and electricity.	1992- Last adjustment in 2006
National law	Kernbrennstoffsteuergesetz (KernbrStG)	Law on the taxation of reactor fuel. The producer of nuclear fuel elements has the obligation to provide information´s about the recipient to secure correct taxation.	2010- Last adjustment in 2015

National regulation	Verordnung über den Vergleich von Kosten und Nutzen der Kraft-Wärme-Kopplung und der Rückführung industrieller Abwärme bei der Wärme- und Kälteversorgung (KWK-Kosten-Nutzen-Vergleich-Verordnung - KNV-V)	The modernization of constructions to use industrial waste heat, by the usage of power-heat cogeneration, demands a draft about cost and benefit.	2015-
National regulation	Verordnung zur Regelung des Netzanschlusses von Anlagen zur Erzeugung von elektrischer Energie (Kraftwerks-Netzanschlussverordnung - KraftNAV)	Regulates the process of network connection for power plants of all kinds. Defines obligatory articles of the contract between network operator and energy operator.	2007-
National regulation	Verordnung über Lieferbeschränkungen für Kraftstoff in einer Versorgungskrise (Kraftstoff-Lieferbeschränkungs-Verordnung - KraftstoffLBV)	People and corporations need to apply for subscription certificates if a bottleneck in fuel supply arises.	1982- Last adjustment in 2015
National law	Gesetz für die Erhaltung, die Modernisierung und den Ausbau der Kraft-Wärme-Kopplung (Kraft-Wärme-Kopplungsgesetz - KWKG)	Law on the modernization and improvement of power-heat cogeneration. The modernization of constructions to use industrial waste heat, by the usage of power-heat cogeneration, demands a draft about cost and benefit. Projects can benefit from subsidies.	2015- Last adjustment in 2017
National regulation	Verordnung über das zentrale elektronische Verzeichnis energiewirtschaftlicher Daten (Marktstammdatenregisterverordnung - MaStRV)	Legal framework for an index about energy industry related data. The data is open to the public except for personal data.	2017-
National regulation	Verordnung über einen Mineralölausgleich in einer Versorgungskrise (Mineralölausgleichs-Verordnung – MinÖlAV)	Regulates the redistribution of oil in case of supply crisis. Oversupplied corporations must exchange oil with undersupplied ones.	1985- Last adjustment in 2017
National law	Netzausbaubeschleunigungsgesetz Übertragungsnetz (NABEG)	Law on the construction speedup of the transmission network.	2011- Last adjustment in 2017

		Regulates the necessary legal procedure. An assessment of environmental effects must be made public. Expropriations can take place if necessary.	
National law	Gesetz zur Nachhaftung für Abbau- und Entsorgungskosten im Kernenergiebereich (Nachhaftungsgesetz – NachhG)	Prevents the evasion of disposal fees in the nuclear energy sector. Obligations can´t be evaded by the selling of companies or change of majority ratios.	2017-
National regulation	Verordnung über Allgemeine Bedingungen für den Netzanschluss und dessen Nutzung für die Elektrizitätsversorgung in Niederspannung (Niederspannungsanschlussverordnung - NAV)	Regulation on connection to the energy network. Legal framework for the whole process.	2006- Last adjustment in 2016
National regulation	Verordnung über Allgemeine Bedingungen für den Netzanschluss und dessen Nutzung für die Gasversorgung in Niederdruck (Niederdruckanschlussverordnung - NDAV)	Regulation on connection to the gas network. Legal framework for the whole process.	2006- Last adjustment in 2016
National regulation	Verordnung zum Nachweis von elektrotechnischen Eigenschaften von Energieanlagen (Elektrotechnische-Eigenschaften-Nachweis-Verordnung - NELEV)	Operator of energy plants need to verify the implementation of technological minimum standards.	2017-
National regulation	Verordnung zur Regelung der Beschaffung und Vorhaltung von Anlagen in der Netzreserve (Netzreserveverordnung - NetzResV)	Regulates the formation of a network reserve compromised of energy plants, which can be used in case of additional need for energy.	2013- Last adjustment in 2016
European directive	Renewable Energy Directive	Until 2020, at least 20% of the EU energy needs should be fulfilled with renewable energies. There are specific targets regarding the usage of renewable energies, dependant on the potential of the respective country (Malta 10%, Sweden 49%).	2009-

Federal state guideline	Richtlinie des Sächsischen Staatsministeriums für Wirtschaft, Arbeit und Verkehr über die Gewährung von Zuwendungen zur Steigerung der Energieeffizienz, zur Nutzung erneuerbarer Energien, zur Speicherung von Energie, zur Errichtung intelligenter Energienetze und zur Erforschung innovativer Energietechniken (Richtlinie Zukunftsfähige Energieversorgung – RL Energie/2014)	Directive regarding the promotion of e.g. energy efficiency and the usage of renewable energy in Saxony. Subsidies can be granted, if the criteria are met.	2015- Last adjustment in 2017
National regulation	Verordnung zu Systemdienstleistungen durch Windenergieanlagen (Systemdienstleistungsverordnung - SDLWindV)	The operators of wind turbines, operating first between 2002-2008, can receive financial benefits.	2009- Last adjustment in 2016
National regulation	Verordnung über die Vergabe von öffentlichen Aufträgen im Bereich des Verkehrs, der Trinkwasserversorgung und der Energieversorgung (Sektorenverordnung - SektVO)	Legal framework for granting assignments for energy and water supply and traffic. Supporting documents related to environmental compliance and quality must be submitted.	2016- Last adjustment in 2017
National law	Gesetz zur Suche und Auswahl eines Standortes für ein Endlager für hochradioaktive Abfälle (Standortauswahlgesetz - StandAG)	Law on searching and choosing a new nuclear waste repository. Regulates and lists requirements for nuclear waste repositories e.g. porousness of rocks.	2017-
National regulation	Verordnung über Allgemeine Bedingungen für die Grundversorgung von Haushaltskunden und die Ersatzversorgung mit Elektrizität aus dem Niederspannungsnetz (Stromgrundversorgungsverord-nung - StromGVV)	Legal framework for the supply of private households with electricity.	2006- Last adjustment in 2016
National regulation	Verordnung über die Entgelte für den Zugang zu Elektrizitätsversorgungsnetzen (Stromnetzentgeltverordnung - StromNEV)	Legal framework for the calculation of costs regarding the access to the power supply.	2005- Last adjustment in 2017
National regulation	Verordnung über den Zugang zu Elektrizitätsversorgungsnetzen (Stromnetzzugangsverordnung - StromNZV)	Legal framework for the access to the power supply.	2005- Last adjustment in 2017

National law	Stromsteuergesetz (StromStG)	Law on electricity tax. Renewable energy is exempt, if the power supply is exclusively used for renewable energy.	1999- Last adjustment in 2017
National regulation	Verordnung zur Durchführung des Stromsteuergesetzes (Stromsteuer-Durchführungsverordnung - StromStV)	By-law detailing the regulations of the above.	2000- Last adjustment in 2018
National law	Gesetz gegen mißbräuchliche Inanspruchnahme von Subventionen (Subventionsgesetz - SubvG)	Wrongfully used subsidies must be returned. The law enforcement agency must be notified if illegal acquirement of subsidies is discovered.	1976-
National law	Gesetz über den Handel mit Berechtigungen zur Emission von Treibhausgasen (Treibhausgas-Emissionshandelsgesetz - TEHG)	Law on trade with greenhouse gas emission rights. Provides the legal framework. Additional emission rights can be received, if e.g. a new air transport is established. Additional emission rights can be bought if needed.	2011- Last adjustment in 2017
National regulation	Verordnung zum Schutz von Übertragungsnetzen (ÜNSchutzV)	Operator of energy plants need to develop a report about risk scenarios, which will be evaluated by public authorities. A plan for security measures is obligatory. Objective is the protection of the energy network.	2012- Last adjustment in 2015
National law	Gesetz zur Neuordnung der Verantwortung in der kerntechnischen Entsorgung (VkENOG)	Law on signing contracts related to nuclear waste disposal. The ministry for economy and energy can sign contracts related to nuclear waste disposal.	2017-
National regulation	Verordnung über die steuerliche Begünstigung von Wasserkraftwerken (WasKwV)	Water plants have taxation benefits, if they were built between 1938-1990.	1944- Last adjustment in 2010
National	Gesetz zur Änderung der Verordnung über die	Legal framework to	1957-

law	steuerliche Begünstigung von Wasserkraftwerken (WasKwVÄndG)	change the regulations from the above.	
National law	Gesetz zur Entwicklung und Förderung der Windenergie auf See (Windenergie-auf-See-Gesetz - WindSeeG)	Law on the advancement of wind energy by sea. Regulates the bidding process. Aim is the reduction of negative impact on the environment and the increase of wind energy production.	2016- Last adjustment in 2017
National law	Gesetz über den nationalen Zuteilungsplan für Treibhausgas-Emissionsberechtigungen in der Zuteilungsperiode 2005 bis 2007 (Zuteilungsgesetz 2007 - ZuG 2007)	Law on the distribution of emission rights in Germany for the period of 2005-2007. Includes the basis of computation.	2004- Last adjustment in 2016
National law	Gesetz über den nationalen Zuteilungsplan für Treibhausgas-Emissionsberechtigungen in der Zuteilungsperiode 2008 bis 2012 (Zuteilungsgesetz 2012 - ZuG 2012)	Law on the distribution of emission rights in Germany for the period of 2008-2012.	2007- Last adjustment in 2016
National regulation	Verordnung über die Zuteilung von Treibhausgas-Emissionsberechtigungen in der Zuteilungsperiode 2005 bis 2007 (Zuteilungsverordnung 2007 - ZuV 2007)	Detailing the distribution of emission rights for the period of 2005-2007.	2004- Last adjustment in 2011
National regulation	Verordnung über die Zuteilung von Treibhausgas-Emissionsberechtigungen in der Zuteilungsperiode 2008 bis 2012 (Zuteilungsverordnung 2012 - ZuV 2012)	Detailing the distribution of emission rights for the period of 2008-2012.	2007- Last adjustment in 2011
National regulation	Verordnung über die Zuteilung von Treibhausgas-Emissionsberechtigungen in der Handelsperiode 2013 bis 2020 (Zuteilungsverordnung 2020 - ZuV 2020)	Detailing the distribution of emission rights for the period of 2013-2020. There are special rules e.g. for heating private households.	2001- Last adjustment in 2017

Food and agriculture

Type of document	Title of document	Short description of document content	Life span of policy

National law	Gesetz zur Weiterentwicklung der Marktstruktur im Agrarbereich (Agrarmarktstrukturgesetz - AgrarMSG)	Regulations for the official approval of agricultural organizations and granting them syndicate status; enforcement of EU regulations.	2013– Last adjustment in 2017
National regulation	Verordnung zur Weiterentwicklung der Marktstruktur im Agrarbereich (Agrarmarktstrukturverordnung - AgrarMSV)	By-law detailing the regulations of the above.	2013– Last adjustment in 2017
National law	Gesetz zur Förderung der agrarstrukturellen und agrarsozialen Anpassung der Landwirtschaft der DDR an die soziale Marktwirtschaft – Fördergesetz (ASLwApFG)	Allows the government to spend incentives for renewing agricultural enterprise structures, including the establishment of family farms and the improvement of infrastructure in rural areas.	1990– Last adjustment in 1992 Application limited to the former GDR domain
Federal state law	Jagdgesetz für das Land Brandenburg (BbgJagdG)	Law on hunting in Brandenburg. Hunting is monitored by authorities and can only be done with a hunting license. Regulates the division in hunting districts.	2003- Last adjustment in 2014
National regulation	Verordnung über die Verwertung von Bioabfällen auf landwirtschaftlich, forstwirtschaftlich und gärtnerisch genutzten Böden (Bioabfallverordnung - BioAbfV)	Regulates the usage of biological waste on agricultural soil and forests. Defines biological waste (e.g. plants) and classifies it.	1998- Last adjustment in 2017
National law	Bundesjagdgesetz (BJagdG)	Law on hunting. Big land owners (usually >75 ha) have their own right for hunting, while smaller owners are forced into cooperatives usually leasing the hunting rights. Hunting rights bear the obligation to take care of the game.	1952– Last adjustment in 2017
National regulation	Verordnung über den Schutz von Wild (Bundeswildschutzverordnung - BWildSchV)	Regulation in relation with the “Bundesjagdgesetz”. Regulates the usage of wildlife, especially which animals can be owned and cultured.	1975- Last adjustment in 2017
National regulation	Verordnung über die Meldung von Biozid-Produkten nach dem Chemikaliengesetz (ChemBiozidMeldeV	Regulation on the notification of biocidal products. Describes how to register biocidal	2011-

	)	products, which is an obligatory process to sell them.	
National law	Gesetz zum Schutz vor gefährlichen Stoffen (Chemikaliengesetz -ChemG)	Implementation of Directives 67/548/EEC, 98/24/E, 1999/45/EC, 2004/9/EC and 2004/10/EC. This law defines the cooperation between institutions related to dangerous substance. The government can deem certain substances as dangerous and limit their usage. This is also the case for venomous or poisonous animals and plants.	1980- Last adjustment in 2017
National regulation	Verordnung über diätetische Lebensmittel (Diätverordnung) (DiätV)	Regulation on dietary food, which defines affiliation (e.g. simple cereal products), allowed food additives and identification.	1963- Last adjustment in 2017
National law	Gesetz zur Durchführung der Direktzahlungen an Inhaber landwirtschaftlicher Betriebe im Rahmen von Stützungsregelungen der gemeinsamen Agrarpolitik (Direktzahlungen-Durchführungsgesetz - DirektZahlDurchfG)	Law implementing direct payments to farmers under support schemes of the common agricultural policy. Supports young farmers and ensures the preservation of permanent grassland. Rewards the usage of environmental friendly procedures.	2014- Last adjustment in 2016
National regulation	Verordnung zur Durchführung der Direktzahlungen an Inhaber landwirtschaftlicher Betriebe im Rahmen von Stützungsregelungen der Gemeinsamen Agrarpolitik (Direktzahlungen-Durchführungsverordnung - DirektZahlDurchfV)	By-law detailing the regulations of the above.	2014- Last adjustment in 2018
National regulation	Verordnung über die Errichtung eines Wissenschaftlichen Beirats für Düngungsfragen (Düngungsbeiratsverordnung - DüBV)	Regulates the formation of an advisory committee for issues related to fertilizer. Provides advice for the ministry.	2003- Last adjustment in 2015
National regulation	Verordnung über das Inverkehrbringen von Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Pflanzenhilfsmitteln (Düngemittelverordnung - DüMV)	Law on placing on the market of fertilizers, soil improvers, growing media and plant adjuvants. There are regulations, for example	2012- Last adjustment in 2017

		related to disease control (e.g. salmonella), but there are exceptions for farm fertilizer.	
National law	Düngegesetz (DüngG)	Law on fertilizers. Highlights the prevention of danger for animals and humans, as well as the securing and improvement of cultivable surfaces. The ministries prepare an agenda to protect water bodies and groundwater from agricultural nitrate.	2009- Last adjustment in 2017
National regulation	Verordnung über Probenahmeverfahren und Analysemethoden für die amtliche Düngemittelüberwachung (Düngemittel-Probenahme- und Analyseverordnung - DüngMProbV)	Regulation on methods regarding the analysis of official fertilizer monitoring. Objective is e.g. the prevention of damage to people and the environment.	1977- Last adjustment in 2009
National law	Gesetz zur Sicherung der Düngemittel- und Saatgutversorgung (DüngMSaatG)	Act to secure fertilizer and seed supply, which regulates the rights and obligations of supplier and farmer. Supplier must be compensated with a part of the return, which was achieved with their seeds.	1949-
National law	Gesetz zur Verlängerung des Gesetzes zur Sicherung der Düngemittel- und Saatgutversorgung (DüngMSaatGVerlG)	Act to renewal the law above	1951-
National regulation	Verordnung über die Anwendung von Düngemitteln, Bodenhilfsstoffen, Kultursubstraten und Pflanzenhilfsmitteln nach den Grundsätzen der guten fachlichen Praxis beim Düngen (Düngeverordnung - DüV)	Regulation on the use of fertilizers, soil improvers, growing medias and plant additives according to the principles of good practice in fertilizing. Prohibits the usage of liquid animal fertilizer and bone manure (or similar) in most aspects of vegetable gardening. The usage of diatomite is heavily restricted.	2017-
National regulation	Verordnung über EU-Normen für Obst und Gemüse (EG-ObstGemüseV)	Regulation on European standards for fruits and vegetables. Apples and pears	2009- Last adjustment in 2014

		are exempt from adherence to the special marketing standards if they meet the general marketing standard.	
National law	Gesetz zur Durchführung der Verordnungen der Europäischen Gemeinschaft oder der Europäischen Union auf dem Gebiet der Gentechnik und über die Kennzeichnung ohne Anwendung gentechnischer Verfahren hergestellter Lebensmittel (EG- Gentechnik-Durchführungsgesetz – EGGenTDurchfG)	Act implementing the Regulations of the European Community and the European Union in the field of genetic engineering and labeling without the use of genetically modified food. Genetically modified food must be labeled. Animals must not be fed with genetic modified food, unless there is enough time until their slaughter (twelve months for cows, four for pigs).	2004- Last adjustment in 2015
National regulation	Verordnung zur Durchführung des EG-Rebflächenrodungsprogramms (EGRebflRodDV)	Regulation implementing the Vineyard grubbing-up scheme. Owners can receive a compensation for uprooting vineyards. Vineyards can be barred from compensation, if the slope is too steep or they are made up of terraces.	2008- Last adjustment in 2009
National regulation	Verordnung über Vermarktungsnormen für Eier (EiMarktV)	Regulation on marketing standards for eggs. Eggs must be labeled with in Germany valid informations. Advertising must be done in a manner, that category and price of the eggs are apparent.	1977- Last adjustment in 2017
National regulation	Verordnung über die Verwendung von Extraktionslösungsmitteln bei der Herstellung von Lebensmitteln (Extraktionslösungsmittelverordnung – ElmV)	Regulation on the use of extraction solvents in the production of food. Most extraction solvents, except for water, are only allowed for specific purposes, which are specified in the document.	1991- Last adjustment in 2018
National regulation	Verordnung über die Zulassung von Erhaltungssorten und das Inverkehrbringen von Saat- und Pflanzgut von Erhaltungssorten (Erhaltungssortenverordnung – ErhaltungsV)	Ordinance on the authorization of conservation varieties and the distribution of seed and seedlings thereof. Conservation variety is achieved, if the art is genetically important.	2009- Last adjustment in 2014

National regulation	Verordnung über das Inverkehrbringen von Saatgut von Erhaltungsmischungen (Erhaltungsmischungsverordnung – ErMiV)	Regulation on the distribution of seeds of conservation mixtures. The amount of seeds is limited, to reduce possible negative impact.	2011- Last adjustment in 2017
National regulation	Verordnung über den Verkehr mit Essig und Essigessenz (EssigV)	Ordinance on the traffic of vinegar and vinegar essence. Defines what counts as vinegar and vinegar essence and how to label it.	1972- Last adjustment in 2017
National law	Gesetz über die Sicherstellung der Grundversorgung mit Lebensmitteln in einer Versorgungskrise und Maßnahmen zur Vorsorge für eine Versorgungskrise (Ernährungssicherstellungs- und vorsorgegesetz – ESVG)	Law on ensuring the basic food supply in a supply crisis and measures to prevent a supply crisis. Enables the German state to use measures to ensure food security. The food situation is insecure, if the supply with food, in at least parts of Germany, is in danger.	2017-
National law	Gesetz zu dem Übereinkommen vom 19. September 1979 über die Erhaltung der europäischen wildlebenden Pflanzen und Tiere und ihrer natürlichen Lebensräume (EuLRaumÜbkG)	Law on the Convention of 19 September 1979 on the conservation of European wild fauna and flora and their natural habitats. The "Bundesamt für Naturschutz" can make exceptions for limitations if there is no other option and it doesn't damage the population of the animal or plant.	1984- Last adjustment in 2015
National regulation	Verordnung zur Durchführung von EU-Sondermaßnahmen im Sektor Obst und Gemüse (EUObstGemüseDV)	Regulation on the implementation of special EU measures in the fruit and vegetables sector. Products, which are improper for the consumption, can in some cases be used as animal feed.	2011-
National regulation	Verordnung über Ausnahmen hinsichtlich des Inverkehrbringens und der Verfütterung von bestimmten Erzeugnissen mit Pestizidrückständen (EU-RHG-Ausnahmeverordnung - EURHGAusnahmV)	Regulation on derogating the placing on the market and feeding certain pesticide residues, in this case fipronil in poultry fat and Metobromuron in corn salad.	2010- Last adjustment in 2013
National regulation	Verordnung über Lizenzen für landwirtschaftliche Erzeugnisse (EG-	Regulation on licenses for agricultural products.	1987- Last adjustment

	Lizenz-Verordnung – EWGLizV)		in 2004
National regulation	Verordnung über Sicherheiten für landwirtschaftliche Erzeugnisse (EG-Sicherheiten-Verordnung – EWGSichV)	Regulation on security for agricultural products. Regulates the guarantees in transactions with agricultural products.	1988- Last adjustment in 2008
National law	Gesetz zur Förderung der Einstellung der landwirtschaftlichen Erwerbstätigkeit (FELEG)	Law on farmers who reached retirement. Regulates the transfer of agricultural land to ensure the continued production of food.	1989- Last adjustment in 2015
National law	Gesetz zur Gleichstellung stillgelegter und landwirtschaftlich genutzter Flächen (FGlG)	Idle agricultural land still counts as agrarian land, if they are registered for monetary compensation related to the common agricultural policy of the European Union.	1995- Last adjustment in 2016
National regulation	Verordnung über die Gewährung von Beihilfen für die private Lagerhaltung bestimmter Fischereierzeugnisse (FischBeihV)	Individuals can ask for assistance for the storage of certain fishery products.	1975- Last adjustment in 1994
National regulation	Gesetz zur Durchführung der Rechtsakte der Europäischen Gemeinschaft über die Etikettierung von Fischen und Fischereierzeugnissen (Fischetikettierungsgesetz - FischEtikettG)	Regulates the labeling related to fish and other fishery products. Implementation of an EU regulation.	2002- Last adjustment in 2015
National regulation	Verordnung zur Durchführung des Fischetikettierungsgesetzes (Fischetikettierungsverordnung - FischEtikettV)	By-law detailing the regulations of the above.	2002- Last adjustment in 2015
National regulation	Fischseuchenverordnung (FischSeuchV 2008)	Ensures the safety of fishery products. Objective is to contain possible fish diseases. Includes quarantine.	2008- Last adjustment in 2016
National regulation	Verordnung über die Gewährung von Vergünstigungen im Rahmen der gemeinsamen Marktorganisation für Fischereierzeugnisse (Fischereierzeugnisse-Vergünstigungs-Verordnung – FischVergünstV)	Regulates the permission of amenities for producers of fishery products.	1983- Last adjustment in 1994
National regulation	Verordnung über die Gewährung von Beihilfen für die private Lagerhaltung von Fleisch und Fleischerzeugnissen	Individuals can ask for assistance for the storage of cattle, pigs and lamb.	1978- Last adjustment in 2011

	von Schweinen, Rindern und Schafen (FlBeihV)		
National law	Fleischgesetz (FlG)	Law on meat, its labeling and distribution. Only accredited persons can classify meat.	2008- Last adjustment in 2016
National regulation	Verordnung über die Durchführung einer Statistik über die Schlachttier- und Fleischuntersuchung (Fleischuntersuchungsstatistik-Verordnung - FlUStatV)	Regulates the execution of a statistic investigation in relation to meat production.	2006- Last adjustment in 2016
National regulation	Futtermittelverordnung (FuttMV 1981)	Law on animal feed. Regulates the allowed ingredients for animal feed, the labeling and other legal issues.	1981- Last adjustment in 2017
National regulation	Verordnung zum Schutz gegen die Geflügelpest (Geflügelpest-Verordnung – GeflPestSchV)	Regulates the protection against avian plaque from prevention, to handling and aftercare. Killing affected avian stock is common.	2007- Last adjustment in 2016
National law	Gesetz zur Regelung der Gentechnik (Gentechnikgesetz - GenTG)	Regulates genetic engineering with the objective to reduce risk for environment and humans. Provides a legal framework for the use of genetic engineering in different application areas e.g. research.	1990- Last adjustment in 2017
National regulation	Verordnung über die gute fachliche Praxis bei der Erzeugung gentechnisch veränderter Pflanzen (Gentechnik-Pflanzenerzeugungsverordnung - GenTPflEV)	Neighbors need to be informed, if a genetic engineered plant is to be generated.	2008-
National regulation	Verordnung über die Sicherheitsstufen und Sicherheitsmaßnahmen bei gentechnischen Arbeiten in gentechnischen Anlagen (Gentechnik-Sicherheitsverordnung - GenTSV)	Dictates the necessary security standards in workplaces involved in genetic engineering e.g. decontamination.	1990- Last adjustment in 2015
National regulation	Verordnung über Antrags- und Anmeldeunterlagen und über Genehmigungs- und Anmeldeverfahren nach dem Gentechnikgesetz (Gentechnik-Verfahrensverordnung - GenTVfV)	Regulates the application procedure for genetic engineering.	1990- Last adjustment in 2008

National regulation	Verordnung über die Überwachung von Getreide aus Interventionsbeständen zur Ausfuhr oder zur Verarbeitung zu bestimmten Erzeugnissen (Getreide-Ausfuhr- und -Verarbeitungs-Überwachungsverordnung - GetrAuVÜV)	Regulates the export and processing related to wheat out of intervention stock. Includes e.g. labeling.	1991- Last adjustment in 2004
National regulation	Verordnung über Vermarktungsnormen für Geflügelfleisch (GFlFleischV)	Regulates the labeling and selling related to poultry products.	2013- Last adjustment in 2014
National regulation	Verordnung zum Schutz gegen bestimmte Salmonelleninfektionen beim Haushuhn und bei Puten (Geflügel-Salmonellen-Verordnung - GflSalmoV)	Dictates the measures of protection against salmonella linked to poultry. Includes general sanitation and veterinary measures.	2009- Last adjustment in 2017
National regulation	Verordnung über das Inverkehrbringen von Saatgut von Populationen der Arten Hafer, Gerste, Weizen und Mais (HaGeWeMaSaatVerkV)	Regulates the usage of certain seeds of oat, barley, wheat and corn.	2015-2018
National regulation	Honigverordnung (HonigV)	Defines honey, its components and its labeling for the commerce.	2004- Last adjustment in 2017
National law	Hopfengesetz (HopfG)	Law on hops. The federal states can arrange production areas for hops.	1996- Last adjustment in 2015
National regulation	Verordnung über die Jagdzeiten (JagdzeitV 1977)	Regulates the hunting season for specific animals.	1977- Last adjustment in 2018
National regulation	Käseverordnung (KäseV)	Regulates the producing, labeling and selling related to cheese products.	1965- Last adjustment in 2017
National regulation	Verordnung über Kaseine und Kaseinate für die menschliche Ernährung (Kasein-Verordnung - KaseinV)	Regulates the producing, labeling and selling related to casein.	2016-
National regulation	Verordnung zur Begrenzung von Kontaminanten in Lebensmitteln (Kontaminanten-Verordnung - KmV)	Regulates the production of contaminants with the objective to reduce the usage.	2010- Last adjustment in 2016
National law	Gesetz über die Registrierung von Betrieben zur Haltung von	Law on the registration of companies with laying hen.	2003- Last adjustment in

	Legehennen (Legehennenbetriebsregisterge-setz - LegRegG)	Regulates identification of hens and eggs as well as the registration of the business.	2014
National regulation	Verordnung zur Durchführung des Legehennenbetriebsregistergeset-zes (Legehennenbetriebsregisterver-ordnung - LegRegV)	By-law detailing the regulations of the above.	2003-
National regulation	Verordnung zum Schutz gegen die Leukose der Rinder (Rinder-Leukose-Verordnung - LeukoseV 1976)	Defines the protection measures against cattle leucosis.	1976-
National law/ Statute	Lebensmittel-, Bedarfsgegenstände- und Futtermittelgesetzbuch (Lebensmittel- und Futtermittelgesetzbuch - LFGB)	Law on food, utensil and animal feed. Includes e.g. prohibitions of certain substances, the labeling, legal issues and the observation of production.	2005- Last adjustment in 2017
National law	Gesetz über den Übergang auf das neue Lebensmittel- und Futtermittelrecht (LFÜG)	By-law detailing the regulations of the above.	2005- Last adjustment in 2015
Federal state law	Landesjagdgesetz für Sachsen-Anhalt (LJagdG)	Law on hunting in Saxony-Anhalt. Hunting is monitored by authorities and can only be done with a hunting license. Regulates the division in hunting districts.	1991- Last adjustment in 2015
Federal state law	Jagdgesetz des Landes Mecklenburg-Vorpommern (Landesjagdgesetz - LJagdG M-V)	Law on hunting in Mecklenburg-Western Pomerania. Hunting is monitored by authorities and can only be done with a hunting license. Regulates the division in hunting districts.	2000- Last adjustment in 2016
National regulation	Verordnung über die Behandlung von Lebensmitteln mit Elektronen-, Gamma- und Röntgenstrahlen, Neutronen oder ultravioletten Strahlen (Lebensmittelbestrahlungsverordnung - LMBestrV)	Regulates labeling and legal frame conditions for the radiation of food with e.g. electron beam. This is the case for domestic and external food.	2000- Last adjustment in 2017
National regulation	Verordnung über Anforderungen an die Hygiene beim Herstellen, Behandeln und Inverkehrbringen von Lebensmitteln (Lebensmittelhygiene-Verordnung - LMHV)	Regulates sanitation in the matter of producing and selling food. A course of instruction must be taken to gain the permission to work with easily perishable food.	2007- Last adjustment in 2018

National law	Landwirtschaftsgesetz (LwG)	Law on agriculture. Objective is to observe the situation of agriculture and to improve and aid the development. Voluntarily given information´s are the foundation of future actions.	1955- Last adjustment in 2015
National regulation	Verordnung über das Inverkehrbringen und die Aussaat von mit bestimmten Pflanzenschutzmitteln behandeltem Maissaatgut (MaisPflSchMV)	Forbids the usage of corn processed with certain pesticides e.g. Clothianidin.	2009- Last adjustment in 2013
National regulation	Verordnung über Margarine- und Mischfetterzeugnisse (Margarine- und Mischfettverordnung - MargMFV)	Regulates labeling related to margarine and mixed-fat products. Products with less than 50% fat are not suitable for cooking.	1990- Last adjustment in 2017
National regulation	Verordnung über Milcherzeugnisse (Milcherzeugnisverordnung - MilchErzV)	Regulation on the production, labeling and selling related to milk products.	1970- Last adjustment in 2017
National law	Gesetz über den Verkehr mit Milch, Milcherzeugnissen und Fetten (Milch- und Fettgesetz – MilchFettG)	Law on the production of milk products. Dairies and producer of milk products can't choose their business partner freely and depend on the choices of public authorities.	1951- Last adjustment in 2015
National regulation	Verordnung über die Güteprüfung und Bezahlung der Anlieferungsmilch (Milch-Güteverordnung – MilchGüV)	Regulation on the control of milk quality to ensure quality. The properties of milk e.g. fat content must be controlled at least three times a month.	1980- Last adjustment in 2010
National regulation	Verordnung über die Kennzeichnung wärmebehandelter Konsummilch (Konsummilch-Kennzeichnungs-Verordnung - MilchKennzV)	Regulation on the production, labeling and selling related to heat treated milk products.	1974- Last adjustment in 2017
National law	Gesetz über Milch, Milcherzeugnisse, Margarineerzeugnisse und ähnliche Erzeugnisse (Milch- und Margarinegesetz – MilchMargG)	Law on milk, margarine and similar products. Legal framework for the controlling and regulation of milk production and distribution. Basis for a lot of regulations above and below.	1990- Last adjustment in 2016
National	Verordnung zur Durchführung der EU-	Regulation on the execution of	2008- Last

regulation	Milchquotenregelung (Milchquotenverordnung - MilchQuotV)	the EU milk quota system. Production quotas for milk can be sold and bought, but only by milk producers. Restriction of milk production.	adjustment in 2015
National regulation	Verordnung zur Durchführung einer Sonderbeihilfe für bestimmte Milcherzeuger (Milchsonderbeihilfeverordnung - MilchSonBeihV)	Milk producer can receive financial assistance, if certain requirements are fulfilled e.g. the delivery of milk in the last month.	2016-
National law	Gesetz zur Durchführung von Sondermaßnahmen der Europäischen Union im Milchmarktbereich (Milchmarktsondermaßnahmengesetz - MilchSonMaßG)	Regulates special measures of the European Union related to the milk market. Market disruption because of financial help must be prevented.	2016-
National law	Gesetz über ein Sonderprogramm mit Maßnahmen für Milchviehhalter (Milch-Sonderprogrammgesetz - MilchSoPrG)	Law on the subsidization of milk pastoralists. Subsidies depend partly on the number of cows (21 Euros per cow).	2010- Last adjustment in 2015
National regulation	Verordnung über natürliches Mineralwasser, Quellwasser und Tafelwasser (Mineral- und Tafelwasser-Verordnung - Min/TafelWV)	Regulation on the production, labeling and selling related to mineral, spring and table water products. Measures to secure water quality include the identification of gem pollution.	1984- Last adjustment in 2017
National regulation	Verordnung zum Schutz gegen die Maul- und Klauenseuche (MKS-Verordnung - MKSeuchV 2005)	Defines the protection measures against foot and mouth disease. Includes quarantine measures and emergency slaughter of affected stock.	2004- Last adjustment in 2017
National regulation	Verordnung über Nahrungsergänzungsmittel (Nahrungsergänzungsmittelverordnung - NemV)	Regulation on the production, labeling and general usage of dietary supplements. The usage of dietary supplements must be registered.	2004- Last adjustment in 2017
Federal state regulation	Verordnung zur Durchführung des Öko-Landbaugesetzes (Öko-LandbauGDVO M-V	Implementation of a national law regarding ecological cultivation in Mecklenburg-Western Pomerania.	2010-
National law	Gesetz zur Durchführung der Rechtsakte der Europäischen Union auf dem Gebiet des ökologischen Landbaus (Öko-Landbaugesetz - ÖLG)	Legal framework on controlling ecologic cultivation.	2008- Last adjustment in 2016

National law	Pachtkreditgesetz (PachtkredG)	Law on leasehold loans. Leaseholder can receive loans on their inventory.	1926- Last adjustment in 1985
National regulation	Pflanzkartoffelverordnung (PflKartV 1986)	Regulations for the labeling and quality control of potatoes. The use of new types of potato must be allowed by the respective responsible public authority.	1986- Last adjustment in 2017
National regulation	Verordnung über Anwendungsverbote für Pflanzenschutzmittel (Pflanzenschutz-Anwendungsverordnung - flSchAnwV 1992)	Prohibition of certain agricultural pesticides for certain applications e.g. prussic acid in greenhouses.	1992- Last adjustment in 2013
National law	Gesetz zum Schutz der Kulturpflanzen (Pflanzenschutzgesetz - PflSchG)	Law on the protection of cultivated plants. Legal framework for the observation of protection measures against the improper use of agricultural pesticides and vermin infestation.	2012- Last adjustment in 2016
National regulation	Verordnung über die Kosten des Bundesamtes für Verbraucherschutz und Lebensmittelsicherheit und des Julius Kühn-Instituts im Pflanzenschutzbereich (Pflanzenschutz-Gebührenverordnung – PflSchGebV)	Compendium about costs and fees in plant protection. Also includes the cost for the registration of new pesticide.	2013-
National regulation	Verordnung über die Prüfung von Pflanzenschutzgeräten (Pflanzenschutz-Geräteverordnung – PflSchGerätV)	Legal framework regarding the control of plant protection equipment.	2013-
National regulation	Verordnung über die Anwendung von Pflanzenschutzmitteln mit Luftfahrzeugen (PflSchMAnwLuftFzgV)	Legal framework on the usage of aircraft related to the use of agricultural pesticides. Public authorities inform the public.	2013-
National regulation	Verordnung über Zulassungs- und Genehmigungsverfahren für Pflanzenschutzmittel (Pflanzenschutzmittelverordnung - PflSchMV)	Legal framework on the admission of agricultural pesticides.	2013-
National regulation	Pflanzenschutz-Sachkundeverordnung (PflSchSachkV 2013)	Legal framework on the certification of competence related to the usage of	2013- Last adjustment in 2015

		agricultural pesticides. Only qualified people can work with pesticides.	
National regulation	Verordnung über das Inverkehrbringen und die Aussaat von mit bestimmten Pflanzenschutzmitteln behandeltem Saatgut (Pflanzenschutz-Saatgutanwendungsverordnung - PflSchSaatgAnwendV)	Prohibition of seeds, which were processed with certain pesticides e.g. clothianidin.	2016-
National regulation	Verordnung zum Schutz gegen übertragbare Geschlechtskrankheiten der Rinder (Rinder-Deckinfektionen-Verordnung – RdeckInfV)	Regulates protection measures und treatment of rind venereal diseases.	1975- Last adjustment in 2014
National regulation	Verordnung über die Genehmigung für Neuanpflanzungen von Rebflächen (RebflAnpflV 02/03)	Grants new vineyards in several federal states.	2000- Last adjustment in 2008
National regulation	Verordnung zur Bekämpfung der Reblaus (Reblausverordnung - RebIV)	Regulation on the suppression of the grape vine louse. Vines from affected areas can only be brought in unaffected ones if the successful decontamination is attested by official institutions.	1988- Last adjustment in 2012
National regulation	Rebenpflanzgutverordnung (RebPflV 1986)	Regulations for the labeling and quality control of vine seeds and vine. The usage of seeds must be permitted by official institutions.	1986- Last adjustment in 2017
National regulation	Verordnung über die Kosten des Verfahrens im Rahmen der Festsetzung der Rückstandshöchstgehalte in Lebens- und Futtermitteln (RHG-GebV)	List of fees relevant for lawsuits related to residues in food and feed.	2009- Last adjustment in 2013
National regulation	Verordnung über Höchstmengen an Rückständen von Pflanzenschutz- und Schädlingsbekämpfungsmitteln, Düngemitteln und sonstigen Mitteln in oder auf Lebensmitteln (Rückstands-Höchstmengenverordnung - RHmV)	Regulation on limits for residues of agricultural pesticides, fertilizer and similar substances on food. Concealment of the usage of agricultural pesticides, fertilizer and similar substances is punishable by law.	1994- Last adjustment in 2010

National regulation	Verordnung zur Durchsetzung des Rindfleischetikettierungsrechts (Rindfleischetikettierungs-Strafverordnung - RiFlEtikettStrV)	Regulates what actions related to labeling beef are punishable by law e.g. wrong labeling.	2001- Last adjustment in 2015
National regulation	Verordnung über die Etikettierung von Rindfleisch und über die Verkehrsbezeichnung und Kennzeichnung von Fleisch von weniger als zwölf Monate alten Rindern (Rindfleischetikettierungsverord-nung - RiFlEtikettV)	Beef labeling must be done in a manner that enables traceability.	2009- Last adjustment in 2015
National regulation	Verordnung über das Verfahren für die Gewährung von Sondererstattungen bei der Ausfuhr von Rindfleisch nach Drittländern (Rindfleisch-Sondererstattungs-Verordnung - RindFlSoErstV 1994)	Beef producer can receive special refunds for the export of beef if certain points are met.	1994- Last adjustment in 2011
National regulation	Verordnung über gesetzliche Handelsklassen und Kategorien für Rinderschlachtkörper (Rinderschlachtkörper-Handelsklassenverordnung - RindHKlV)	Classification of rind carcasses in several grades. Regulates rind carcass labeling.	2008- Last adjustment in 2014
National regulation	Verordnung zum Schutz gegen die Salmonellose der Rinder (Rinder-Salmonellose-Verordnung – RindSalmV)	Regulates protection measures und treatment of rind salmonella. Affected stock is slaughtered in most cases.	1972- Last adjustment in 2014
National regulation	Verordnung zum Schutz gegen die Tuberkulose des Rindes (Tuberkulose-Verordnung – RindTbV)	Regulates protection measures und treatment of rind tuberculosis. Affected stock is slaughtered in most cases.	1972- Last adjustment in 2017
Federal state guideline	Richtlinie des Sächsischen Staatsministeriums für Umwelt und Landwirtschaft zur Förderung von Vorhaben der umweltgerechten Flächenbewirtschaftung im Freistaat Sachsen (Förderrichtlinie Agrarumwelt- und Klimamaßnahmen – RL AUK/2015)	Directive regarding the promotion of ecological cultivation in Saxony. Subsidies can be granted, if the criteria are met.	2015- Last adjustment in 2017
Federal state guideline	Richtlinie des Sächsischen Staatsministeriums für Umwelt und Landwirtschaft für die Förderung von besonderen Initiativen zur Entwicklung der Land- und Forstwirtschaft, des	Directive regarding the promotion of e.g. the reduction of negative environmental influence and the advancement of agriculture and forestry in	2015- Last adjustment in 2017

	ländlichen Raumes sowie des Umwelt- und Naturschutzes, zur Minderung der Belastung durch Umwelteinwirkungen, der Imkerei sowie von Berufsbildungsmaßnahmen der Land-, Forst- und Hauswirtschaft im Freistaat Sachsen (Förderrichtlinie Besondere Initiativen – RL BesIn/2007)	Saxony. Subsidies can be granted, if the criteria are met.	
National regulation	Saatgutaufzeichnungsverordnung (SaatAufzV)	Law on the record of seeds.	1986- Last adjustment in 2009
National regulation	Saatgutbeihilfeverordnung (SaatBeihV 1993)	Seed producer can receive financial support.	1993- Last adjustment in 1995
National regulation	Verordnung über die Meldung und Vorführung von Saatgut bei der Einfuhr (SaatEinfMeldV)	Legal framework for the registration of imported seeds.	1975- Last adjustment in 2005
National law	Saatgutverkehrsgesetz*) (SaatG)	Law on e.g. usage of seeds. Seeds can be prohibited, if necessary for the protection of people and environment e.g. biodiversity.	1985- Last adjustment in 2016
National regulation	Verordnung über den Verkehr mit Saatgut landwirtschaftlicher Arten und von Gemüsearten (Saatgutverordnung – SaatV)	Regulates the producing, trading and labeling related to seeds for agricultural usage and vegetable seeds.	1986- Last adjustment in 2017
National regulation	Verordnung über hygienische Anforderungen beim Halten von Schweinen (Schweinehaltungshygieneverordnung - SchHaltHygV)	Regulates hygienic measures for pig housing. Medical examinations must be made, if there are several cases of dead pigs in a short amount of time.	1999- Last adjustment in 2017
National regulation	Verordnung zur Durchführung eines Monitorings auf das Virus der Klassischen und der Afrikanischen Schweinepest bei Wild- und Hausschweinen (Schweinepest-Monitoring-Verordnung - SchwPestMonV)	Boars will be monitored to reduce the chances of swine fever and African swine fever.	2016-
National regulation	Verordnung zum Schutz gegen die Schweinepest und die Afrikanische Schweinepest (Schweinepest-Verordnung - SchwPestV 1988)	Regulates protection measures und treatment of swine fever and African swine fever. Affected stock is slaughtered in most cases.	1988- Last adjustment in 2018

National regulation	Verordnung zur Verminderung der Salmonellenverbreitung durch Schlachtschweine (Schweine-Salmonellen-Verordnung - SchwSalmoV)	Regulates protection measures to reduce the spread of salmonella by pigs. Blood tests must be made.	2007- Last adjustment in 2017
Federal state law	Thüringer Gesetz zur Förderung der Land- und Forstwirtschaft sowie des Gartenbaus (ThürLwFöG)	Law on the promotion of agriculture and forestry in Thuringia. Grants subsidies for environmental friendly cultivation.	1994- Last adjustment in 2011
National regulation	Verordnung über Nachweispflichten der Tierhalter für Arzneimittel, die zur Anwendung bei Tieren bestimmt sind (Tierhalter-Arzneimittelanwendungs- und Nachweisverordnung - THAMNV)	Regulates the usage of medicaments on animals, especially the burden of proof. Medicaments can only be used on animals for food production, if merely affected animals receive them.	2015-
National regulation	Verordnung über Anforderungen an die Hygiene beim Herstellen, Behandeln und Inverkehrbringen von bestimmten Lebensmitteln tierischen Ursprungs (Tierische Lebensmittel Hygieneverordnung - Tier-LMHV)	Hygienic regulations on the production and selling related to animal source food. The source must be traceable.	2007- Last adjustment in 2018
National regulation	Verordnung zur Regelung bestimmter Fragen der amtlichen Überwachung des Herstellens, Behandelns und Inverkehrbringens von Lebensmitteln tierischen Ursprungs (Tierische Lebensmittel-Überwachungsverordnung - Tier-LMÜV)	By-law detailing certain regulations of the above.	2007- Last adjustment in 2016
National law	Gesetz zur Durchführung unionsrechtlicher Vorschriften über Verbote und Beschränkungen hinsichtlich des Handels mit bestimmten tierischen Erzeugnissen sowie zu Haltungs- und Abgabeverboten in bestimmten Fällen (Tiererzeugnisse-Handels-Verbotsgesetz - TierErzHaVerbG)	Fur-bearing animals can only be bred if they are not taken from nature and the requirements for species-appropriate housing are secured.	2008- Last adjustment in 2017
National law	Gesetz zur Vorbeugung vor und Bekämpfung von Tierseuchen (Tiergesundheitsgesetz - TierGesG)	Law on protection measures und treatment of animal diseases. Monetary compensation is possible, if e.g. animals were killed by official	2013- Last adjustment in 2017

		decree. Killing illegal animals won't be compensated.	
National regulation	Verordnung über Sera, Impfstoffe und Antigene nach dem Tiergesundheitsgesetz (Tierimpfstoff-Verordnung - TierImpfStV 2006)	By-law detailing certain regulations of the below. Legal framework on the production, selling, monitoring and usage of e.g. animal vaccines.	2006- Last adjustment in 2017
National law	Tierschutzgesetz (TierSchG)	Law on animal protection. Experiments on animals are allowed e.g. for research or the protection of the environment.	1972- Last adjustment in 2017
National regulation	Verordnung zum Schutz von Tieren im Zusammenhang mit der Schlachtung oder Tötung und zur Durchführung der Verordnung (EG) Nr. 1099/2009 des Rates (Tierschutz-Schlachtverordnung - TierSchlV)	Legal framework for culling. Regulates the whole process. The pain and stress for animals must be as low as possible.	2012-
National regulation	Verordnung zum Schutz landwirtschaftlicher Nutztiere und anderer zur Erzeugung tierischer Produkte gehaltener Tiere bei ihrer Haltung (Tierschutz-Nutztierhaltungsverordnung - TierSchNutztV)	Regulates the protection of livestock e.g. housing. Certain requirements e.g. related to ventilation must be met.	2001- Last adjustment in 2017
National regulation	Verordnung über anzeigepflichtige Tierseuchen (TierSeuchAnzV)	List of animal diseases which are subject to registration.	1991- Last adjustment in 2016
National law	Tierzuchtgesetz (TierZG)	Law on breeding. Legal framework for everything related to the breeding of productive livestock e.g. cattle and pigs.	2006- Last adjustment in 2017
National regulation	Verordnung über Lehrgänge nach dem Tierzuchtgesetz (TierZG1989LehrgV)	Regulates the acquirement of a "breeding certification" related to the law above. The seminar takes at least six weeks and covers e.g. hygiene.	1992-
National regulation	Verordnung über meldepflichtige Tierkrankheiten (TKrMeldpflV 1983)	List of animal diseases which are subject to registration.	1983- Last adjustment in 2015
National regulation	Verordnung zum Schutz gegen die Verschleppung von Tierseuchen im Viehverkehr (Viehverkehrsverordnung -	Regulation and legal framework on the protection from animal diseases. Includes details about	2007- Last adjustment in 2016

	ViehVerkV)	disinfection, quarantines and other hygienic measures.	
National regulation	Verordnung über das Inverkehrbringen und Befördern von Wirtschaftsdünger (WDüngV)	The distribution of industrial fertilizer must be documented. Public authorities must be notified, if new fertilizer is sold.	2010- Last adjustment in 2017
National law	Weingesetz (WeinG 1994)	Law on wine. Includes guidelines concerning the production, definition and labeling. Misuse of geographical labeling is forbidden.	1994- Last adjustment in 2017
National regulation	Weinverordnung (WeinV 1995)	Defines guidelines concerning the production, definition and labeling related to wine products.	1995- Last adjustment in 2017
National regulation	Verordnung über einige zur menschlichen Ernährung bestimmte Zuckerarten (Zuckerartenverordnung - ZuckArtV 2003)	Regulation on the production, labeling and selling related to certain sugar. Implementation of EU-guidelines.	2003- Last adjustment in 2017

Land use

Type of document	Title of document	Short description of document content	Life span of policy
National regulation	Verordnung über die Raumordnung in der deutschen ausschließlichen Wirtschaftszone in der Ostsee (AWZ Ostsee-ROV)	Regional planning for German parts of the Baltic Sea. Reserves an offshore area of 1010 km² for wind parks.	2009–
National law	Baugesetzbuch (BauGB)	Framework law for federal states' provisions on building. Contains provisions that land should be used sparingly and that measures should both, mitigate and adapt, to climate change with respect to environmental protection issues. This law also enacts several EU Directives.	1960– Last adjustment in 2017
National	Bundesberggesetz (BBergG)	This is the law on mining.	1980–

law		With the respective permission, persons or companies can require cession of ground for mining purposes. On this basis forests and whole villages can be removed for lignite pits.	Last adjustment in 2017
Federal state law	Brandenburgisches Abfall- und Bodenschutzgesetz (BbgAbfBodG)	Law on waste and soil protection in Brandenburg. Monitoring measures must be paid by the polluter if he was acting without permission.	1997- Last adjustment in 2016
Federal state law	Brandenburgische Bauordnung (BbgBO)	Law on construction in Brandenburg. Regulates e.g. the usage of certain construction materials.	2016-
National law	Gesetz zum Schutz vor schädlichen Bodenveränderungen und zur Sanierung von Altlasten (Bundes-Bodenschutzgesetz - BBodSchG)	Law on the protection and restoration of soil. Decontamination efforts are under jurisdiction of public authorities if the degree of contamination is to extensive. The same is applies, if the danger for the individual or the public is significant. The state can demand compensation from land owners if the area rises in worth because of the decontamination efforts.	1998- Last adjustment in 2017
National regulation	Bundes-Bodenschutz- und Altlastenverordnung (BBodSchV)	By-law detailing the regulations of the above.	1999- Last adjustment in 2017
Federal state law	Ausführungsgesetz des Landes Sachsen-Anhalt zum Bundes-Bodenschutzgesetz (Bodenschutz-Ausführungsgesetz Sachsen-Anhalt - BodSchAG LSA)	Implementation of the law above in Saxony-Anhalt.	2002- Last adjustment in 2009
National law	Gesetz über Naturschutz und Landschaftspflege (Bundesnaturschutzgesetz BNatSchG)	Law on environmental and landscape protection. Wild animals and natural	2010– Replacing older

		ecosystems shall be protected by best practices, authorisation obligations for interventions, and the definition of protected areas. There are links into the building law and with many laws of the federal states. Generally, the effect of this law is limited, because there are many voluntary provisions and only mild punishments	legislation; last adjustment in 2017
National law	Gesetz zur Erhaltung des Waldes und zur Förderung der Forstwirtschaft (Bundeswaldgesetz BWaldG)	Law on forest protection and the advancement of forestry. Forest transformation requires the approval of the responsible authority. Defines the possible usage of forested areas and how to support them.	1975- Last adjustment in 2017
National regulation	Verordnung über Deponien und Langzeitlager (Deponieverordnung - DepV)	Law on landfills and long-term storage. Regulates among other things the regulations related to the maintenance of landfills, whose goal is the reuction of emissions, interference with groundwater and other damaging influences on the environment. Defines necessary properties of a potential location e.g. the distance to residential areas and the distance from the groundwater surface, which should be at least 1 meter even at groundwater peak level.	2009- Last adjustment in 2017
National regulation	Verordnung über den Erwerb land- und forstwirtschaftlicher Flächen und das Verfahren nach dem Ausgleichsleistungsgesetz (Flächenerwerbsverordnung - FlErwV)	Defines what counts as agricultural or forestry usage of land. It also regulates the prices of	1995- Last adjustment in 2014

		agricultural and forestry areas and who can buy them under which circumstances.	
National law	Flurbereinigungsgesetz (FlurbG)	Law on the reallocation of land. This law makes it possible to change the land tenure, if its needed for agricultural and forestry matters or if it´s necessary for land development. Regulates the whole process including rights and responsibilities of the German state and involved persons.	1953- Last adjustment in 2008
National law	Gesetz zum Ausgleich von Auswirkungen besonderer Schadensereignisse in der Forstwirtschaft (Forstschäden-Ausgleichsgesetz – ForstSchAusglG)	Forest owners can be forced to reduce lumbering if events caused significant damage to the forests. They can reduce their tax, if they form a reserve to deal with such events.	1969- Last adjustment in 2015
National regulation	Verordnung über Erhebungen zum forstlichen Umweltmonitoring (ForUmV)	Regulates what information´s will be gathered to observe the condition of forests e.g. the growth of trees.	2013-
National regulation	Forstvermehrungsgut-Durchführungsverordnung (FoVDV)	By-law detailing the regulations of the below.	2002-
National law	Forstvermehrungsgutgesetz (FoVG)	Law on the protection and preservation of forests and their biodiversity.	2002- Last adjustment in 2015
National regulation	Verordnung über Herkunftsgebiete für forstliches Vermehrungsgut (Forstvermehrungsgut Herkunftsgebietsverordnung - FoVHgV)	Detailing the labeling related to reproductive material in forestry. Related to the origin of the reproductive material.	1994- Last adjustment in 2003
National regulation	Forstvermehrungsgut-Zulassungsverordnung (FoVZV)	Detailing the labeling related to reproductive material in forestry.	2002-
National	Gesetz über die Gemeinschaftsaufgabe	Law on improvement of	1969- Last

law	"Verbesserung der Agrarstruktur und des Küstenschutzes" (GAK-Gesetz - GAKG)	agriculture and coastal preservation. Defines those issues as common task. Objective is the improvement of competitiveness and the reduction of negative impact on the environment.	adjustment in 2016
National regulation	Verordnung zum Schutz vor Gefahrstoffen (Gefahrstoffverordnung - GefStoffV)	Dictates the labeling and handling related to hazardous material and provides technical guidelines.	2010- Last adjustment in 2017
National regulation	Verordnung zur Festlegung der Nutzungsbestimmungen für die Bereitstellung von Geodaten des Bundes (GeoNutzV)	Geo information of the state are free usable unless it would breach a contract with third parties or there are special legal circumstances.	2013-
National law	Gesetz über den Zugang zu digitalen Geodaten (Geodatenzugangsgesetz - GeoZG)	Defines geo information´s and their potential use. Regulates the services provided by geo institutions.	2009- Last adjustment in 2012
National regulation	Verordnung über die Bewirtschaftung von gewerblichen Siedlungsabfällen und von bestimmten Bau- und Abbruchabfällen (Gewerbeabfallverordnung - GewAbfV)	Regulation on handling related to commercial waste and certain construction waste. Classifies waste in material categories which must be gathered and processed separately.	2017-
National law	Grundgesetz für die Bundesrepublik Deutschland (GG)	Basic Law of the Federal Republic of Germany. The federal states can issue laws in many topics themselves e.g. protection of the environment and shooting law. German law stands above the laws of the federal states in case of conflict. This can also lead to conflict with guidelines and directives	1949- Last adjustment in 2017

		of the European Union.	
National law	Gesetz über Maßnahmen zur Verbesserung der Agrarstruktur und zur Sicherung land- und forstwirtschaftlicher Betriebe (Grundstückverkehrsgesetz - GrdstVG)	Forestry and agricultural areas can only be sold with a permission. Objective is the securing and improvement of the agricultural structure.	1961- Last adjustment in 2008
National regulation	Anordnung über Halden und Restlöcher (HaldeRlAnO)	Adapted regulation of the GDR. Heaps must be used in a safe way for people and environment.	1980-
National law	Gesetz gegen den Handel mit illegal eingeschlagenem Holz (Holzhandels-Sicherungs-Gesetz - HolzSiG)	Illegal "produced" timber cannot be traded without repercussion.	2011- Last adjustment in 2015
National law	Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen (Kreislaufwirtschaftsgesetz - KrWG)	Law on waste and its environmental friendly disposal. Includes recycling and plans disposal of waste in the future.	2012- Last adjustment in 2017
National law	Gesetz über die Durchforschung des Reichsgebietes nach nutzbaren Lagerstätten (Lagerstättengesetz – LagerstG)	Law on searching for natural mineral deposits. Damage dealt by drilling or similar things will be compensated. Access to property excluding living quarters must be granted.	1934- Last adjustment in 2001
National regulation	Verordnung zur Ausführung des Gesetzes über die Durchforschung des Reichsgebietes nach nutzbaren Lagerstätten (Lagerstättengesetz – LagerstGDV)	By-law detailing the regulations of the above.	1934-
Federal state law	Waldgesetz des Landes Brandenburg (LWaldG)	Law on forest in Brandenburg e.g. usage and protection.	2004- Last adjustment in 2014
Federal state law	Gesetz zur Erhaltung und Pflege des Waldes (Landeswaldgesetz - LWaldG)	Law on forest in Berlin e.g. usage and protection.	2004- Last adjustment in 2016
Federal state law	Waldgesetz für das Land Mecklenburg-Vorpommern (Landeswaldgesetz - LWaldG)	Law on forest in Mecklenburg-Western Pomerania e.g. usage and protection.	2011- Last adjustment in 2016
Federal	Gesetz zur Erhaltung und Bewirtschaftung des	Law on forest in Saxony-	2016-

state law	Waldes, zur Förderung der Forstwirtschaft sowie zum Betreten und Nutzen der freien Landschaft im Land Sachsen-Anhalt (Landeswaldgesetz Sachsen-Anhalt - LWaldG)	Anhalt e.g. usage, monitoring and protection.	
National regulation	Verordnung über die Nachweisführung bei der Entsorgung von Abfällen (Nachweisverordnung - NachwV)	Regulates the process of verification management concerning waste disposal. Verifications are necessary to secure the orderly disposal of waste and minimize the impact on the environment.	2006- Last adjustment in 2017
Federal state law	Naturschutzgesetz des Landes Sachsen-Anhalt (NatSchG LSA)	Law on the protection of the environment in Saxony-Anhalt. Regulates e.g. legal interferences with nature.	2010- Last adjustment in 2015
Federal state law	Gesetz zur Regionalplanung und zur Braunkohlen- und Sanierungsplanung (RegBkPlG)	Law on regional planning and lignite restoration. Regulates what is part of lignite restoration efforts e.g. the condition of the landscape.	1993- Last adjustment in 2014
National law	Raumordnungsgesetz (ROG)	Law on land use planning. Environmental combability tests are mandatory for the preparation of land use plans. The public must be informed about land use plans in a timely manner.	2008- Last adjustment in 2017
Federal state law	Waldgesetz für den Freistaat Sachsen (SächsWaldG)	Law on forestry in Saxony. Regulates usage and protection of forests.	1992- Last adjustment in 2015
National law	Sortenschutzgesetz (SortSchG 1985)	Law on the protection of plant species to ensure biodiversity.	1985- Last adjustment in 2017
Federal state law	Straßen- und Wegegesetz des Landes Mecklenburg-Vorpommern (StrWG - MV)	Law on the construction of roads and paths in Mecklenburg-Western Pomerania. Legal framework for questions regarding e.g. roads.	1993- Last adjustment in 2017
Federal	Thüringer Bodenschutzgesetz (ThürBodSchG)	Law on soil protection in	2003- Last

state law		Thuringia. Regulates responsibilities and tasks related to soil protection.	adjustment in 2007
Federal state law	Gesetz zur Erhaltung, zum Schutz und zur Bewirtschaftung des Waldes und zur Förderung der Forstwirtschaft (Thüringer Waldgesetz - ThürWaldG -)	Law on forest protection and the promotion of forestry in Thuringia. Subsidies for the preservation of forests in possible.	2008- Last adjustment in 2016
National law	Gesetz über die Vermeidung und Sanierung von Umweltschäden (Umweltschadensgesetz - USchadG)	Law on environmental damage ant its avoidance. Legal framework. The person responsible is obligated to compensate for the damage and pay for rehabilitation measures.	2007- Last adjustment in 2016
National law	Umweltstatistikgesetz (UStatG)	Law on the establishment of the environmental statistic. Information about e.g. waste, waste disposal and costs for environmental protection of corporations are gathered.	2005- Last adjustment in 2017
National regulation	Verordnung über die Umweltverträglichkeitsprüfung bergbaulicher Vorhaben (UVP-V Bergbau)	Law on the examination of the environmental compatibility for mining operations. Only some cases need to do the examination.	1990- Last adjustment in 2017
National law	Gesetz über die Umweltverträglichkeitsprüfung (UVPG)	Law on the examination of the environmental compatibility. Legal framework for the whole process.	1990- Last adjustment in 2017
National law	Gesetz zur Beschleunigung der Planungen für Verkehrswege in den neuen Ländern sowie im Land Berlin (Verkehrswegeplanungsbeschleunigungsgesetz – VerkPBG)	Law to improve the planning speed for new traffic infrastructure in Berlin and the new federal states. Reduces bureaucratic hindrances related to planning.	1991- Last adjustment in 2015
National	Verordnung über den Versatz von Abfällen	Regulation on the	2002- Last

regulation	unter Tage (Versatzverordnung - VersatzV)	displacement of waste belowground. Metals must be recycled and not displaced underground. Dangerous substances and components are not permitted for this kind of waste disposal.	adjustment in 2012
European directive	Waste Framework Directive (WFD)	Regulation on the usage of waste. Waste separation must be done in every member state until 2015. There are recycling quotas for certain materials, which must be reached until 2020.	2008-

Climate

Type of document	Title of document	Short description of document content	Life span of policy
National law	Gesetz zum Schutz vor schädlichen Umwelteinwirkungen durch Luftverunreinigungen, Geräusche, Erschütterungen und ähnliche Vorgänge (Bundes-Immissionsschutzgesetz - BImSchG)	Law on the protection from emission, noise and similar processes. Corporations must reduce their emissions. Construction projects should be done in a manner, that protects residential property and landscape from damaging environmental impact.	1974- Last adjustment in 2017
National regulation	Verordnung über die Begrenzung von Abgasemissionen aus Dieselmotoren in der Binnenschifffahrt (Binnenschiffs-Abgasemissionsverordnung - BinSchAbgasV)	Implementation of EU regulations: To reduce emissions, only ships with acceptable engines are allowed for inland navigation.	2005- Last adjustment in 2016
National regulation	Verordnung über Anforderungen an eine nachhaltige Herstellung von Biokraftstoffen (Biokraftstoff-Nachhaltigkeitsverordnung - Biokraft-NachV)	Implementation of EU directives: Biofuels must be produced in a sustainable way and shall be furthered according to these regulations. They must not be harvested from forests, protected	2009– Last adjustment in 2016

		areas, pastures with high biological diversity, or from wetland and peat bog areas. GHG emissions from biofuels must be decreased by at least 50%.	
National law	Gesetz zur Verminderung von Luftverunreinigungen durch Bleiverbindungen in Ottokraftstoffen für Kraftfahrzeugmotore (Benzinbleigesetz - BzBlG)	Law to reduce emissions by lead compounds in fuel. Lead compounds are responsible for atmospheric pollution and have a damaging environmental impact.	1971- Last adjustment in 2015
National regulation	Verordnung zum Schutz des Klimas vor Veränderungen durch den Eintrag bestimmter fluorierter Treibhausgase (Chemikalien-Klimaschutzverordnung - ChemKlimaschutzV)	Regulation on fluorinated greenhouse gases, which are mostly used in cooling systems. Corporations need a license to be allowed to recover them but can also assign a third party to do so.	2008- Last adjustment in 2017
National regulation	Verordnung über Stoffe, die die Ozonschicht schädigen (Chemikalien-Ozonschichtverordnung - ChemOzonSchichtV)	Regulation on substances which can damage the ozone layer. The operator, if not available the owner, is responsible for the recovery of substances. They have the obligation to prevent leak and keep the substances safe.	2006- Last adjustment in 2015
National regulation	Verordnung über Verbote und Beschränkungen des Inverkehrbringens und über die Abgabe bestimmter Stoffe, Gemische und Erzeugnisse nach dem Chemikaliengesetz (Chemikalien-Verbotsverordnung – ChemVerbotsV)	Defines who can trade with chemical substances and which substances are an exception under special circumstances (e.g. chemistry modular).	2017-
National regulation	Chemikalienrechtliche Verordnung zur Begrenzung der Emissionen flüchtiger organischer Verbindungen (VOC) durch Beschränkung des Inverkehrbringens lösemittelhaltiger Farben und Lacke (Lösemittelhaltige Farben- und Lack-Verordnung - ChemVOCFarbV)	Regulates the usage of solvent-based paints and varnishes to reduce emissions of volatile organic compounds (VOC). Limits have been made, which must be adhered to. Mostly relevant for the construction and car industry.	2004- Last adjustment in 2015
National law	Gesetz zur Errichtung einer Stiftung "Deutsche Bundesstiftung	Law on the establishment of the foundation “Deutsche	1990- Last adjustment

	Umwelt" (DBUStiftG)	Bundesstiftung Umwelt". Goals of the institution involve the improvement of cooperation in environmental matters between public institutions, corporations and the individual, as well as the development of environmentally friendly processes under consideration for smaller and medium sized companies. The protection of national cultural assets from damaging environmental influences is also a responsibility.	in 2016
National law	Gesetz über den Deutschen Wetterdienst (DWD-Gesetz - DWDG)	Law on the German Weather Service. Responsibilities encompass all climatic problems e.g. the assurance of infrastructure, aviation and seafaring. Another relevant point is the evaluation of climate change and its impact on the environment and society.	1998- Last adjustment in 2017
National law	Gesetz zur Errichtung eines Sondervermögens „Energie- und Klimafonds" (EKFG)	Law on the establishment of a special fund "Energy and Climate Fund". Objective is the financial support of projects in relation to renewable energy and the protection of the climate and the environment.	2010- Last adjustment in 2014
EU action programme (voluntary)	Eco-Management and Audit Scheme (EMAS)	Common programm for cooperation between companies. Objective is the improvement and promotion of environemntally sound practices and awareness about the topic.	1993- Last adjustment in 2017
National law	Gesetz über die umweltgerechte Gestaltung energieverbrauchsrelevanter Produkte (Energieverbrauchsrelevante-Produkte-Gesetz – EVPG)	Law on ecodesign of energy-related products. Energy relevant products need to conform to environment conform provisions.	2008- Last adjustment in 2015
National regulation	Verordnung zur Durchführung des Gesetzes über die umweltgerechte Gestaltung	Regulation implementing the law on the environmentally sound design of energy-related	2013- Last adjustment in 2017

	energieverbrauchsrelevanter Produkte (EVPG-Verordnung – EVPGV)	products. Defines what counts as environmentally sound design.	
European directive	Industrial Emissions Directive (IPPC)	Regulates the reduction of emissions caused by the industry. Uses “polluter pays” principle. Best available technology must be used. Exceptions can be made, if the use would be lower than the costs.	2011-
National law	Gesetz über die Erweiterung des Katastrophenschutzes (KatSchErwG)	Protects helper of disaster control from work related consequences.	1968- Last adjustment in 2006
National regulation	Bergverordnung zum Schutz der Gesundheit gegen Klimaeinwirkungen (Klima-Bergverordnung - KlimaBergV)	Regulates the protection of employees against climate impacts. This regulation is for employees working in the mountains. Defines time limits for e.g. mining, dependent e.g. on the temperature.	1983- Last adjustment in 2017
National Management Plan	Klimaschutzplan 2050: Klimaschutzpolitische Grundsätze und Ziele der Bundesregierung	Reduction of greenhouse gas emissions compared to 1990 by 40% in 2020, 55% in 2030, 70% in 2040 and 85% in 2050. Reduction of energy usage of houses by 80% in 2050.	2016-
Federal state law	Thüringer Umweltinformationsgesetz (ThürUIG)	Law on environment information’s in Thuringia. Regulates the access to information´s regarding the environment. Access can be denied, if private or public interests would be severely affected.	2006- Last adjustment in 2017
National law	Gesetz zur Ausführung der Verordnung (EG) Nr. 1221/2009 des Europäischen Parlaments und des Rates vom 25. November 2009 über die freiwillige Teilnahme von Organisationen an einem Gemeinschaftssystem für Umweltmanagement und Umweltbetriebsprüfung und zur Aufhebung der Verordnung (EG) Nr. 761/2001, sowie der	Implementation of EU directives. Organizations can voluntary participate in a common system for environment management. This law provides the legal framework for the admission procedure and responsibilities. Participating organizations and corporations need to respect environment protection.	1995- Last adjustment in 2017

	Beschlüsse der Kommission 2001/681EG und 2006/193/EG (Umweltauditgesetz - UAG)		
National regulation	Verordnung nach dem Umweltauditgesetz über die Erweiterung des Gemeinschaftssystems für das Umweltmanagement und die Umweltbetriebsprüfung auf weitere Bereiche (UAG-Erweiterungsverordnung - UAG-ErwV)	Advances participation possibilities for the above.	1998-
National law	Gesetz zur Anwendung des Umweltauditgesetzes und seiner Rechtsverordnungen auf die Verordnung (EG) Nr. 761/2001 des Europäischen Parlaments und des Rates vom 19. März 2001 über die freiwillige Beteiligung von Organisationen an einem Gemeinschaftssystem für das Umweltmanagement und die Umweltbetriebsprüfung (UAGAnwG)	Further detailing the above.	2001-
National regulation	Verordnung über die Beleihung der Zulassungsstelle nach dem Umweltauditgesetz (UAG-Beleihungsverordnung - UAGBV)	Further detailing the above. Admission office is in Bonn.	1995- Last adjustment in 2017
National regulation	Verordnung über Gebühren und Auslagen für Amtshandlungen der Zulassungsstelle und der Widerspruchsbehörde bei der Durchführung des Umweltauditgesetzes (UAG-Gebührenverordnung - UAGGebV)	Further detailing the above. List about costs and fees.	2002- Last adjustment in 2013
National regulation	Verordnung zur Übertragung der Zuständigkeit für die Verfolgung und Ahndung bestimmter Ordnungswidrigkeiten nach § 37 Abs. 1 des Umweltauditgesetzes auf das Bundesverwaltungsamt (UAGOWiZustV)	Further detailing the above.	2004- Last adjustment in 2015
National regulation	Verordnung über das Verfahren zur Zulassung von Umweltgutachtern und	Further detailing the above. Regulates the procedure to become environmental auditor.	1995- Last adjustment in 2017

	Umweltgutachterorganisationen sowie zur Erteilung von Fachkenntnisbescheinigungen nach dem Umweltauditgesetz (UAG-Zulassungsverfahrensverordnung - UAGZVV)	Also possible for organizations.	
National law	Gesetz über die Errichtung eines Umweltbundesamtes (UBAG)	Law on the establishment of the "Umweltbundesamt" (German Federal Environmental Agency).	1974- Last adjustment in 2015

There exist federal state laws and regulations which implement national laws and regulations. Laws on the same topic of the individual federal states are most of the time like each other, with only small exceptions.

Inventory of policy goals of Germany and it´s federal states - Berlin, Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt and Thuringia

Policies of the German Federal States derive mostly from national laws and regulations and the laws of federal states regarding the same topic are like each other in most cases. Documents are mostly listed under their abbreviation.

Water policy of Germany and it´s federal states		
Overarching objectives	Specific objectives	Reference documents (Selection)
Reduction of pollutants e.g. fertilizer in surface water bodies and groundwater and with it the improvement of water quality	Reduction of wastewater deduction into e.g. rivers	Abwasserabgabengesetz - AbwAG Abwasserverordnung - AbwV Brandenburgisches Wassergesetz (BbgWG) Berliner Wassergesetz (BWG) Industriekläranlagen-Zulassungs- und Überwachungsverordnung - IZÜV) Oberflächengewässerverordnung - OGewV
	Pollution reduction of water in the river basins of the Warnow/Peene, Elbe and Oder (2016-2021)	Aktualisierung des Bewirtschaftungsplans nach § 83 WHG bzw. Artikel 13 der Richtlinie 2000/60/EG für den deutschen Teil der Flussgebietseinheit Elbe für den Zeitraum von 2016 bis 2021 Aktualisierter Bewirtschaftungsplan nach Artikel 13 der Richtlinie 2000/60/EG bzw. § 83 WHG für den deutschen Teil der IFGE Oder Bewirtschaftungszeitraum 2016 bis 2021 Aktualisierung des Bewirtschaftungsplans nach § 83 WHG bzw. Artikel 13 der Richtlinie 2000/60/EG für die Flussgebietseinheit Warnow/Peene für den Zeitraum von 2016 bis

		2021 Die Europäische Wasserrahmenrichtlinie (EU-WRRL)
	Reducing the pollution by waste	Brandenburgisches Abfall- und Bodenschutzgesetz (BbgAbfBodG) (Bundes-Bodenschutzgesetz - BBodSchG) Bundes-Bodenschutz- und Altlastenverordnung (BBodSchV) Bodenschutz-Ausführungsgesetz Sachsen-Anhalt - BodSchAG LSA) Deponieverordnung - DepV Versatzverordnung - VersatzV
	Reducing the pollution by e.g. fuel	Binnenschiffs-Abgasemissionsverordnung - BinSchAbgasV
	Reducing the pollution by fertilizer	Düngegesetz (DüngG) Die Europäische Wasserrahmenrichtlinie (EU-WRRL) Grundwasserverordnung - GrwV Oberflächengewässerverordnung - OGewV
Improvement of waterway infrastructure	Development of the Oder-Havel waterway.	Bundeswasserstraßenausbaugesetz (WaStrAbG)
Preservation of biodiversity in water bodies	Preservation of biodiversity in water bodies in the river basins of the Warnow/Peene, Elbe and Oder (2016-2021)	Aktualisierung des Bewirtschaftungsplans nach § 83 WHG bzw. Artikel 13 der Richtlinie 2000/60/EG für den deutschen Teil der Flussgebietseinheit Elbe für den Zeitraum von 2016 bis 2021 Aktualisierter Bewirtschaftungsplan nach Artikel 13 der Richtlinie 2000/60/EG bzw. § 83 WHG für den deutschen Teil der IFGE Oder Bewirtschaftungszeitraum 2016 bis 2021 Aktualisierung des Bewirtschaftungsplans nach § 83 WHG bzw. Artikel 13 der Richtlinie 2000/60/EG für die Flussgebietseinheit Warnow/Peene für den Zeitraum von 2016 bis 2021 Die Europäische Wasserrahmenrichtlinie (EU-WRRL) Wasserhaushaltsgesetz - WHG
Sustainable usage of water resources	Reduction of water usage	Aktualisierung des Bewirtschaftungsplans nach § 83 WHG bzw. Artikel 13 der Richtlinie 2000/60/EG für den deutschen Teil der Flussgebietseinheit Elbe für den Zeitraum von 2016 bis 2021 Aktualisierter Bewirtschaftungsplan nach Artikel 13 der Richtlinie 2000/60/EG bzw. § 83

		WHG für den deutschen Teil der IFGE Oder Bewirtschaftungszeitraum 2016 bis 2021 Aktualisierung des Bewirtschaftungsplans nach § 83 WHG bzw. Artikel 13 der Richtlinie 2000/60/EG für die Flussgebietseinheit Warnow/Peene für den Zeitraum von 2016 bis 2021 Die Europäische Wasserrahmenrichtlinie (EU-WRRL) Wasserhaushaltsgesetz - WHG
Free usage of waterways	Free passage along the Elbe river	Gesetz zu dem Abkommen vom 26. Januar 1988 zwischen der Regierung der Bundesrepublik Deutschland und der Regierung der Tschechoslowakischen Sozialistischen Republik über den Binnenschiffsverkehr (BinSchAbkCSKG) Abkommen zwischen der Regierung der Bundesrepublik Deutschland und der Regierung der Tschechoslowakischen Sozialistischen Republik über den Binnenschiffsverkehr (BinSchAbk CSK)
Flood control	Reduction of flood risk and prevention of damage to people, infrastructure and agriculture.	Brandenburgisches Wassergesetz (BbgWG) Berliner Wassergesetz (BWG)

Energy policy of Germany and it´s federal states		
Overarching objectives	Specific objectives	Reference documents (Selection)
End of nuclear energy usage in Germany	End of nuclear energy usage in Germany until 2022	Atomgesetz - AtG
	Safe disposal of radioactive waste	Entsorgungsfondsgesetz – EntsorgFondsG) Nachhaftungsgesetz – NachhG Standortauswahlgesetz - StandAG Gesetz zur Neuordnung der Verantwortung in der kerntechnischen Entsorgung (VkENOG)
Promotion of renewable energy	Possible construction of offshore wind parks in the Baltic Sea	AWZ Ostsee-ROV
	Increasing the usage of renewable energy to 40-45 percent in 2025, 55-60 percent in 2035 and at least 80 percent in 2050.	Erneuerbare-Energien-Gesetz - EEG 2017 Erneuerbare-Energien- Verordnung – EEV

	Increasing the usage of renewable energies in the heating sector	Erneuerbare-Energien Wärmegesetz – EEWärmeG
	Possible construction of offshore wind parks in the Baltic Sea	AWZ Ostsee-ROV
	Promotion of bio diesel	Biokraftstoff-Nachhaltigkeitsverordnung - Biokraft-NachV
Improvement of the power network	Improvement and expansion of the power supply system to meet the needs of renewable energies, creation of a reserve usable in emergencies	Erneuerbare-Energien-Gesetz - EEG 2017 Erneuerbare-Energien- Verordnung – EEV Energieleitungsausbaugesetz – EnLAG Netzausbaubeschleunigungsgesetz Übertragungsnetz (NABEG) Netzreserveverordnung - NetzResV Verordnung zum Schutz von Übertragungsnetzen (ÜNSchutzV)
Reduction of energy usage	Using materials and construction techniques to reduce the unnecessary usage and waste of energy	Baugesetzbuch BauGB Brandenburgische Bauordnung (BbgBO) Energieeinsparungsgesetz – EnEG Energieeinsparverordnung – EnEV Berliner Energiewendegesetz (EWG Bln)
	Using energy efficient procedures	Gesetz über Energiedienstleistungen und andere Energieeffizienzmaßnahmen (EDL-G) Energieeinsparverordnung – EnEV Berliner Energiewendegesetz (EWG Bln) KWK-Kosten-Nutzen-Vergleich-Verordnung - KNV-V Kraft-Wärme-Kopplungsgesetz - KWKG)
	Reduction of energy usage	Verordnung zur Durchführung des Treibhausgas- Emissionshandelsgesetzes in der Handelsperiode 2013 bis 2020 (Emissionshandelsverordnung 2020 - EHV 2020) Verordnung über die Versteigerung von Emissionsberechtigungen nach dem Zuteilungsgesetz 2012 (Emissionshandels-Versteigerungsverordnung 2012 - EHVV 2012) Treibhausgas-Emissionshandelsgesetz - TEHG
	Reduction of energy usage of houses by 80% in 2050.	Klimaschutzplan 2050: Klimaschutzpolitische Grundsätze und Ziele der Bundesregierung

Food and agriculture policy of Germany and it´s federal states		
Overarching objectives	Specific objectives	Reference documents (Selection)
Ensuring food quality and production	Renewing agriculture enterprise structures in	Fördergesetz (ASLwApFG)

	Eastern Germany	
	Regulating the usage of biocidal products	Verordnung über die Meldung von Biozid-Produkten nach dem Chemikaliengesetz (ChemBiozidMeldeV)
	Monitoring agricultural development	Landwirtschaftsgesetz (LwG)
	Preservation of permanent grassland	Direktzahlungen-Durchführungsgesetz - DirektZahlDurchfG Direktzahlungen-Durchführungsverordnung - DirektZahlDurchfV)
	Improvement of cultivable surfaces	Düngegesetz (DüngG) Düngeverordnung - DüV Gesetz über die Gemeinschaftsaufgabe "Verbesserung der Agrarstruktur und des Küstenschutzes" (GAK-Gesetz - GAKG)
	Securing food production	Gesetz zur Sicherung der Düngemittel- und Saatgutversorgung (DüngMSaatG) Gesetz zur Verlängerung des Gesetzes zur Sicherung der Düngemittel- und Saatgutversorgung (DüngMSaatGVerlG) Düngeverordnung – DüV Ernährungssicherstellungs- und vorsorgegesetz – ESVG Gesetz zur Förderung der Einstellung der landwirtschaftlichen Erwerbstätigkeit Flurbereinigungsgesetz (FlurbG) Tierzuchtgesetz (TierZG)
	Securing food quality	EG-ObstGemüseV Verordnung über Vermarktungsnormen für Eier (EiMarktV) Verordnung über den Verkehr mit Essig und Essigessenz (EssigV) Verordnung zur Durchführung von EU-Sondermaßnahmen im Sektor Obst und Gemüse (EUObstGemüseDV) Verordnung über Vermarktungsnormen für Geflügelfleisch (GFlFleischV) Käseverordnung (KäseV) Legehennenbetriebsregistergesetz - LegRegG) Legehennenbetriebs-registerverordnung - LegRegV Lebensmittelhygiene-Verordnung - LMHV
	Research in genetic engineering without endangering e.g. the environment	EG- Gentechnik-Durchführungsgesetz – EGGenTDurchfG (Gentechnikgesetz - GenTG) Gentechnik- Pflanzenerzeugungsverordnung - GenTPflEV

		Gentechnik-Sicherheitsverordnung - GenTSV Gentechnik-Verfahrensverordnung - GenTVfV
Prevention of animal diseases and diseases in general	Prevention of diseases induced by fertilizer	Düngemittelverordnung - DüMV Düngegesetz (DüngG) Düngeverordnung - DüV
	Prevention of animal diseases	Tiergesundheitsgesetz - TierGesG Fischseuchenverordnung (FischSeuchV 2008) Verordnung zum Schutz gegen die Geflügelpest (Geflügelpest-Verordnung – GeflPestSchV) Geflügel-Salmonellen-Verordnung - GflSalmoV Rinder- Leukose-Verordnung - LeukoseV 1976 MKS-Verordnung - MKSeuchV 2005
Promotion of ecological cultivation	Increase of environmental friendly procedures in agriculture	Direktzahlungen-Durchführungsgesetz - DirektZahlDurchfG Verordnung zur Durchführung des Öko-Landbaugesetzes (Öko-LandbauGDVO M-V
Protection of animals	Protection of wildlife in Europe	Gesetz zu dem Übereinkommen vom 19. September 1979 über die Erhaltung der europäischen wildlebenden Pflanzen und Tiere und ihrer natürlichen Lebensräume (EuLRaumÜbkG) Verordnung über die Jagdzeiten (JagdzeitV 1977) Tierschutzgesetz (TierSchG)
Ensuring biodiversity	Protection of genetically important plant species	Erhaltungssortenverordnung – ErhaltungsV Erhaltungsmischungsverordnung – ErMiV Sortenschutzgesetz (SortSchG 1985)

Land use policy of Germany and it´s federal states		
Overarching objectives	Specific objectives	Reference documents (Selection)
Improvement of rural infrastructure and agriculture	Improvement of rural infrastructure in Eastern Germany	Fördergesetz (ASLwApFG)
Sustainable and environmental friendly use of land	Land should be used sparingly	Baugesetzbuch BauGB
	Land should be used environmental friendly (if possible)	Deponieverordnung - DepV
	Reduction of damage to land	(Bundes-Bodenschutzgesetz - BBodSchG) Bodenschutz-Ausführungsgesetz Sachsen-Anhalt - BodSchAG LSA) Verordnung zum Schutz vor Gefahrstoffen (Gefahrstoffverordnung - GefStoffV) Gewerbeabfallverordnung - GewAbfV) Kreislaufwirtschaftsgesetz - KrWG

	Protection of landscapes by best practices	Bundesnaturschutzgesetz BNatSchG
	Ignite restoration	Gesetz zur Regionalplanung und zur Braunkohlen- und Sanierungsplanung (RegBkPlG)
Mining mportant e.g. metals	Acquisition of land for mining purposes	Bundesberggesetz (BBergG) Lagerstättengesetz – LagerstG Lagerstättengesetz – LagerstGDV
Preservation of forests and their biodiversity	Regulation of hunting	Jagdgesetz für das Land Brandenburg (BbgJagdG) Bundesnaturschutzgesetz BNatSchG Flurbereinigungsgesetz (FlurbG) Verordnung über die Jagdzeiten (JagdzeitV 1977)
	Advancement of forestry	Bundeswaldgesetz BWaldG SächsWaldG Thüringer Waldgesetz - ThürWaldG
	Protection of forests	Forstvermehrungsgutgesetz (FoVG) Forstvermehrungsgut-Durchführungsverordnung (FoVDV) SächsWaldG Thüringer Waldgesetz - ThürWaldG

Climate policy of Germany and it´s federal states		
Overarching objectives	Specific objectives	Reference documents (Selection)
Reduction of emissions	Reduction of emissions by construction measures	Bundes-Immissionsschutzgesetz - BImSchG
	Reduction of emissions by ship engines	Binnenschiffs-Abgasemissionsverordnung - BinSchAbgasV
	Reduction of emissions by car engines and fuels	Benzinbleigesetz - BzBlG
	Reduction of emissions by fluorinated greenhouse gases	Chemikalien-Klimaschutzverordnung - ChemKlimaschutzV
	Reduction of emissions by substances that can damage the ozone layer	Chemikalien-Ozonschichtverordnung - ChemOzonSchichtV
	Reduction of emissions by volatile organic compounds (VOC)	Lösemittelhaltige Farben- und Lack-Verordnung - ChemVOCFarbV
	Reduction of emissions by waste	Deponieverordnung - DepV
	Reduction of emissions caused by energy production	Erneuerbare-Energien-Gesetz - EEG 2017
	Carbon neutral building landscape in	Energieeinsparverordnung – EnEV

	2050	
	Reduction of greenhouse gas emissions compared to 1990 by 40% in 2020, 55% in 2030, 70% in 2040 and 85% in 2050.	Klimaschutzplan 2050: Klimaschutzpolitische Grundsätze und Ziele der Bundesregierung
	Greenhouse Gas Emissions by bio diesel must be reduced by at least 50%	Biokraftstoff-Nachhaltigkeitsverordnung - Biokraft-NachV
Promotion of awareness about the environment	Creation of a common system for environment management	Umweltauditgesetz - UAG UAG-Erweiterungsverordnung - UAG-ErwV UAGAnwG UAG-Beleihungsverordnung - UAGBV UAG-Gebührenverordnung - UAGGebV UAGOWiZustV UAG-Zulassungsverfahrensverordnung - UAGZVV

Inventory of policy means of Germany and it´s federal states - Berlin, Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt and Thuringia

Water policy of Germany and it´s federal states		
General instrument or instrument category	Specific policy instruments	Reference documents (Selection)
Standards for pollution with certain substances	Standards regarding the pollution of water bodies with certain substances set in the Water Framework Directive. Objective is the achievement of a "good status" for all groundwater and surface water bodies. Implemented in the respective water laws of Germany and its federal states. Specific limits are listed in the document.	Die Europäische Wasserrahmenrichtlinie (EU-WRRL) Brandenburgisches Wassergesetz (BbgWG) Berliner Wassergesetz (BWG) Wasserhaushaltsgesetz – WHG
Monitoring the condition of water bodies and groundwater	Monitoring measures taken to achieve the objectives of the Water Framework Directive. Implemented in the respective water laws of	Die Europäische Wasserrahmenrichtlinie (EU-WRRL) Wasserhaushaltsgesetz - WHG

	Germany and its federal states. Specific measures are listed in the document.	
Fee for the deduction of wastewater	The fees for the deduction of wastewater are set in a series of laws and regulations. Specific fees are listed in the documents.	Abwasserabgabengesetz - AbwAG Abwasserverordnung - AbwV
Fee for the pollution with waste	The fees for the pollution with waste are set in a series of laws and regulations. Specific fees are listed in the documents.	Brandenburgisches Abfall- und Bodenschutzgesetz (BbgAbfBodG) (Bundes-Bodenschutzgesetz - BBodSchG) Bundes-Bodenschutz- und Altlastenverordnung (BBodSchV)
Construction and maintenance of dikes	Flood control measures set e.g. in the water laws of the respective federal states. Specific measures are listed in the respective documents.	Brandenburgisches Wassergesetz (BbgWG) Berliner Wassergesetz (BWG)
Usage regulation	Includes e.g. regulations regarding the usage of water by the industry. Part of the respective water laws of Germany and it´s federal states. Specific regulations are listed in the respective documents.	Brandenburgisches Wassergesetz (BbgWG) Berliner Wassergesetz (BWG)

Energy policy of Germany and it´s federal states		
General instrument or instrument category	Specific policy instruments	Reference documents (Selection)
Construction standards regarding e.g. used materials	Standards are listed in the respective documents. Objective is e.g. noise protection and energy efficiency.	Baugesetzbuch BauGB Brandenburgische Bauordnung (BbgBO)
Data gathering and monitoring	Data gathering regarding e.g. energy usage and costs for environmental protection. Regulated by the law on environment statistic.	Energiestatistikgesetz (EnStatG) Marktstammdatenregisterverordnung - MaStRV

Regulation on biofuels	Regulation on what counts as bio fuel and how it must be produced.	Biomasseverordnung - BiomasseV Biomassestrom-Nachhaltigkeitsverordnung - BioSt-NachV
Standards regarding energy usage	The respective regulations and laws set the standards regarding energy usage and how they must be identified.	Energieverbrauchskenn-zeichnungsverordnung – EnVKV) Energieverbrauchsrelevante-Produkte-Gesetz – EVPG EVPG-Verordnung – EVPGV
Subsidies for the usage of energy efficient procedures	The subsidies are mostly generated by the EEG-apportionment and the emission trade. The amount varies. Regulated by the respective laws and regulations.	Gesetz über Energiedienstleistungen und andere Energieeffizienzmaßnahmen (EDL-G) Gesetz zur Errichtung eines Sondervermögens „Energie- und Klimafonds “(EKFG)
Subsidies for the promoting and production of renewable energies	The subsidies are mostly generated by the EEG-apportionment and the emission trade. The amount varies. Regulated by the respective laws and regulations.	Erneuerbare-Energien-Ausführungsverordnung – EEAV Gesetz zur Errichtung eines Sondervermögens „Energie- und Klimafonds “(EKFG) Systemdienstleistungsverordnung - SDLWindV Verordnung über die steuerliche Begünstigung von Wasserkraftwerken (WasKwV) Gesetz zur Änderung der Verordnung über die steuerliche Begünstigung von Wasserkraftwerken (WasKwVÄndG) Windenergie-auf-See-Gesetz - WindSeeG)
Fees	Fees for the hindrance of the energy revolution can be issued. Selling electricity more than once is also a reason for fees. Regulated by the respective laws.	Gesetz über Energiedienstleistungen und andere Energieeffizienzmaßnahmen (EDL-G) Stromsteuergesetz (StromStG) Erneuerbare-Energien-Gesetz
Chance of contracts regarding energy and fuel supply	Measures set in a series of regulations regarding the handling of energy and fuel supply in emergencies.	Verordnung über die Sicherstellung der Gasversorgung (Gaslastverteilungs-Verordnung - GasLastV) Verordnung zur Sicherung der Gasversorgung in einer Versorgungskrise (Gassicherungsverordnung – GasSV) Kraftstoff-Lieferbeschränkungs-Verordnung - KraftstoffLBV) Mineralölausgleichs-Verordnung – MinÖlAV

Food and agriculture policy of Germany and it´s federal states		
General instrument or	Specific policy	Reference documents (Selection)

instrument category	instruments	
Standards	The standards regarding labelling are regulated by the respective laws and regulations concerning the specific product or product group.	Fischetikettierungsgesetz - FischEtikettG Fischetikettierungsverordnung - FischEtikettV Fleischgesetz (FlG) Verordnung über Vermarktungsnormen für Geflügelfleisch (GFlFleischV)
Monitoring and data gathering	Statistic regarding the production of meat. Specific measures are part of the respective regulation.	Verordnung über die Durchführung einer Statistik über die Schlachttier- und Fleischuntersuchung (Fleischuntersuchungsstatistik-Verordnung - FlUStatV)
The culturing related to wildlife is under regulation	Specific measures and regulations are part of the regulation.	Bundeswildschutzverordnung - BWildSchV
Standards on ingredients	Standards for specific ingredients are regulated in the respective regulation.	Verordnung über diätetische Lebensmittel (Diätverordnung) (DiätV) Extraktionslösungsmittelverordnung – ElmV Futtermittelverordnung (FuttMV 1981) Kasein-Verordnung - KaseinV Kontaminanten-Verordnung - KmV
Regulations and standards on the usage and production of fertilizer	The production and usage of fertilizer is regulated in several laws and regulations.	Düngemittelverordnung - DüMV Düngegesetz (DüngG) Düngemittel-Probenahme- und Analyseverordnung - DüngMProbV) Düngeverordnung - DüV
Regulation on the usage of seeds	The usage of seeds is regulated in several regulations.	Erhaltungsmischungsverordnung – ErMiV EG-Lizenz-Verordnung – EWGLizV
Subsidies/Compensation for uprooting vineyards	Up to 50 percent of the costs can be compensated.	Verordnung zur Durchführung des EG-Rebflächenrodungsprogramms (EGRebflRodDV)
Subsidies for ecological cultivation	The scope of subsidies varies between the federal states. Combines efforts of EU, Germany and it´s federal states.	Förderrichtlinie Agrarumwelt- und Klimamaßnahmen – RL AUK/2015 Förderrichtlinie Besondere Initiativen – RL BesIn/2007
Ban of dangerous substances	Authorities can forbid dangerous substances. Regulated by several laws and regulations.	Chemikaliengesetz -ChemG Düngeverordnung - DüV
Killing sick animals	The killing of sick animals is regulated by law. Mostly used to prevent further spread of diseases.	Tiergesundheitsgesetz - TierGesG

Land use policy of Germany and it´s federal states		
General instrument or instrument category	Specific policy instruments	Reference documents (Selection)
Monitoring forests	Monitoring data regarding forests e.g. their condition is regulated by the national law on forests and the respective regulation.	Verordnung über Erhebungen zum forstlichen Umweltmonitoring (ForUmV) Bundeswaldgesetz
Determining hunting seasons	The regulation of hunting seasons is done by the respective hunting laws.	Jagdgesetz für das Land Brandenburg (BbgJagdG) Bundesjagdgesetz (BJagdG)
Environmental combability tests	An environmental compability test must be done for the permission of new mining actions. Regulated by law and regulations.	Raumordnungsgesetz Verordnung über die Umweltverträglichkeitsprüfung bergbaulicher Vorhaben
Subsidies for owner of forest areas	Subsidies for owner of forest areas, if e.g. an event caused significant damage. Compensation for potential loss of revenue. The compensation is paid because lumbering can be banned for a time, to grant the forest time to recover. Regulated by law.	Gesetz zum Ausgleich von Auswirkungen besonderer Schadensereignisse in der Forstwirtschaft (Forstschäden-Ausgleichsgesetz – ForstSchAusglG)
Fees for illegal hunting	The specific fees are listed in the respective hunting laws.	Jagdgesetz für das Land Brandenburg (BbgJagdG) Bundesjagdgesetz (BJagdG)
Fees for unlawful waste disposal	The specific fees are listed in the respective laws regarding soil protection.	(Bundes-Bodenschutzgesetz - BBodSchG) Bundes-Bodenschutz- und Altlastenverordnung (BBodSchV)
Expropriation (with compensation) to acquire land for mining purposes e.g. lignite	Regulated by law. Certain criteria must be met.	Bundesberggesetz (BBergG)
Expropriations to acquire land for agriculture	Regulated by law. Certain criteria must be met.	Flurbereinigungsgesetz
Expropriations to acquire land, if it´s	Regulated by law. Certain criteria must be met.	Flurbereinigungsgesetz

necessary for land development		
Interventions	The possibility to intervene, if the landscaoe could be damaged, is granted by law.	Bundesnaturschutzgesetz
Regulation of forest transformation	Forest transformation and the selling related to forestry area needs approval by the authorities. Regulated by law.	Bundeswaldgesetz Grundstückverkehrsgesetz

Climate policy of Germany and it´s federal states		
General instrument or instrument category	Specific policy instruments	Reference documents (Selection)
Construction standards regarding e.g. used materials	Standards are listed in the respective documents. Objective is e.g. noise protection.	Baugesetzbuch BauGB Brandenburgische Bauordnung (BbgBO) Bundes-Immissionsschutzgesetz - BImSchG
Standards regarding the energy efficiency of building	Energy efficiency codes/certificate for building. Listed in the respective regulation.	Energieeinsparverordnung – EnEV
Monitoring climate change	The monitoring measures are regulated by law. Includes monitoring of changes and the prediction of possible consequences of climate change. Responsibility of the German Weather Service.	DWD-Gesetz - DWDG
Data gathering	Data gathering regarding waste disposal and costs for environmental protection. Regulated by the law on environment statistic.	Umweltstatistikgesetz (UStatG)
Standards for emissions by ship engines	Specific limits are listed in the respective regulation.	Binnenschiffs-Abgasemissionsverordnung - BinSchAbgasV
Standards for emissions by car engines	Specific limits are listed in the respective law.	Benzinbleigesetz - BzBlG
Standards on the usage of substances that can damage the ozone layer	Specific limits are listed in the respective regulation.	Chemikalien-Ozonschichtverordnung - ChemOzonSchichtV

Standards on the usage of volatile organic compounds	Specific limits are listed in the respective regulation.	Lösemittelhaltige Farben- und Lack-Verordnung - ChemVOCFarbV
Subsidies	Subsidies for projects related to the protection of the environment and energy. The amount depends on the revenue generated by the trade with emission rights. The government supports the fund financially, since the revenue dropped significantly.	Gesetz zur Errichtung eines Sondervermögens „Energie- und Klimafonds "(EKFG)
Trade with emission rights (EU ETS)	Implemented in national law. Allocation is regulated by national regulations. The EU CAP lvl should decrease annually by 1.74 percent.	Verordnung zur Durchführung des Treibhausgas- Emissionshandelsgesetzes in der Handelsperiode 2013 bis 2020 (Emissionshandelsverordnung 2020 - EHV 2020) Verordnung über die Versteigerung von Emissionsberechtigungen nach dem Zuteilungsgesetz 2012 (Emissionshandels-Versteigerungsverordnung 2012 - EHVV 2012)
Establishment of the foundation "Deutsche Bundesstiftung Umwelt"	Established by law. German environment foundation.	Gesetz zur Errichtung einer Stiftung "Deutsche Bundesstiftung Umwelt" (DBUStiftG)
Establishment of the „Energie- und Klimafonds" (EKFG)	Established by law. Fund for energy and climate projects.	Gesetz zur Errichtung eines Sondervermögens „Energie- und Klimafonds "(EKFG)
Establishment of the "Umweltbundesamt" (German Federal Environmental Agency)	Established by law.	Gesetz über die Errichtung eines Umweltbundesamtes (UBAG)

5. Assessment of policy coherence

5.1. Assessment of interactions between nexus critical objectives

This sub-chapter includes the following elements:

- Table with the description of the nexus critical objectives and explanation of the reason why these instruments are considered particularly critical or interesting to investigate in a nexus perspective
- Scoring matrix illustrating the interactions among the selected objectives
- Justification of the scoring
- Description of the overall assessment: what are the most relevant/striking results
- Reporting of the validation of assessment done with stakeholders

Illustration of the nexus critical objectives for which to assess interactions

Water		
Code	Heading (short description)	Detailed description (including specification of context)
W1	**Reduction of pollutants**	Includes all sources of pollution
W2	**Reduction of water usage**	Includes all sectors e.g. industry and agriculture
W3	**Improvement of waterway infrastructure**	Construction of e.g. new channels (in Eastern Germany)
W4	**Preservation of biodiversity in water bodies**	Protection of animals and plants (in water)
W5	**Flood control**	Mainly construction and maintenance of dikes
Energy		
Code	Heading (short description)	Detailed description (including specification of context)
E1	**End of nuclear energy usage in Germany**	Shutdown of nuclear energy plants and disposal of nuclear waste
E2	**Promotion of renewable energy**	Includes construction of new e.g. solar plants
E3	**Promotion of biofuel**	First generation biofuel
E4	**Improvement of the power network**	Expansion of the power network to meet the needs of renewable energies
E5	**Reduction of energy usage**	Includes all sectors which use energy
Food and agriculture		
Code	Heading (short description)	Detailed description (including specification of context)
F1	**Ensuring food quality**	Includes the regulation of e.g.

		allowed ingredients and procession of food products
F2	**Ensuring food production**	Includes the regulation of e.g. agriculture areas and their usage
F3	**Prevention of animal diseases**	Includes hygiene regulations. Reduction of risks for humans and animals alike. Focused mainly on livestock.
F4	**Promotion of ecological cultivation**	Expansion of environmental friendly sustainable cultivation
F5	**Protection of animals**	Protection of wildlife and stock from e.g. animal cruelty
F6	**Ensuring biodiversity**	Protection of wildlife by e.g. hunting regulations
Land use		
Code	Heading (short description)	Detailed description (including specification of context)
L1	**Improvement of rural infrastructure and agriculture**	Construction of e.g. roads and improvement of the agriculture structure (in Eastern Germany)
L2	**Sustainable and environmental friendly use of land**	Landscape should only be changed if necessary and, if possible, in a non-damaging way
L3	**Mining important e.g. metals**	Acquirement of resources e.g. lignite by expropriation
L4	**Preservation of forests**	Ban on forest transformation unless allowed by authorities
Climate		
Code	Heading (short description)	Detailed description (including specification of context)
C1	**Reduction of emissions**	Includes all sectors with emissions
C2	**Promotion of awareness about the environment**	Includes the informing about effects of actions on the environment

Scoring matrix illustrating the interactions among the selected objectives

What happens to objective x (in rows) → **(affected)**If we make progress on objective y (in column)
↓**(affecting)**

	W1	W2	W3	W4	W5	E1	E2	E3	E4	E5	F1	F2	F3	F4	F5	F6	L1	L2	L3	L4	C1	C2
W1		0	-1/0	+2/+3	0	0	0	0	0	0	+1/+2	-1/-2	0	0	+2	+1	0	+3	-1/0	+1	0	+1
W2	+2		0	+1	0	0	0	-1/0	0	0	-2/-1	-2/-1	0	0	+1	+1	0	+2	0	+1/0	0	+1

W3	-2/-1	0		-2/-1/0	-1/0	0	0	0	0	0	0	0	0	0	-1/0	-1/0	+2	-1/0	0	-1/0	0	0
W4	+2/+1	+1/0	-1		0	0	-1/0	0	0	0	0	0	0	0	+2	+2	0	+1	0	0	0	+1
W5	0	0	-1/0	0		0	0	0	0	0	0	+1/+2	0	0	0	0	+1	0	0	0	0	0
E1	0	0	0	0	0		+1/0	0	0	0	0	0	0	0	0	0	0	+1	0	0	+2/-2	+1
E2	0	+1/0	0	-1	0	+1/0		+1	0	0	0	-1/0	0	0	0	0	0	+2	0	0	+3	+2
E3	0	-1/0	0	0	0	0	+1		0	0	0	-2/-1	0	-1	0	0	0	+1/0	0	0	+1/0	+1
E4	0	0	0	0	0	0	+2/+3	0		+1	0	0	0	0	0	0	0	0	0	0	+1/0	0
E5	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	+2	0	0	+3	+1
F1	-2/-1	-1	0	0	0	0	0	0	0	0		-1/0	+1	+1	0	0	0	0	0	0	0	0
F2	-2/-1	--1	0	0	0	0	-1/0	-1	0	0	-1/0		0	0	-1/0	0	0	-2/-1	-1/0	-2/0	-1	0
F3	0	0	0	0	0	0	0	0	0	0	+3	+3		0	+3	+1	0	0	0	0	0	0
F4	+1	+1	0	0	0	0	0	-1	0	0	+1	0	0		0	0	0	+2	0	0	+1/0	+2
F5	+1	0	0	+2	0	0	0	0	0	0	0	-1	+1	0		+3	-1/0	+1	-1/0	0	0	0
F6	0	0	0	+2	0	0	0	0	0	0	0	+1	0	0	+2		-1/0	+2	-1	+2	0	0
L1	0	0	+2	0	0	0	0	0	0	-1/0	0	0	0	0	0	0		-1/0	0	-1/0	0	0
L2	+3	+2	-1/0	+2	0	+1	+2	+1/0	0	+2	0	-2	0	+2	+1	+2	-1/0		-3	+3	+2	0
L3	-1/0	0	0	0	0	0	0	0	0	-1/0	0	-1/0	0	0	-1/0	-1/0	0	-3		-1/0	-1	0
L4	+1	0	-1/0	+1/0	0	0	0	+1/-1	0	0	0	-2/0	0	0	+2	+2	-1	+3	-1/0		0	+1
C1	0	0	0	0	0	0	+2	+1/0	0	+3	0	-1/0	0	0	0	0	0	+1	-2	0		+1
C2	+1/0	+1/0	0	+1/0	0	0	+1	+1	0	+2	0	0	0	+1	+1	+1	0	+1	-1	+1	+1	

Justification of the scoring

Interaction	Score	Justification
W1>W2	0	No significant interaction.
W1>W3	-1/0	The need to reduce pollution can hinder construction activities.
W1>W4	+2/+3	The reduction of pollution is important and sometimes essential to ensure biodiversity. Less pollution is important to secure natural habitats.

W1>W5	0	No significant interaction.
W1>E1	0	No significant interaction.
W1>E2	0	No significant interaction.
W1>E3	0	No significant interaction.
W1>E4	0	No significant interaction.
W1>E5	0	No significant interaction.
W1>F1	+1/+2	The reduction of pollution implies the reduction of fertilizer usage, which could reduce the pollution of food with chemical residues.
W1>F2	-1/-2	The reduction of pollution implies the reduction of fertilizer usage, which could decrease the quantity of food to varying degrees.
W1>F3	0	No significant interaction.
W1>F4	0	No significant interaction.
W1>F5	+2	Reduction of pollution protects animals from their negative effects.
W1>F6	+1	The Reduction of pollution helps preserve biodiversity.
W1>L1	0	No significant interaction.
W1>L2	+3	The reduction of pollution is a requirement for the achievement of sustainability.
W1>L3	-1/0	The reduction of pollution can hinder mining, if water bodies are nearby.
W1>L4	+1	Forests profit from less polluted water bodies.
W1>C1	0	No significant interaction.
W1>C2	+1	The need to reduce pollution of water bodies raises awareness.
W2>W1	+2	Less usage means less pollutants.
W2>W3	0	No significant interaction.
W2>W4	+1	Less usage supports the preservation of biodiversity.
W2>W5	0	No significant interaction.
W2>E1	0	No significant interaction.
W2>E2	0	No significant interaction.
W2>E3	-1/0	Reduction of water usage could negatively influence the production of biofuels.
W2>E4	0	No significant interaction.
W2>E5	0	No significant interaction.
W2>F1	-2/-1	The reduction of water usage could influence the quality of food to varying degrees.
W2>F2	-2/-1	The reduction of water usage could influence the quantity of food to varying degrees.
W2>F3	0	No significant interaction.
W2>F4	0	No significant interaction.
W2>F5	+1	The reduction of water usage protects e.g. water animals.
W2>F6	+1	The reduction of water usage protects e.g. water animals and with-it biodiversity.
W2>L1	0	No significant interaction.
W2>L2	+2	Sustainability greatly profits from reduced water usage, since less water “leaves”.
W2>L3	0	No significant interaction.
W2>L4	+1/0	Forests can profit since they have more for themselves.
W2>C1	0	No significant interaction.

W2>C2	+1	The need to reduce water usage raises awareness.
W3>W1	-2/-1	Construction activities produce pollution.
W3>W2	0	No significant interaction.
W3>W4	-2/-1/0	Change of natural habitats to varying degrees.
W3>W5	-1/0	Potential problems regarding the compatibility of waterway infrastructure and flood control.
W3>E1	0	No significant interaction.
W3>E2	0	No significant interaction.
W3>E3	0	No significant interaction.
W3>E4	0	No significant interaction.
W3>E5	0	No significant interaction.
W3>F1	0	No significant interaction.
W3>F2	0	No significant interaction.
W3>F3	0	No significant interaction.
W3>F4	0	No significant interaction.
W3>F5	-1/0	The construction and improvement of waterway infrastructure could negatively affect animals.
W3>F6	-1/0	The construction and improvement of waterway infrastructure could negatively affect the natural habitat of animals and with-it biodiversity.
W3>L1	+2	Directly related to each other.
W3>L2	-1/0	The improvement of waterway infrastructure can negatively impact the environment and reduce sustainability.
W3>L3	0	No significant interaction.
W3>L4	-1/0	Can hinder forest preservation, if forested areas are affected.
W3>C1	0	No significant interaction.
W3>C2	0	No significant interaction.
W4>W1	+2/+1	Inseparably connected in most cases.
W4>W2	+1/0	Barely any connection, the protection of water bodies often implies and requires to a certain degree the use of less water.
W4>W3	-1	The need to protects water bodies interferes with the improvement of infrastructure.
W4>W5	0	No significant interaction.
W4>E1	0	No significant interaction.
W4>E2	-1/0	The preservation of biodiversity in water bodies could influence the construction of new water power plants.
W4>E3	0	No significant interaction.
W4>E4	0	No significant interaction.
W4>E5	0	No significant interaction.
W4>F1	0	No significant interaction.
W4>F2	0	No significant interaction.
W4>F3	0	No significant interaction.
W4>F4	0	No significant interaction.
W4>F5	+2	The preservation of biodiversity is directly related to the protection of animals.
W4>F6	+2	Directly linked to each other.
W4>L1	0	No significant interaction.

W4>L2	+1	The preservation of biodiversity enables the environmentally friendly use of land.
W4>L3	0	No significant interaction.
W4>L4	0	No significant interaction.
W4>C1	0	No significant interaction.
W4>C2	+1	The measures taken to preserve biodiversity in water bodies helps to spread awareness.
W5>W1	0	No significant interaction.
W5>W2	0	No significant interaction.
W5>W3	-1/0	Potential problems regarding the compatibility of waterway infrastructure and flood control.
W5>W4	0	No significant interaction.
W5>E1	0	No significant interaction.
W5>E2	0	No significant interaction.
W5>E3	0	No significant interaction.
W5>E4	0	No significant interaction.
W5>E5	0	No significant interaction.
W5>F1	0	No significant interaction.
W5>F2	+1/+2	Protection of agriculture areas increases.
W5>F3	0	No significant interaction.
W5>F4	0	No significant interaction.
W5>F5	0	No significant interaction.
W5>F6	0	No significant interaction.
W5>L1	+1	Agriculture infrastructure profits from decreased flood risk.
W5>L2	0	No significant interaction.
W5>L3	0	No significant interaction.
W5>L4	0	No significant interaction.
W5>C1	0	No significant interaction.
W5>C2	0	No significant interaction.
E1>W1	0	No significant interaction.
E1>W2	0	No significant interaction.
E1>W3	0	No significant interaction.
E1>W4	0	No significant interaction.
E1>W5	0	No significant interaction.
E1>E2	+1/0	The end of nuclear energy supports renewable energies to a certain degree, since new energy sources become necessary.
E1>E3	0	No significant interaction.
E1>E4	0	No significant interaction.
E1>E5	0	No significant interaction.
E1>F1	0	No significant interaction.
E1>F2	0	No significant interaction.
E1>F3	0	No significant interaction.
E1>F4	0	No significant interaction.
E1>F5	0	No significant interaction.
E1>F6	0	No significant interaction.
E1>L1	0	No significant interaction.

E1>L2	+1	No additional nuclear waste.
E1>L3	0	No significant interaction.
E1>L4	0	No significant interaction.
E1>C1	-2/+2	The influence depends on the replacement of nuclear energy. Renewable energy would aid in reducing emissions, while e.g. lignite would counteract it.
E1>C2	+1	The end of nuclear energy and nuclear waste disposal increased the awareness about the consequences for the environment.
E2>W1	0	No significant interaction.
E2>W2	-1/0	Usage of water could increase, if additional water power plants are constructed.
E2>W3	0	No significant interaction.
E2>W4	-1/0	Water power plants influence rivers.
E2>W5	0	No significant interaction.
E2>E1	+1/0	The promotion of renewable energies supports the end of nuclear energy and makes it easier.
E2>E3	+1	Both are renewable energies.
E2>E4	0	No significant interaction.
E2>E5	0	No significant interaction.
E2>F1	0	No significant interaction.
E2>F2	-1/0	Areas formerly used for agriculture are sometimes needed to produce renewable energy e.g. solar plants.
E2>F3	0	No significant interaction.
E2>F4	0	No significant interaction.
E2>F5	0	No significant interaction.
E2>F6	0	No significant interaction.
E2>L1	0	No significant interaction.
E2>L2	+2	The sustainable usage of land and its resources profits greatly from the promotion of renewable energy and the reduction of e.g. lignite mining.
E2>L3	0	No significant interaction.
E2>L4	0	No significant interaction.
E2>C1	+3	The reduction of emissions depends greatly on the usage of renewable energy.
E2>C2	+2	The promotion of renewable energy greatly increases the awareness.
E3>W1	0	No significant interaction.
E3>W2	-1/0	The production of biofuels and the cultivation of needed crops could require more water.
E3>W3	0	No significant interaction.
E3>W4	0	No significant interaction.
E3>W5	0	No significant interaction.
E3>E1	0	No significant interaction.
E3>E2	+1	Both are renewable energies.
E3>E4	0	No significant interaction.
E3>E5	0	No significant interaction.
E3>F1	0	No significant interaction.
E3>F2	-2/-1	The production of biofuel reduces the cultivation of plants intended for

		food production. Degree varies.
E3>F3	0	No significant interaction.
E3>F4	-1	The profit-oriented production of biofuel can hinder the development of ecological cultivation.
E3>F5	0	No significant interaction.
E3>F6	0	No significant interaction.
E3>L1	0	No significant interaction.
E3>L2	+1/0	The increase of biofuels is related to the reduction of fossil fuels.
E3>L3	0	No significant interaction.
E3>L4	0	No significant interaction.
E3>C1	+1/0	Biofuel reduces emissions slightly, compared to other fuels.
E3>C2	+1	The promotion of biofuel increases awareness.
E4>W1	0	No significant interaction.
E4>W2	0	No significant interaction.
E4>W3	0	No significant interaction.
E4>W4	0	No significant interaction.
E4>W5	0	No significant interaction.
E4>E1	0	No significant interaction.
E4>E2	+2/+3	A developed power network is necessary for the success of renewable energies, you could argue that its indispensable.
E4>E3	0	No significant interaction.
E4>E5	+1	Less waste of energy related to an ineffective power network.
E4>F1	0	No significant interaction.
E4>F2	0	No significant interaction.
E4>F3	0	No significant interaction.
E4>F4	0	No significant interaction.
E4>F5	0	No significant interaction.
E4>F6	0	No significant interaction.
E4>L1	0	No significant interaction.
E4>L2	0	No significant interaction.
E4>L3	0	No significant interaction.
E4>L4	0	No significant interaction.
E4>C1	+1/0	The improvement of the power network can potentially aid the reduction of emissions, since less energy is wasted, and the distribution will be improved greatly.
E4>C2	0	No significant interaction.
E5>W1	0	No significant interaction.
E5>W2	0	No significant interaction.
E5>W3	0	No significant interaction.
E5>W4	0	No significant interaction.
E5>W5	o	No significant interaction.
E5>E1	0	No significant interaction.
E5>E2	0	No significant interaction.
E5>E3	0	No significant interaction.
E5>E4	0	No significant interaction.
E5>F1	0	No significant interaction.

E5>F2	0	No significant interaction.
E5>F3	0	No significant interaction.
E5>F4	0	No significant interaction.
E5>F5	0	No significant interaction.
E5>F6	0	No significant interaction.
E5>L1	0	No significant interaction.
E5>L2	+2	The reduction of energy usage is unavoidable for the sustainable use of land.
E5>L3	0	No significant interaction.
E5>L4	0	No significant interaction.
E5>C1	+3	The reduction of energy usage is directly linked with the reduction of emissions.
E5>C2	+1	The need to reduce energy usage directly translates to an increased awareness regarding the environment.
F1>W1	-2/-1	Ensuring food quality is partly dependant on fertilizer, which pollute water bodies to varying degrees.
F1>W2	-1	Water is needed to ensure food quality. A reduction is impossible in some cases.
F1>W3	0	No significant interaction.
F1>W4	0	No significant interaction.
F1>W5	0	No significant interaction.
F1>E1	0	No significant interaction.
F1>E2	0	No significant interaction.
F1>E3	0	No significant interaction.
F1>E4	0	No significant interaction.
F1>E5	0	No significant interaction.
F1>F2	-1/0	Production could be slowed down to ensure quality.
F1>F3	+1	Better quality means less risk of disease.
F1>F4	+1	Ecological cultivation often improves quality.
F1>F5	0	No significant interaction.
F1>F6	0	No significant interaction.
F1>L1	0	No significant interaction.
F1>L2	0	No significant interaction.
F1>L3	0	No significant interaction.
F1>L4	0	No significant interaction.
F1>C1	0	No significant interaction.
F1>C2	0	No significant interaction.
F2>W1	-2/-1	Ensuring food production is partly dependant on fertilizer, which pollute water bodies to varying degrees.
F2>W2	-1	Ensuring food quality is partly dependant on the free usage of water.
F2>W3	0	No significant interaction.
F2>W4	0	No significant interaction.
F2>W5	0	No significant interaction.
F2>E1	0	No significant interaction.
F2>E2	-1/0	Areas needed for e.g. solar plants are used for agriculture.
F2>E3	-1	The need to ensure food production constrains the production of

		biofuel.
F2>E4	0	No significant interaction.
F2>E5	0	No significant interaction.
F2>F1	-1/0	Quality can be affected to improve the amount of food production.
F2>F3	0	No significant interaction.
F2>F4	0	No significant interaction.
F2>F5	-1/0	The protection of animals can be deemed less important than the fast production of food.
F2>F6	0	No significant interaction.
F2>L1	0	No significant interaction.
F2>L2	-2/-1	Sustainability could be ignored to increase production. The degree can vary.
F2>L3	-1/0	Mining can suffer, if the production of food is of higher priority.
F2>L4	-2/0	Forest areas can be transformed, if additional land for agriculture becomes necessary.
F2>C1	-1	The production of food produces emissions and hinders their reduction.
F2>C2	0	No significant interaction.
F3>W1	0	No significant interaction.
F3>W2	0	No significant interaction.
F3>W3	0	No significant interaction.
F3>W4	0	No significant interaction.
F3>W5	0	No significant interaction.
F3>E1	0	No significant interaction.
F3>E2	0	No significant interaction.
F3>E3	0	No significant interaction.
F3>E4	0	No significant interaction.
F3>E5	0	No significant interaction.
F3>F1	+3	The quality of food made from sick animals is low.
F3>F2	+3	The production is severely affected, if animals are sick.
F3>F4	0	No significant interaction.
F3>F5	+3	Sick animals are in danger and not sufficient protected from harm.
F3>F6	+1	Reducing the risk of disease helps ensuring biodiversity.
F3>L1	0	No significant interaction.
F3>L2	0	No significant interaction.
F3>L3	0	No significant interaction.
F3>L4	0	No significant interaction.
F3>C1	0	No significant interaction.
F3>C2	0	No significant interaction.
F4>W1	+1	Ecological cultivation reduces the use of fertilizer, which benefits the reduction of pollution.
F4>W2	+1	Only the necessary amount of water is used.
F4>W3	0	No significant interaction.
F4>W4	0	No significant interaction.
F4>W5	0	No significant interaction.
F4>E1	0	No significant interaction.
F4>E2	0	No significant interaction.

F4>E3	-1	Ecological cultivation can reduce profit and production of biofuel.
F4>E4	0	No significant interaction.
F4>E5	0	No significant interaction.
F4>F1	+1	F4 supports the achievement of F1. Ecological cultivation often improves quality.
F4>F2	0	No significant interaction.
F4>F3	0	No significant interaction.
F4>F5	0	No significant interaction.
F4>F6	0	No significant interaction.
F4>L1	0	No significant interaction.
F4>L2	+2	Ecological promotion directly promotes environmental friendly usage of land.
F4>L3	0	No significant interaction.
F4>L4	0	No significant interaction.
F4>C1	+1/0	Ecological cultivation can possible reduce the production of emissions.
F4>C2	+2	The promotion of ecological cultivation increases the awareness about the environment directly.
F5>W1	+1	The protection of animals is linked to the reduction of pollution in water bodies.
F5>W2	0	No significant interaction.
F5>W3	0	No significant interaction.
F5>W4	+2	The protection of animals requires the preservation of natural habitats and biodiversity.
F5>W5	0	No significant interaction.
F5>E1	0	No significant interaction.
F5>E2	0	No significant interaction.
F5>E3	0	No significant interaction.
F5>E4	0	No significant interaction.
F5>E5	0	No significant interaction.
F5>F1	0	No significant interaction.
F5>F2	-1	The protection of animals can be deemed more important than the fast production of food.
F5>F3	+1	Protected animals are less likely to be affected by diseases.
F5>F4	0	No significant interaction.
F5>F6	+3	The protection of animals from harm is essential to ensure biodiversity.
F5>L1	-1/0	The protection of animals can hinder the construction of infrastructure, e.g. if endangered species are affected.
F5>L2	+1	The protection of animals supports the sustainable use of land, since it preserves natural conditions to a certain degree.
F5>L3	-1/0	The protection of animals can hinder mining, e.g. if endangered species are affected.
F5>L4	0	No significant interaction.
F5>C1	0	No significant interaction.
F5>C2	0	No significant interaction.
F6>W1	0	No significant interaction.
F6>W2	0	No significant interaction.

F6>W3	0	No significant interaction.
F6>W4	+2	Directly linked to each other.
F6>W5	0	No significant interaction.
F6>E1	0	No significant interaction.
F6>E2	0	No significant interaction.
F6>E3	0	No significant interaction.
F6>E4	0	No significant interaction.
F6>E5	0	No significant interaction.
F6>F1	0	No significant interaction.
F6>F2	0	No significant interaction.
F6>F3	0	No significant interaction.
F6>F4	0	No significant interaction.
F6>F5	+2	Ensuring biodiversity is an important part of animal protection.
F6>L1	-1/0	Construction of infrastructure can be hindered, e.g. if endangered species are affected.
F6>L2	+2	The preservation of biodiversity is part of a sustainable use of land and its resources.
F6>L3	-1	Mining can be hindered, e.g. if endangered species are affected.
F6>L4	+2	The preservation of forests is aided by the preservation of natural habitats and biodiversity.
F6>C1	0	No significant interaction.
F6>C2	0	No significant interaction.
L1>W1	0	No significant interaction.
L1>W2	0	No significant interaction.
L1>W3	+2	Directly linked to each other.
L1>W4	0	No significant interaction.
L1>W5	0	No significant interaction.
L1>E1	0	No significant interaction.
L1>E2	0	No significant interaction.
L1>E3	0	No significant interaction.
L1>E4	0	No significant interaction.
L1>E5	-1/0	The improvement of infrastructure could increase energy usage in certain cases.
L1>F1	0	No significant interaction.
L1>F2	0	No significant interaction
L1>F3	0	No significant interaction.
L1>F4	0	No significant interaction.
L1>F5	0	No significant interaction.
L1>F6	0	No significant interaction.
L1>L2	-1/0	Improvement of infrastructure can negatively interfere with nature.
L1>L3	0	No significant interaction.
L1>L4	-1/0	Improvement of infrastructure can negatively interfere with nature.
L1>C1	0	No significant interaction.
L1>C2	0	No significant interaction.
L2>W1	+3	The sustainable and environmentally friendly usage of land and its resources is necessary to reduce the pollution of water bodies.

L2>W2	+2	The sustainable and environmentally friendly usage of land promotes the reduction of water usage, since its essential.
L2>W3	-1/0	The sustainable and environmentally friendly usage of land could be a hindrance, if new waterway infrastructure must be constructed.
L2>W4	+2	The sustainable and environmentally friendly usage of land directly supports the preservation of biodiversity.
L2>W5	0	No significant interaction.
L2>E1	+1	A sustainable usage of land furthers the end of nuclear energy.
L2>E2	+2	Renewable energies are supported, if sustainability is needed and promoted.
L2>E3	+1/0	A reduction of fossil fuels and with it an increase of sustainability supports the advancement of biofuels.
L2>E4	0	No significant interaction.
L2>E5	+2	A sustainable usage of land directly translates to less energy usage.
L2>F1	0	No significant interaction.
L2>F2	-2	The need to look out for sustainability can hinder the production of food, at least "short-term".
L2>F3	0	No significant interaction.
L2>F4	+2	Sustainable and environmentally friendly use of land directly supports ecological cultivation.
L2>F5	+1	Animal protection is supported by environmentally friendly practices.
L2>F6	+2	Sustainability supports the protection of biodiversity.
L2>L1	-1/0	The sustainable use of land can negatively impact the improvement of infrastructure.
L2>L3	-3	Mining is not sustainable and environmentally compatible.
L2>L4	+3	A sustainable use of land is necessary for the preservation of forests.
L2>C1	+2	A sustainable use of land and its resources goes hand in hand with the reduction of emissions.
L2>C2	0	No significant interaction.
L3>W1	-1/0	Mining can lead to additional pollution.
L3>W2	0	No significant interaction.
L3>W3	0	No significant interaction.
L3>W4	0	No significant interaction.
L3>W5	0	No significant interaction.
L3>E1	0	No significant interaction.
L3>E2	0	No significant interaction.
L3>E3	0	No significant interaction.
L3>E4	0	No significant interaction.
L3>E5	-1/0	Mining needs energy.
L3>F1	0	No significant interaction.
L3>F2	-1/0	Mining can influence food production to a certain degree, if former agriculture areas are used for mining purposes.
L3>F3	0	No significant interaction.
L3>F4	0	No significant interaction.
L3>F5	-1/0	Mining can possibly endanger animals and their natural habitat.
L3>F6	-1/0	Mining can possibly endanger animals and their natural habitat.

L3>L1	0	No significant interaction.
L3>L2	-3	Mining is not sustainable and environmentally compatible.
L3>L4	-1/0	Forested area suffers if mining actions are taken nearby.
L3>C1	-1	Mining can produce emissions.
L3>C2	0	No significant interaction.
L4>W1	+1	The preservation of forest reduces pollution by erosion.
L4>W2	0	No significant interaction.
L4>W3	-1/0	The preservation of forests can hinder the construction of new waterway infrastructure.
L4>W4	+1/0	The preservation of forests can positively influence biodiversity in water bodies.
L4>W5	0	No significant interaction.
L4>E1	0	No significant interaction.
L4>E2	0	No significant interaction.
L4>E3	-1/0	Forests could suffer, if areas are needed for the cultivation of plants necessary to produce biofuels.
L4>E4	0	No significant interaction.
L4>E5	0	No significant interaction.
L4>F1	0	No significant interaction.
L4>F2	-2/0	The preservation of forest can hinder the production of food, since it can prevent the transformation of forested in agriculture areas.
L4>F3	0	No significant interaction.
L4>F4	0	No significant interaction.
L4>F5	+2	The preservation of forests protects animals and their natural habitat.
L4>F6	+2	The preservation of forests protects animals and their natural habitat.
L4>L1	-1	The preservation of forests can negatively impact the improvement of infrastructure.
L4>L2	+3	The preservation of forests in necessary for a sustainable use of land.
L4>L3	-1/0	The preservation of forests can be constraining for mining efforts.
L4>C1	0	No significant interaction.
L4>C2	+1	The preservation of forests increases the awareness about the environment.
C1>W1	0	No significant interaction.
C1>W2	0	No significant interaction.
C1>W3	0	No significant interaction.
C1>W4	0	No significant interaction.
C1>W5	0	No significant interaction.
C1>E1	0	No significant interaction.
C1>E2	+2	The need to reduce emissions aids the development of renewable energy.
C1>E3	+1/0	Biofuel produces less emissions than fossil fuel.
C1>E4	0	No significant interaction.
C1>E5	+3	The need to reduce emissions leads to a reduction of energy usage.
C1>F1	0	No significant interaction.
C1>F2	-1/0	The reduction of emissions can constrain the production of food.
C1>F3	0	No significant interaction.

C1>F4	0	No significant interaction.
C1>F5	0	No significant interaction.
C1>F6	0	No significant interaction.
C1>L1	0	No significant interaction.
C1>L2	+1	The reduction of emissions improves the sustainable usage of land.
C1>L3	-2	Mining is hindered significantly, if emissions must be reduced.
C1>L4	0	No significant interaction.
C1>C2	+1	The necessity to reduce emissions supports awareness.
C2>W1	+1	Awareness helps avoiding the further unnecessary pollution of water bodies.
C2>W2	+1	Awareness about the importance of responsible water usage supports the reduction thereof.
C2>W3	0	No significant interaction.
C2>W4	+1	The preservation of biodiversity in water bodies profits from increased awareness.
C2>W5	0	No significant interaction.
C2>E1	0	No significant interaction.
C2>E2	+1	Awareness aids the promotion of renewable energies.
C2>E3	+1	Awareness aids the promotion of biofuel.
C2>E4	0	No significant interaction.
C2>E5	+2	Awareness is important to realize the necessity of reduced energy usage.
C2>F1	0	No significant interaction.
C2>F2	0	No significant interaction.
C2>F3	0	No significant interaction.
C2>F4	+1	Increased awareness supports the promotion of ecological cultivation.
C2>F5	+1	Increased awareness supports the protection of animals.
C2>F6	+1	Increased awareness supports the preservation of biodiversity.
C2>L1	0	No significant interaction.
C2>L2	+1	Awareness is necessary to further sustainability.
C2>L3	-1	Awareness about the consequences of mining can be a hindrance.
C2>L4	+1	Awareness aids the preservation of forests.
C2>C1	+1	Awareness helps reducing emissions.

Description of the overall assessment: what are the most relevant/striking results

The assessment shows that awareness about the consequences actions can have on the environment is a supporting factor for objectives in most sectors. This relation goes both ways, since e.g. the measures taken to protect water bodies increase the awareness about the issue at the same time. The reduction of water pollution and emissions is unavoidable, if you want to achieve sustainability and protect the environment. Animal protection and ensuring biodiversity is directly linked to the achievement of sustainability and can only be done, if natural habitats e.g. forests and water bodies, are protected from mayor harm. Agriculture and with it the production of food could be negatively influenced by the desire to reduce pollution of water bodies, since fertilizer are one of the main reasons for the insertion of pollutants. A change regarding the usage of fertilizer seems necessary, if a significant betterment of water quality is to be achieved. Similar things could be said about the reduction of water usage.
The end of nuclear energy is an opportunity for the promotion of renewable energies since new energy sources are needed to provide the necessary electricity. Covering the arisen demand by lignite would

instead damage the achievement of sustainability and sabotage e.g. the reduction of emissions. Lignite mining and mining in general is hardly compatible with the protection of the environment and sustainability, therefore constrains the achievement of environment related objectives. The reduction of emissions can only be achieved with the development and promotion of renewable energies sources, which is also directly related to the successful development of the power network. The production of biofuels constrains the production of food, since plants are used to produce biofuels instead of food products. The production and quality of food as well as the protection of animals is directly related to the prevention of animal diseases. An improvement of infrastructure can negatively influence and constrain the achievement of environment related objectives.

Reporting of the validation of assessment done with stakeholders

Throughout the preparation of this assessment low-level interactions with stakeholders were continuously maintained. However, we deliberately spared our stakeholders reviewing and commenting about this entire document – such an exercise would not only have courted their resentment but very likely led to contradictory answers as everyone's individual views and spheres of interest cannot be served likewise by an honestly non-partisan analysis.

This holds even more as the finalization of this report stretched into the holiday season and only very selective responses could have been expected. We are therefore convinced to have portrayed the situation with less biases than there would have been if any positions of single last-minute respondents had been finally interspersed into this report.

Assessment of interactions between nexus critical instruments and nexus critical objectives

This sub-chapter includes the following elements:

- Table illustrating the selected nexus critical instruments, including an explanation of the reason why these instruments are considered particularly critical or interesting to investigate in a nexus perspective
- Justification of the scores
- Description of the interaction between NCIs and NCOs, including an explanation how individual (one instrument) or multiple (more instruments together) interactions may hamper or support the achievement of the nexus critical objectives.
- Reporting of the validation of assessment done with stakeholders

Table 1 illustrating the selected nexus critical instruments, including an explanation of the reason why these instruments are considered particularly critical or interesting to investigate in a nexus perspective

Water		
Code	Heading (short description)	Detailed description (including specification of context)
Wa	Fees	Includes fees e.g. for the pollution of water.
Wb	Standards/Regulations	Limits for pollution.
Wc	Monitoring	Includes the observation of pollution and water usage.
Wd	Usage regulation	Includes the regulation of water access and usage for

		different sectors e.g. industry and agriculture.
We	Dike construction and maintenance	Includes Dike construction and maintenance as well as other flood control measures.
Energy		
Code	Heading (short description)	Detailed description (including specification of context)
Ea	Fees	Includes e.g. fees for the violation of regulations.
Eb	Regulations/Standards	For heating systems, energy demand of buildings…
Ec	Monitoring	Monitoring energy usage and compliance to the above.
Ed	Subsidies	For the usage of renewable energies and reduction of energy demand.
Ee	Shutdown of atomic power plants	Shutdown of atomic power plants.
Ef	Biddings	For e.g. solar plants.
Food and agriculture		
Code	Heading (short description)	Detailed description (including specification of context).
Fa	Fees	Fees for the disregard of regulations and standards.
Fb	Regulations/Standards	Which ingredients, how to produce food products…
Fc	Monitoring	Monitoring and controlling the compliance to the above.
Fd	Subsidies	Subsidies for farmer and ecological cultivation.
Fe	Interventions	Killing sick animals.
Land use		
Code	Heading (short description)	Detailed description (including specification of context)
La	Fees	Fees for damaging land e.g. unlawful waste disposal.
Lb	Regulations/Standards	To ensure combability with the environment, hunting regulations…
Lc	Monitoring	Monitoring and controlling the compliance to the above.
Ld	Subsidies	For the improvement of infrastructure in Eastern Germany and forest owners in case of damage to the forest.
Le	Intervention	If land is in danger of receiving mayor damage or unlawful transformation.
Lf	Expropriation	For mining and land planning purposes.
Climate		
Code	Heading (short description)	Detailed description (including specification of context)
Ca	Fees	E.g. fees for producing too much emissions.
Cb	Regulations/Standards	Related to emissions.
Cc	Monitoring	Monitoring and controlling the compliance to the above.
Cd	Subsidies	For projects related to the protection of the environment and with the objective to strengthen the awareness.
Ce	Establishments	Of organisations, councils…

Justification of the scores

	W	W	W	W	W	E	E	E	E	E	F	F2	F3	F	F5	F6	L	L2	L	L	C	C	To	T	Tot

	1	2	3	4	5	1	2	3	4	5	1			4			1		3	4	1	2	t. n. (+)	o t. n. (-)	. n. (+/-)
Wa	+3	+3	0	+1	0	0	0	-1	0	0	-1	-1	+1	+1	0	0	0	0	-1	0	0	0	+9	-4	+9/-4
Wb	+3	0	0	+3	0	0	0	0	0	0	-1	-1	0	0	+1	+1	0	+3	0	0	0	+1	+12	-2	+12/-2
Wc	+3	+3	0	+3	+2	0	0	0	0	0	0	0	0	0	+1	+1	0	+1	0	+1	0	+1	+16	0	+16/0
Wd	+2	+3	0	+2	0	0	0	0	0	0	-1	-1	0	0	0	+1	0	+3	-1/0	+1	0	+1	+13	-3	+13/-3
We	0	0	-1/0	0	0	0	0	0	0	0	0	+1	0	0	0	0	+1	0	0	0	0	+1	+3	-1	+3/-1
Ea	0	0	0	0	0	0	+1	+1	0	+1	0	0	0	0	0	0	0	0	0	0	0	0	+3	0	+3/0
Eb	0	0	0	0	0	0	+2	+2	0	+2	0	0	0	0	0	0	0	+2	0	0	+2	+1	+11	0	+11/0
Ec	0	0	0	0	0	0	+1	+1	0	+2	0	0	0	0	0	0	0	0	0	0	0	+1	+5	0	+5/0
Ed	0	0	0	0	0	0	+2	+1	+1	+2	0	-1	0	0	0	0	0	0	0	0	0	0	+6	-1	+6/-1
Ee	0	0	0	0	0	+3	+2	0	0	0	0	0	0	0	0	0	0	+1	0	0	+2/-2	+1	+9	-2	+9/-2
Ef	0	0	0	0	0	0	+2	0	+2	0	0	0	0	0	0	0	0	+1	0	0	0	0	+5	0	+5/0
Fa	0	0	0	0	0	0	0	0	0	0	+3	0	0	0	0	0	0	0	0	0	0	0	+3	0	+3/0
Fb	0	0	0	0	0	0	0	0	0	0	+3	+1/-2	+3	+1	+3	+1	0	+3	0	+1	0	+1	+17	-2	+17/-2
Fc	0	0	0	0	0	0	0	0	0	0	+3	+2	+3	0	+2	+1	0	+1	0	0	0	+1	+13	0	+13/0
Fd	0	0	0	0	0	0	0	0	0	0	+1	+2/+3	0	+2	0	0	0	+1/0	0	0	0	0	+7(6)	0	+7(6)/0
Fe	0	0	0	0	0	0	0	0	0	0	+2	+2/-2	+2/+3	0	+2	+1	0	0	0	0	0	0	+9(10)	-2	+9(10)/-2
La	+2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+2	-1	+2	0	0	+6	-1	+6/-1
Lb	+2	0	0	+1	0	0	0	0	+1	+1	0	+1/-1	0	0	+1	+1	0	+3	-1	+2	+1	+1	+15	-2	+15/-2
Lc	+2	0	0	+1	0	0	0	0	0	+1	0	0	0	0	+2	+2	0	+3	0	+2	+1	+1	+15	0	+15/0
Ld	0	0	+1	0	0	0	0	0	0	0	0	0	0	0	+1	+1	+2	0	0	+2	0	0	+7	0	+7/0
Le	+3	0	0	+3	0	0	0	0	0	0	0	0	0	0	+3	+3	0	+3	-2/0	+3	0	+1	+19	-2	+19/-2

Lf	0	0	0	0	0	0	0	0	0	0	0	-2/0	0	0	0	0	0	0	+3	-2/0	0	0	+3	-4	+3/-4
Ca	0	0	0	0	0	0	+1	+1	0	+1	0	0	0	0	0	0	0	+1	0	0	+3	0	+7	0	+7/0
Cb	0	0	0	0	0	0	+2	+2	0	+2	0	0	0	0	0	+1	0	+3	-1/0	+1	+3	+1	+15	-1	+15/-1
Cc	0	0	0	0	0	0	+1	+1	0	+1	0	0	0	0	0	0	0	+2	0	0	+3	+1	+9	0	+9/0
Cd	+1	+1	0	+2	0	0	0	0	0	0	0	0	0	+2	+2	+2	0	+2	0	+2	0	+2	+16	0	+16/0
Ce	+1	+1	0	+2	0	+1	+1	+1	0	+1	0	0	0	+1	+1	+2	0	+3	0	+2	+1	+3	+21	0	+21/0
Tot.n.(+)	+22	+11	+1	+18	+2	+4	+15	+10	+4	+14	+12	+10(11)	+9(10)	+7	+19	+18	+3	+38	+3	+19	+16	+19			
Tot.n.(-)	0	0	-1	0	0	0	0	-1	0	0	-3	-11	0	0	0	0	0	0	-7	-2	-2	0			
Tot.n.(+/-)	+22/0	+11/0	+1/-1	+18/0	+2/0	+4/0	+15/0	+10/-1	+4/0	+14/0	+12/-3	+10(11)/-11	+9(10)/0	+7/0	+19/0	+18/0	+3/0	+38/0	+3/-7	+19/-2	+16/-2	+19/0			

Interaction	Score	Justification
Wa>W1	+3	Fees are fundamental for the success. Consequences are needed.
Wa>W2	+3	Fees are fundamental for the success. Consequences are needed.
Wa>W3	0	No significant interaction.
Wa>W4	+1	Fees for pollution and excessive water usage directly support the preservation of biodiversity.
Wa>W5	0	No significant interaction.
Wa>E1	0	No significant interaction.
Wa>E2	0	No significant interaction.
Wa>E3	-1	They can hinder the cultivation of biofuel plants since fertilizer are used, which are a main factor for water pollution.
Wa>E4	0	No significant interaction.
Wa>E5	0	No significant interaction.
Wa>F1	-1	They interfere in the usage of fertilizer, which are a main factor for water pollution.

Wa>F2	-1	They interfere in the usage of fertilizer, which are a main factor for water pollution.
Wa>F3	0	No significant interaction.
Wa>F4	+1	They support ecological cultivation, which uses less fertilizer. Reduced risk of having to pay fees for water pollution.
Wa>F5	0	No significant interaction.
Wa>F6	0	No significant interaction.
Wa>L1	0	No significant interaction.
Wa>L2	0	No significant interaction.
Wa>L3	-1	Fees for e.g. water pollution are a liability for mining efforts.
Wa>L4	0	No significant interaction.
Wa>C1	0	No significant interaction.
Wa>C2	0	No significant interaction.
Wb>W1	+3	Limits and regulations are fundamental to reduce pollution.
Wb>W2	0	No significant interaction.
Wb>W3	0	No significant interaction.
Wb>W4	+3	Limits and regulations are fundamental to protect biodiversity.
Wb>W5	0	No significant interaction.
Wb>E1	0	No significant interaction.
Wb>E2	0	No significant interaction.
Wb>E3	0	No significant interaction.
Wb>E4	0	No significant interaction.
Wb>E5	0	No significant interaction.
Wb>F1	-1	Limits influence the free usage of fertilizer.
Wb>F2	-1	Limits influence the free usage of fertilizer.
Wb>F3	0	No significant interaction.
Wb>F4	0	No significant interaction.
Wb>F5	+1	Pollution limits enable animal protection. Less pollution equals less negative influence on animals.
Wb>F6	+1	Pollution limits enable biodiversity preservation. Less pollution equals less negative influence on natural habitats.
Wb>L1	0	No significant interaction.
Wb>L2	+3	Limits and regulations are fundamental to reduce pollution, which is crucial for sustainability.
Wb>L3	0	No significant interaction.
Wb>L4	0	No significant interaction.
Wb>C1	0	No significant interaction.
Wb>C2	+1	Regulations and limits increase awareness by existing.
Wc>W1	+3	Monitoring water quality is fundamental to reduce pollution.
Wc>W2	+3	Monitoring the usage of water is necessary to reduce water usage.
Wc>W3	0	No significant interaction.
Wc>W4	+3	Ensuring biodiversity is impossible, if risk factors like pollution are not monitored.
Wc>W5	+2	Monitoring is needed to know what measures must be taken to reduce flood risk.
Wc>E1	0	No significant interaction.

Wc>E2	0	No significant interaction.
Wc>E3	0	No significant interaction.
Wc>E4	0	No significant interaction.
Wc>E5	0	No significant interaction.
Wc>F1	0	No significant interaction.
Wc>F2	0	No significant interaction.
Wc>F3	0	No significant interaction.
Wc>F4	0	No significant interaction.
Wc>F5	+1	The protection of animals is aided significantly.
Wc>F6	+1	Monitoring supports the protection of biodiversity significantly.
Wc>L1	0	No significant interaction.
Wc>L2	+1	Monitoring e.g. the adherence to limits supports sustainability.
Wc>L3	0	No significant interaction.
Wc>L4	+1	Monitoring e.g. the adherence to limits supports the preservation of forests.
Wc>C1	0	No significant interaction.
Wc>C2	+1	The fact that limits are monitored raises awareness.
Wd>W1	+2	Less water usage means less pollution in a lot of cases.
Wd>W2	+3	Limits and regulations are fundamental to reduce water usage.
Wd>W3	0	No significant interaction.
Wd>W4	+2	The reduction of water usage relieves natural habitats.
Wd>W5	0	No significant interaction.
Wd>E1	0	No significant interaction.
Wd>E2	0	No significant interaction.
Wd>E3	0	No significant interaction.
Wd>E4	0	No significant interaction.
Wd>E5	0	No significant interaction.
Wd>F1	-1	The regulation of water usage interferes in food production and quality.
Wd>F2	-1	The regulation of water usage interferes in food production and quality.
Wd>F3	0	No significant interaction.
Wd>F4	0	No significant interaction.
Wd>F5	0	No significant interaction.
Wd>F6	+1	Ensuring biodiversity profits from water usage regulation. Less interferences in nature.
Wd>L1	0	No significant interaction.
Wd>L2	+3	Sustainability can only be achieved, if water usage is reduced.
Wd>L3	-1/0	The regulation of water usage can potentially hinder mining, if water is needed.
Wd>L4	+1	Ensuring biodiversity profits from water usage regulation. Less interference in nature.
Wd>C1	0	No significant interaction.
Wd>C2	+1	Water regulation and with it the need to reduce water usage raise awareness about the environment.
We>W1	0	No significant interaction.

We>W2	0	No significant interaction.
We>W3	-1/0	The construction of dikes can potentially hinder the improvement of waterway infrastructure.
We>W4	0	No significant interaction.
We>E1	0	No significant interaction.
We>E2	0	No significant interaction.
We>E3	0	No significant interaction.
We>E4	0	No significant interaction.
We>E5	0	No significant interaction.
We>F1	0	No significant interaction.
We>F2	+1	The construction of dikes supports the production of food since agriculture areas are less likely to be flooded.
We>F3	0	No significant interaction.
We>F4	0	No significant interaction.
We>F5	0	No significant interaction.
We>F6	0	No significant interaction.
We>L1	+1	The construction of dikes supports the improvement of agriculture and rural infrastructure since areas are less likely to be flooded.
We>L2	0	No significant interaction.
We>L3	0	No significant interaction.
We>L4	0	No significant interaction.
We>C1	0	No significant interaction.
We>C2	+1	The construction of dikes raises awareness about the topic.
Ea>W1	0	No significant interaction.
Ea >W2	0	No significant interaction.
Ea >W3	0	No significant interaction.
Ea >W4	0	No significant interaction.
Ea>W5	0	No significant interaction.
Ea >E1	0	No significant interaction.
Ea >E2	+1	Fees for inobservance of regulations for e.g. energy supply sources are necessary.
Ea >E3	+1	Fees for inobservance of regulations for e.g. biofuel content are necessary.
Ea >E4	0	No significant interaction.
Ea >E5	+1	Fees for inobservance of regulations for e.g. heating are necessary.
Ea >F1	0	No significant interaction.
Ea >F2	0	No significant interaction.
Ea >F3	0	No significant interaction.
Ea >F4	0	No significant interaction.
Ea >F5	0	No significant interaction.
Ea >F6	0	No significant interaction.
Ea >L1	0	No significant interaction.
Ea >L2	0	No significant interaction.
Ea >L3	0	No significant interaction.
Ea >L4	0	No significant interaction.
Ea >C1	0	No significant interaction.

Ea >C2	0	No significant interaction.
Eb>W1	0	No significant interaction.
Eb >W2	0	No significant interaction.
Eb >W3	0	No significant interaction.
Eb >W4	0	No significant interaction.
Eb>W5	0	No significant interaction.
Eb >E1	0	No significant interaction.
Eb >E2	+2	The regulations greatly contribute to the promotion of renewable energies.
Eb >E3	+2	The regulations greatly contribute to the promotion of biofuels.
Eb >E4	0	No significant interaction.
Eb >E5	+2	Objective of the regulations is often the reduction of energy usage.
Eb >F1	0	No significant interaction.
Eb >F2	0	No significant interaction.
Eb >F3	0	No significant interaction.
Eb >F4	0	No significant interaction.
Eb >F5	0	No significant interaction.
Eb >F6	0	No significant interaction.
Eb >L1	0	No significant interaction.
Eb >L2	+2	The regulations pursue the objective of increased sustainability.
Eb >L3	0	No significant interaction.
Eb >L4	0	No significant interaction.
Eb >C1	+2	The regulations are most of the times directly tied to the reduction of emissions.
Eb >C2	+1	The need to adhere to the regulations increases awareness.
Ec>W1	0	No significant interaction.
Ec >W2	0	No significant interaction.
Ec >W3	0	No significant interaction.
Ec >W4	0	No significant interaction.
Ec>W5	0	No significant interaction.
Ec >E1	0	No significant interaction.
Ec >E2	+1	The fact that the regulations are monitored supports the promotion of renewable energies.
Ec >E3	+1	The fact that the regulations are monitored supports the promotion of biofuels.
Ec >E4	0	No significant interaction.
Ec >E5	+2	The reduction of energy usage greatly depends on the controlling and monitoring thereof.
Ec >F1	0	No significant interaction.
Ec >F2	0	No significant interaction.
Ec >F3	0	No significant interaction.
Ec >F4	0	No significant interaction.
Ec >F5	0	No significant interaction.
Ec >F6	0	No significant interaction.
Ec >L1	0	No significant interaction.
Ec >L2	0	No significant interaction.

Ec >L3	0	No significant interaction.
Ec >L4	0	No significant interaction.
Ec >C1	0	No significant interaction.
Ec >C2	+1	The fact that regulations are monitored automatically spreads awareness.
Ed>W1	0	No significant interaction.
Ed >W2	0	No significant interaction.
Ed >W3	0	No significant interaction.
Ed >W4	0	No significant interaction.
Ed>W5	0	No significant interaction.
Ed >E1	0	No significant interaction.
Ed >E2	+2	Subsidies for the improvement and development of renewable energies are important.
Ed >E3	+1	Subsidies to produce biofuel support the producer.
Ed >E4	+1	Subsidies support the improvement of the power network.
Ed >E5	+2	The reduction of energy usage depends partly on the modernization of existing buildings. The adaption to new regulations is supported by subsidies.
Ed >F1	0	No significant interaction.
Ed >F2	-1	Subsidies for biofuel can negatively influence the production of food.
Ed >F3	0	No significant interaction.
Ed >F4	0	No significant interaction.
Ed >F5	0	No significant interaction.
Ed >F6	0	No significant interaction.
Ed >L1	0	No significant interaction.
Ed >L2	0	No significant interaction.
Ed >L3	0	No significant interaction.
Ed >L4	0	No significant interaction.
Ed >C1	0	No significant interaction.
Ed >C2	0	No significant interaction.
Ee>W1	0	No significant interaction.
Ee >W2	0	No significant interaction.
Ee >W3	0	No significant interaction.
Ee >W4	0	No significant interaction.
Ee>W5	0	No significant interaction.
Ee >E1	+3	The end of atomic energy is impossible without a shutdown of atomic power plants. Self-explanatory.
Ee >E2	+2	The shutdown supports the promotion of renewable energies since new energy sources are needed to replace old sources.
Ee >E3	0	No significant interaction.
Ee >E4	0	No significant interaction.
Ee >E5	0	No significant interaction.
Ee >F1	0	No significant interaction.
Ee >F2	0	No significant interaction.
Ee >F3	0	No significant interaction.
Ee >F4	0	No significant interaction.

Ee >F5	0	No significant interaction.
Ee >F6	0	No significant interaction.
Ee >L1	0	No significant interaction.
Ee >L2	+1	The shutdown supports sustainability e.g. no new nuclear waste material.
Ee >L3	0	No significant interaction.
Ee >L4	0	No significant interaction.
Ee >C1	+2/-2	The shutdown could lead to an increase or decrease of emissions dependant on the replacement energy sources.
Ee >C2	+1	The shutdown increased awareness about the environment.
Ef>W1	0	No significant interaction.
Ef >W2	0	No significant interaction.
Ef >W3	0	No significant interaction.
Ef >W4	0	No significant interaction.
Ef>W5	0	No significant interaction.
Ef >E1	0	No significant interaction.
Ef >E2	+2	Biddings of new power plants greatly support the promotion of renewable energies.
Ef >E3	0	No significant interaction.
Ef >E4	+2	Biddings of new parts for the improved power network greatly support the advancement of the objective.
Ef >E5	0	No significant interaction.
Ef >F1	0	No significant interaction.
Ef >F2	0	No significant interaction.
Ef >F3	0	No significant interaction.
Ef >F4	0	No significant interaction.
Ef >F5	0	No significant interaction.
Ef >F6	0	No significant interaction.
Ef >L1	0	No significant interaction.
Ef >L2	+1	Biddings for new e.g. solar plants increase sustainability.
Ef >L3	0	No significant interaction.
Ef >L4	0	No significant interaction.
Ef >C1	0	No significant interaction.
Ef >C2	0	No significant interaction.
Fa>W1	0	No significant interaction.
Fa >W2	0	No significant interaction.
Fa >W3	0	No significant interaction.
Fa >W4	0	No significant interaction.
Fa>W5	0	No significant interaction.
Fa >E1	0	No significant interaction.
Fa >E2	0	No significant interaction.
Fa >E3	0	No significant interaction.
Fa >E4	0	No significant interaction.
Fa >E5	0	No significant interaction.
Fa >F1	+3	Consequences for the disregard of regulations are needed.
Fa >F2	0	No significant interaction.

Fa >F3	0	No significant interaction.
Fa >F4	0	No significant interaction.
Fa >F5	0	No significant interaction.
Fa >F6	0	No significant interaction.
Fa >L1	0	No significant interaction.
Fa >L2	0	No significant interaction.
Fa >L3	0	No significant interaction.
Fa >L4	0	No significant interaction.
Fa >C1	0	No significant interaction.
Fa >C2	0	No significant interaction.
Fb>W1	0	No significant interaction.
Fb >W2	0	No significant interaction.
Fb >W3	0	No significant interaction.
Fb >W4	0	No significant interaction.
Fb>W5	0	No significant interaction.
Fb >E1	0	No significant interaction.
Fb >E2	0	No significant interaction.
Fb >E3	0	No significant interaction.
Fb >E4	0	No significant interaction.
Fb >E5	0	No significant interaction.
Fb >F1	+3	Standards and regulations are necessary to reach and secure food quality.
Fb >F2	+1/-2	Food production can be hindered by certain regulations. Can also be supported in the long term.
Fb >F3	+3	Standards and regulations are necessary to prevent animal diseases.
Fb >F4	+1	The regulation of e.g. fertilizer usage can directly translate to an increase of ecological cultivation.
Fb >F5	+3	Standards and regulations are necessary to protect animals from harm.
Fb >F6	+1	Regulations on e.g. the usage of fertilizer also supports biodiversity.
Fb >L1	0	No significant interaction.
Fb >L2	+3	Regulations in the food sector play a big role in the achievement of sustainability, since damaging use of land should be decreasing because of them.
Fb >L3	0	No significant interaction.
Fb >L4	+1	Regulations on e.g. the usage of fertilizer also supports the preservation of forests.
Fb >C1	0	No significant interaction.
Fb >C2	+1	Food regulations and standards raise the awareness.
Fc>W1	0	No significant interaction.
Fc >W2	0	No significant interaction.
Fc >W3	0	No significant interaction.
Fc >W4	0	No significant interaction.
Fc>W5	0	No significant interaction.
Fc >E1	0	No significant interaction.
Fc >E2	0	No significant interaction.

Fc >E3	0	No significant interaction.
Fc >E4	0	No significant interaction.
Fc >E5	0	No significant interaction.
Fc >F1	+3	Securing food quality is impossible without monitoring thereof.
Fc >F2	+2	Securing food production benefits from the monitoring thereof.
Fc >F3	+3	Preventing animal diseases is impossible without monitoring the measures taken against them.
Fc >F4	0	No significant interaction.
Fc >F5	+2	Animal protection is aided significantly by the control of protection measures.
Fc >F6	+1	Monitoring the adherence to regulations aids biodiversity.
Fc >L1	0	No significant interaction.
Fc >L2	+1	Monitoring the adherence to regulations aids the achievement of sustainability.
Fc >L3	0	No significant interaction.
Fc >L4	0	No significant interaction.
Fc >C1	0	No significant interaction.
Fc >C2	+1	Monitoring raises awareness.
Fd>W1	0	No significant interaction.
Fd >W2	0	No significant interaction.
Fd >W3	0	No significant interaction.
Fd >W4	0	No significant interaction.
Fd>W5	0	No significant interaction.
Fd >E1	0	No significant interaction.
Fd >E2	0	No significant interaction.
Fd >E3	0	No significant interaction.
Fd >E4	0	No significant interaction.
Fd >E5	0	No significant interaction.
Fd >F1	+1	Subsidies support food quality to a certain degree.
Fd >F2	+2/+3	The production of food is greatly dependant on subsidies, especially if the objective is to guarantee competitive ability.
Fd >F3	0	No significant interaction.
Fd >F4	+2	The promotion of ecological cultivation is greatly reinforced by subsidies for its advancement.
Fd >F5	0	No significant interaction.
Fd >F6	0	No significant interaction.
Fd >L1	0	No significant interaction.
Fd >L2	+1/0	Sustainability can profit from subsidies for ecological cultivation.
Fd >L3	0	No significant interaction.
Fd >L4	0	No significant interaction.
Fd >C1	0	No significant interaction.
Fd >C2	0	No significant interaction.
Fe>W1	0	No significant interaction.
Fe >W2	0	No significant interaction.
Fe >W3	0	No significant interaction.
Fe >W4	0	No significant interaction.

Fe>W5	0	No significant interaction.
Fe >E1	0	No significant interaction.
Fe >E2	0	No significant interaction.
Fe >E3	0	No significant interaction.
Fe >E4	0	No significant interaction.
Fe >E5	0	No significant interaction.
Fe >F1	+2	Killing sick animals greatly aids food quality.
Fe >F2	+2/-2	Killing sick animals is necessary to secure food production but can at the same time greatly disturb it, especially if healthy animals must be killed.
Fe >F3	+2/+3	Killing sick animals protects the remaining ones from harm and is unavoidable to prevent the further spread of disease.
Fe >F4	0	No significant interaction.
Fe >F5	+2	Killing sick animals protects the remaining ones from harm and is unavoidable.
Fe >F6	+1	Killing sick animals can help secure biodiversity since a further spread of diseases could be prevented.
Fe >L1	0	No significant interaction.
Fe >L2	0	No significant interaction.
Fe >L3	0	No significant interaction.
Fe >L4	0	No significant interaction.
Fe >C1	0	No significant interaction.
Fe >C2	0	No significant interaction.
La>W1	+2	Fees for waste disposal are necessary to reduce water pollution. Waste often pollutes groundwater.
La >W2	0	No significant interaction.
La >W3	0	No significant interaction.
La >W4	0	No significant interaction.
La>W5	0	No significant interaction.
La >E1	0	No significant interaction.
La >E2	0	No significant interaction.
La >E3	0	No significant interaction.
La >E4	0	No significant interaction.
La >E5	0	No significant interaction.
La >F1	0	No significant interaction.
La >F2	0	No significant interaction.
La >F3	0	No significant interaction.
La >F4	0	No significant interaction.
La >F5	0	No significant interaction.
La >F6	0	No significant interaction.
La >L1	0	No significant interaction.
La >L2	+2	Consequences are needed to protect the land and the environment.
La >L3	-1	Fees for damaging land can be a liability for mining efforts.
La >L4	+2	Consequences are needed to protect forests from unlawful waste disposal.
La >C1	0	No significant interaction.

La >C2	0	No significant interaction.
Lb>W1	+2	The regulation of waste disposal and land usage directly translates to a reduction of water pollution.
Lb >W2	0	No significant interaction.
Lb >W3	0	No significant interaction.
Lb >W4	+1	Waste disposal regulations support the protection of biodiversity.
Lb>W5	0	No significant interaction.
Lb >E1	0	No significant interaction.
Lb >E2	0	No significant interaction.
Lb >E3	0	No significant interaction.
Lb >E4	+1	Regulations, which promote sustainability, support renewable energies.
Lb >E5	+1	Regulations, which promote sustainability, support the reduction of energy usage.
Lb >F1	0	No significant interaction.
Lb >F2	+1/-1	Regulations regarding sustainability and land use can be of supportive nature or a liability, depending on the circumstances.
Lb >F3	0	No significant interaction.
Lb >F4	0	No significant interaction.
Lb >F5	+1	Waste disposal regulations support the protection of animals.
Lb >F6	+1	Waste disposal regulations support the protection of biodiversity.
Lb >L1	0	No significant interaction.
Lb >L2	+3	The regulations are necessary to reach sustainability.
Lb >L3	-1	The regulations are a liability for mining efforts.
Lb >L4	+2	The preservation of forest is supported significantly by regulations regarding waste disposal and land use.
Lb >C1	+1	Regulations reduce emissions caused by insufficient waste disposal.
Lb >C2	+1	The regulations raise awareness about the topic.
Lc>W1	+2	Monitoring regulations is necessary. Their significance is limited otherwise.
Lc >W2	0	No significant interaction.
Lc >W3	0	No significant interaction.
Lc >W4	+1	Monitoring regulations is necessary. Their significance is limited otherwise.
Lc>W5	0	No significant interaction.
Lc >E1	0	No significant interaction.
Lc >E2	0	No significant interaction.
Lc >E3	0	No significant interaction.
Lc >E4	0	No significant interaction.
Lc >E5	+1	Monitoring regulations is necessary. Their significance is limited otherwise.
Lc >F1	0	No significant interaction.
Lc >F2	0	No significant interaction.
Lc >F3	0	No significant interaction.
Lc >F4	0	No significant interaction.
Lc >F5	+2	Monitoring regulations is necessary. Their significance is limited

		otherwise.
Lc >F6	+2	Monitoring regulations is necessary. Their significance is limited otherwise.
Lc >L1	0	No significant interaction.
Lc >L2	+3	Monitoring regulations is necessary. Their significance is limited otherwise.
Lc >L3	0	No significant interaction.
Lc >L4	+2	Monitoring regulations is necessary. Their significance is limited otherwise.
Lc >C1	+1	Monitoring regulations is necessary. Their significance is limited otherwise.
Lc >C2	+1	Monitoring raises awareness.
Ld>W1	0	No significant interaction.
Ld >W2	0	No significant interaction.
Ld >W3	+1	Subsidies for the improvement of infrastructure in Eastern Germany support the achievement of the objective.
Ld >W4	0	No significant interaction.
Ld>W5	0	No significant interaction.
Ld >E1	0	No significant interaction.
Ld >E2	0	No significant interaction.
Ld >E3	0	No significant interaction.
Ld >E4	0	No significant interaction.
Ld >E5	0	No significant interaction.
Ld >F1	0	No significant interaction.
Ld >F2	0	No significant interaction.
Ld >F3	0	No significant interaction.
Ld >F4	0	No significant interaction.
Ld >F5	+1	Subsidies for forest owners in case of significant damage to the forest support the protection of animals to a certain degree.
Ld >F6	+1	Subsidies for forest owners in case of significant damage to the forest support the biodiversity.
Ld >L1	+2	Infrastructure improvement in Eastern Germany profits from subsidies.
Ld >L2	0	No significant interaction.
Ld >L3	0	No significant interaction.
Ld >L4	+2	Subsidies for forest owners in case of significant damage to the forest support the preservation of forests.
Ld >C1	0	No significant interaction.
Ld >C2	0	No significant interaction.
Le>W1	+3	Intervention, if mayor damage could be sustained, is a significant instrument regarding the reduction of pollution.
Le >W2	0	No significant interaction.
Le >W3	0	No significant interaction.
Le >W4	+3	Intervention, if mayor damage could be sustained, is a significant instrument regarding the preservation of biodiversity in water bodies.
Le>W5	0	No significant interaction.

Le >E1	0	No significant interaction.
Le >E2	0	No significant interaction.
Le >E3	0	No significant interaction.
Le >E4	0	No significant interaction.
Le >E5	0	No significant interaction.
Le >F1	0	No significant interaction.
Le >F2	0	No significant interaction.
Le >F3	0	No significant interaction.
Le >F4	0	No significant interaction.
Le >F5	+3	Intervention, if mayor damage could be sustained, is a significant instrument regarding the protection of animals.
Le >F6	+3	Intervention, if mayor damage could be sustained, is a significant instrument.
Le >L1	0	No significant interaction.
Le >L2	+3	The possibility to intervene is necessary to secure sustainability and environmentally sound use of land.
Le >L3	-2/0	Interventions could hinder mining in certain situations.
Le >L4	+3	Intervention, if mayor damage could be sustained, is a significant instrument.
Le >C1	0	No significant interaction.
Le >C2	+1	Interventions raise awareness.
Lf>W1	0	No significant interaction.
Lf >W2	0	No significant interaction.
Lf >W3	0	No significant interaction.
Lf >W4	0	No significant interaction.
Lf>W5	0	No significant interaction.
Lf >E1	0	No significant interaction.
Lf >E2	0	No significant interaction.
Lf >E3	0	No significant interaction.
Lf >E4	0	No significant interaction.
Lf >E5	0	No significant interaction.
Lf >F1	0	No significant interaction.
Lf >F2	-2/0	Can disturb food production, if farmers are affected.
Lf >F3	0	No significant interaction.
Lf >F4	0	No significant interaction.
Lf >F5	0	No significant interaction.
Lf >F6	0	No significant interaction.
Lf >L1	0	No significant interaction.
Lf >L2	0	No significant interaction.
Lf >L3	+3	Is absolute necessary to be able to mine freely.
Lf >L4	-2/0	Can disturb the preservation of forests, if forest owners are affected.
Lf >C1	0	No significant interaction.
Lf >C2	0	No significant interaction.
Ca>W1	0	No significant interaction.
Ca >W2	0	No significant interaction.
Ca >W3	0	No significant interaction.

Ca >W4	0	No significant interaction.
Ca>W5	0	No significant interaction.
Ca >E1	0	No significant interaction.
Ca >E2	+1	Emission fees lead to opportunities for the promotion of renewable energies, which produce less emissions.
Ca >E3	+1	Emission fees lead to opportunities for the promotion of biofuels, which produce less emissions.
Ca >E4	0	No significant interaction.
Ca >E5	+1	Emission fees promote the reduction of energy usage.
Ca >F1	0	No significant interaction.
Ca >F2	0	No significant interaction.
Ca >F3	0	No significant interaction.
Ca >F4	0	No significant interaction.
Ca >F5	0	No significant interaction.
Ca >F6	0	No significant interaction.
Ca >L1	0	No significant interaction.
Ca >L2	+1	Emission fees help to promote a sustainable use of land and its resources.
Ca >L3	0	No significant interaction.
Ca >L4	0	No significant interaction.
Ca >C1	+3	Consequences are needed to achieve the reduction of emissions.
Ca >C2	0	No significant interaction.
Cb>W1	0	No significant interaction.
Cb >W2	0	No significant interaction.
Cb >W3	0	No significant interaction.
Cb >W4	0	No significant interaction.
Cb>W5	0	No significant interaction.
Cb >E1	0	No significant interaction.
Cb >E2	+2	The promotion of renewable energies profits significantly from emission regulations.
Cb >E3	+2	The promotion of biofuels profits significantly from emission regulations.
Cb >E4	0	No significant interaction.
Cb >E5	+2	The reduction of energy usage profits significantly from emission regulations.
Cb >F1	0	No significant interaction.
Cb >F2	0	No significant interaction.
Cb >F3	0	No significant interaction.
Cb >F4	0	No significant interaction.
Cb >F5	0	No significant interaction.
Cb >F6	+1	Less emission means less negative influence on nature, which helps securing biodiversity.
Cb >L1	0	No significant interaction.
Cb >L2	+3	Emission regulations are necessary to achieve sustainability.
Cb >L3	-1/0	Emission regulations can potentially be a liability for mining.
Cb >L4	+1	Less emission means less negative influence on nature, which helps

		preserving forests.
Cb >C1	+3	Regulations are necessary to achieve a reduction of emissions.
Cb >C2	+1	Regulations and standards raise awareness.
Cc>W1	0	No significant interaction.
Cc >W2	0	No significant interaction.
Cc >W3	0	No significant interaction.
Cc >W4	0	No significant interaction.
Cc>W5	0	No significant interaction.
Cc >E1	0	No significant interaction.
Cc >E2	+1	Monitoring emissions supports the promotion of renewable energies.
Cc >E3	+1	Monitoring emissions supports the promotion of biofuels.
Cc >E4	0	No significant interaction.
Cc >E5	+1	Monitoring emissions supports the reduction of energy usage.
Cc >F1	0	No significant interaction.
Cc >F2	0	No significant interaction.
Cc >F3	0	No significant interaction.
Cc >F4	0	No significant interaction.
Cc >F5	0	No significant interaction.
Cc >F6	0	No significant interaction.
Cc >L1	0	No significant interaction.
Cc >L2	+2	Reaching sustainability is greatly supported, if the production of emissions is monitored.
Cc >L3	0	No significant interaction.
Cc >L4	0	No significant interaction.
Cc >C1	+3	The reduction of emissions is impossible without monitoring the process.
Cc >C2	+1	The monitoring raises awareness.
Cd>W1	+1	Subsidies for environment related projects support the reduction of water pollution.
Cd >W2	+1	Subsidies for environment related projects support the reduction of water usage.
Cd >W3	0	No significant interaction.
Cd >W4	+2	Subsidies for environment related projects support the preservation of biodiversity in water bodies significantly.
Cd>W5	0	No significant interaction.
Cd >E1	0	No significant interaction.
Cd >E2	0	No significant interaction.
Cd >E3	0	No significant interaction.
Cd >E4	0	No significant interaction.
Cd >E5	0	No significant interaction.
Cd >F1	0	No significant interaction.
Cd >F2	0	No significant interaction.
Cd >F3	0	No significant interaction.
Cd >F4	+2	Subsidies for environment related projects support the promotion of ecological cultivation.
Cd >F5	+2	Subsidies for environment related projects support the protection of

		animals.
Cd >F6	+2	Subsidies for environment related projects support the preservation of biodiversity.
Cd >L1	0	No significant interaction.
Cd >L2	+2	Subsidies for environment related projects reinforce the objective significantly.
Cd >L3	0	No significant interaction.
Cd >L4	+2	Subsidies for environment related projects support the preservation of forests.
Cd >C1	0	No significant interaction.
Cd >C2	+2	Subsidies and the support of environment projects in general raise awareness significantly.
Ce>W1	+1	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. reduction of water pollution.
Ce >W2	+1	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. reduction of water usage.
Ce >W3	0	No significant interaction.
Ce >W4	+2	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. protection of biodiversity in water bodies.
Ce>W5	0	No significant interaction.
Ce >E1	+1	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. the end of nuclear energy-
Ce >E2	+1	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. promotion of renewable energies.
Ce >E3	+1	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. promotion of biofuels.
Ce >E4	0	No significant interaction.
Ce >E5	+1	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. reduction of energy usage.
Ce >F1	0	No significant interaction.
Ce >F2	0	No significant interaction.
Ce >F3	0	No significant interaction.
Ce >F4	+1	The establishment of councils and organisations, which promote

		awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. protection of biodiversity in water bodies.
Ce >F5	+1	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. protection of animals.
Ce >F6	+2	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. protection of biodiversity.
Ce >L1	0	No significant interaction.
Ce >L2	+3	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and climate are significant for the achievement of many objectives e.g. the sustainable use of land and resources. They are essential for this objective.
Ce >L3	0	No significant interaction.
Ce >L4	+2	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and clima are significant for the achievement of many objectives e.g. preservation of forests.
Ce >C1	+1	The establishment of councils and organisations, which promote awareness, as well as support projects related to the environment and clima are significant for the achievement of many objectives e.g. the reduction of emissions.
Ce >C2	+3	They use all kind of measures to raise awareness e.g. events and medias. One of their main objectives is raising awareness.

Description of the interaction between NCIs and NCOs, including an explanation how individual (one instrument) or multiple (more instruments together) interactions may hamper or support the achievement of the nexus critical objectives. NCIs, which are fundamental for the success of the objectives of one sector, can at the same time negatively influence and hinder the achievement of objectives belonging to a different sector. An example of that is the objective of food production and the ensuring thereof. It is constrained by the desire to reduce negative impact on the environment. The instruments of other sectors e.g. fees and regulations, pressure food producer and farmer. Its similar for matters concerning mining, since its damaging for the environment and not compatible with sustainability. Expropriations are necessary to achieve access to ressources but can also damage the landscape and objectives related to the protection of the environment. They can also lead to social problems.
Regulations and standards are necessary to achieve the NCOs. At the same time is monitoring adherence to these standards inevitable, since regulations that are not controlled could as well be non-existent. There must be consequences for breaching these regulations since controlling alone isn't effective e.g. fees.

It can be said that every NCI that involves matters concerning the environment raises the awareness about the topic. Every objective related to the protection of the environment and climate directly profits from the establishment of organisations and public offices tasked with the management of projects regarding these topics. The possibility to intervene in dangerous situations concerning the environment and land use is an important instrument of the state to prevent irreparable damage to landscape and biodiversity. Subsidies are a great method to support the achievement of certain objectives regarding e.g. food production and the promotion of renewable energies. They must be strictly controlled to be sure that they are used in the way they were intended to.

Reporting of the validation of assessment done with stakeholders
Throughout the preparation of this assessment low-level interactions with stakeholders were continuously maintained. However, we deliberately spared our stakeholders reviewing and commenting about this entire document – such an exercise would not only have courted their resentment but very likely led to contradictory answers as everyone's individual views and spheres of interest cannot be served likewise by an honestly non-partisan analysis.

This holds even more as the finalization of this report stretched into the holiday season and only very selective responses could have been expected. We are therefore convinced to have portrayed the situation with less biases than there would have been if any positions of single last-minute respondents had been finally interspersed into this report.

Assessment of vertical interactions between policies

This sub-chapter includes the following elements:

- the summary table of vertical interaction, including description of to what extend and why higher-level policies are transposed and implemented at lower level and to what extend and why lower level policies are supported or hampered by higher level policies
- the description of how vertical interactions may hamper or support the achievement of the nexus critical objectives.
- Reporting of the validation of assessment done with stakeholders

Table 2 The summary table of vertical interaction, including description of to what extend and why higher-level policies are transposed and implemented at lower level and to what extend and why lower level policies are supported or hampered by higher level policies

HIGHER>LOWER	
Higher level policies <u>successfully</u> implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
Eco Management and Audit Scheme	The Eco Management and Audit Scheme is an EU-Program related to environment management and eco-audit of corporations, whose participation is voluntary. The implementation on national and federal state level was managed by a series of laws and regulations e.g. “Umweltauditgesetz “. The program is relevant for all objectives related to the environment; waste disposal, reduction of energy usage, emissions and polution, sustainability and raise of awareness about the environment.
EU Emissions Trading System	The EU Emissions Trading System is implemented on national level. Objective is the reduction of emissions, but it also

	influences the NCOs reduction of energy usage and promotion of renewable energies. Emissions producer have the right to produce a certain amount of emissions. Additional rights can be bought if needed.
Common agricultural policy (CAP)	The CAP of the European Union is mostly relevant for the objectives; Securing food production, securing food quality, improvement of rural infrastructure and agriculture and sustainable use of land and its ressources. The subsidies for farmers are the most relevant part of the CAP. The allocation of subsidies is supported by the public authorities, especially by the ones of federal state level. Germany an it´s federal states support the receiver of subsidies with additional funds of their own. The CAP is considered in management plans regarding agriculture and land use. The frequent change of the allocation process is a problem, which often leads to problems regarding the errorless implementation.
Forest protection and hunting laws	This mainly affects Germany and the respective federal states. The laws on national level have equivalents on federal state level.
Prevention of animal diseases	The prevention of animal diseases is regulated by the EU. The respective laws, regulations and standards are implemented on lower scale by the member states. Measures are taken in context to the situation and the disease in question. There exist systems regarding the tracking livestock and diseases to better contain outbreaks (Animal Disease Notification System). The monitoring is conducted in cooperation between the EU and the authorities of the respective state.
Waste disposal laws and regulations	Waste disposal is regulated by the EU and implemented across all lower scales (National State – Federal States – Municipalities) depending on the respective responsibilities. Waste disposal is important for the NCOs; reduction of water pollution, reduction of emissions and sustainable use of land.
Higher level policies <u>only partly</u> implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
EU Water Framework Directive	The EU Water Framework Directive is related to the achievement of the NCOs; reduction of water pollution and usage, protection of biodiversity, especially in water bodies, the improvement of waterway infrastructure and the sustainable use of land and its resources. The objectives should be reached by the implemention of pollution limits and standards, which must be enforced and controlled. Management plans regarding the protection and development of river basins were made. The policy is implemented in all scales of government (EU – National State – Federal States – Municipalities). Laws and regulations were implemented to provide the legal framework for the achievement of the policy objectives and adhere to the regulations. There are still problems regarding the implementation, mostly

	related to the low interest of policy makers and questions regarding financing (shared responsibility between Germany and it´s federal states). Several arrangements are still based on voluntary actions. The policy objectives collide with the interests of the agriculture industry e.g. the use of fertilizer, which results in water pollution. Reaching the objectives will take at least until 2027, longer than originally intended.
Klimaschutzplan 2050: Klimaschutzpolitische Grundsätze und Ziele der Bundesregierung	This policy is significant for basically all NCOs. Objective is the reduction of emissions by 80-95 percent until 2050. The document shows possible measures to reach this objective. The implementation of the policy differs from sector to sector, since it's a program that encompass´ basically all areas with relevance for the environment and emissions production. This policy is closely related to the Energy Roadmap 2050 of the European Union and is at least partly an implementation. (More see e.g. "Energy Revolution").
Energy Roadmap 2050	This EU-policy is significant for basically all NCOs. Objective is the reduction of emissions by 80-95 percent until 2050. The implementation in Germany is carried out by the "Klimaschutzplan 2050"(see above).
Energy Revoultion	The "Energy Revolution" in Germany is implemented on national and federal state level and is relevant for the achievement of the NCOs; reduction of energy usage, promotion of renewable energies and biofuels, improvement of the power network, end of nuclear energy, reduction of emissions and sustainability. The implementation in lower scale is mostly successful, but the measures taken are not sufficient to reach the objectives, at least not in a timely manner. The improvement of the power network is to slow, and the interests of the industry are most of the time held in higher regard than the objectives of the "Energy Revolution", e.g. shown by the continued lignite mining and use of lignite power plants, as well as the exception of energy intensive corporations from the "eeg-apportionment", which should be paid by all power users equally. Related to the "Klimaschutzplan 2050".
Higher level policies poorly implemented at lower scale	
Policy	Description of reason and how NCOs are influenced
LOWER >HIGHER	
Lower level policies fully supported by higher level policies	
Policy	Description of reason and how NCOs are influenced
Management plans for e.g. Elbe river	The management plans were developed to implement the EU Water Framework Directive and are in line with the objectives of the directive.
Respective laws on the usage and protection of water	The respective laws of the federal states are in line with European and national laws and regulations and are accordingly

	supported. Laws and regulations exist on all scales (EU – National State – Federal States – Municipalities).
Lower level policies only partly supported by higher level policies	
Policy	Description of reason and how NCOs are influenced
Forest protection	The protection of forests in Germany is regulated on national as well as federal state level, but there doesn't exist a "big" EU-Directive which defines the topic on the same magnitude the EU Water Framework Directive does in the water sector.
Lower level policies hindered/disrupted by higher level policies	
Policy	Description of reason and how NCOs are influenced
Animal protection	The protection of animals, especially of livestock, is hindered by the EU. National laws and regulations cannot be stricter than the EU laws, thus they dictate the maximum amount of protection possible. The laws and regulations of the European Union contradict each other in some cases and have to many exceptions.

The description of how vertical interactions may hamper or support the achievement of the nexus critical objectives.

The delegation of policies to a lower level can increase the accuracy with which the relevant authorities can use and implement policies and their respective instruments, which should theoretically aid the achievement of the objectives. In practice is the implementation across scales is often the source of several problems. The topic of responsibility is a great obstacle especially in Germany since the federal states are separate entities and have, to a certain degree, their own laws and regulations, even if they are mostly very similar to each other and derive from national laws.

The involvement of the European Union only worsens the situation and further complicates the matter. There is shared responsibility in many areas, which results in difficulties e.g. related to funding projects. Both, Germany and the respective federal states, sometimes try to avoid paying for projects and hope the other will do so instead. This issue often leads to long delays and hinders the achievement of NCOs. The implementation of new policies can take a lot longer, if it needs to be done on several different levels of government and the speed to react to new developments can be significantly reduced.

Shared responsibility could potentially mean an increase in both personnel and funds, but this is often not the case. Even policies with the same objective can hinder each other, if they are not sufficient coordinated and the different levels of government are unable to work together. The implementation of policies is often slowed down or incomplete to uphold interests of the economy, which are often held in higher regard than the achievement of policy objectives.

Reporting of the validation of assessment done with stakeholders

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6. Formal and informal arrangements adopted to address conflicts, negotiate trade-offs and exploit synergies in practice

This chapter includes the following elements:

- The summary table of the formal and informal arrangements
- A description of the formal and informal rules and practices
- A description of the enabling and hindering factors
- Reporting of the validation of assessment done with stakeholders

Table 3 The summary table of the formal and informal arrangements

Type of arrangement (formal/infor-mal)	Description of Arrangement	Function of the arrangement (coordination, decision making, knowledge sharing, etc.)	Why it is working or not working (enabling and limiting factors)	How the arrangement affects the achievement of nexus critical objectives
Formal	Formal agreement between farmer and water boards regarding the reduction of fertilizer usage. Farmer receive payments, if they reduce their usage of fertilizer. Objective is the reduction of nitrate pollution in groundwater. Similar agreements exist informal without the involvement of money.	Reduction of groundwater pollution.	The agreement works to a certain degree, if economic interests are not significantly endangered, because both sides need groundwater with good quality.	This arrangement could help reducing groundwater pollution and in the long term secure food production and quality.
	Conference of environment ministers. Participants are the respective ministers and senators of Germany and it´s federal states. Meetings are two times per year.	Coordinating environment policies.	The conference is working. Decisions are not binding law, just recommendations.	This conference could help achieve all environment related NCOs, since cooperation between the respective federal states is needed to achieve them.
	Workshop regarding the adjustment to climate change. Participants include e.g. member of	Sharing information's and supporting decision-making	The workshop is working as intended.	This workshop could help achieve all environment related NCOs. The

	ministries and representatives of society groups. Objective is the improvement of the decision-making process regarding handling climate change.			consideration of all affected groups is important for the achievement of the NCOs.
	Conference of agriculture ministers, Participants are the respective ministers and senators of Germany and it´s federal states. Meetings are two times per year.	Coordinating agriculture policies.	The conference is working. Decisions are not binding law, just recommendations.	This conference could help achieve all agriculture related NCOs, since cooperation between the respective federal states is needed to achieve them.
	Conference of ministers responsible for land use planning. Participants are the respective ministers and senators of Germany and it´s federal states. Meetings are once per year.	Coordinating land use planning.	The conference is working. Decisions are not binding law, just recommendations.	This conference could help achieve all NCOs related to land use, since cooperation between the respective federal states is needed to achieve them.
	Conference of ministers of transport. Participants are the respective ministers and senators Germany and it´s federal states. Meetings are two times per year.	Coordinating transportation policies.	The conference is working. Decisions are not binding law, just recommendations.	This conference could help achieve the objectives related to infrastructure, since cooperation between the respective federal states is needed to achieve them.
	Workshop regarding water. Participants are the department heads of the respective federal state authorities and representatives of the national state. Meetings are two	Supporting decision-making.	The workshop is working as intended. Supports the Conference of environment ministers.	This workshop could help achieve the objectives related to the water sector.

	times per year. Related to the Conference of environment ministers.			
	Workshop regarding the protection of the environment, landscape management and regeneration. Participants are the department heads of the respective federal state authorities and representatives of the national state. Meetings are two times per year. Related to the Conference of environment ministers.	Supporting decision-making.	The workshop is working as intended. Supports the Conference of environment ministers.	This workshop could help achieve the objectives related to the environment and land use.
	Workshop regarding immission control. Participants are the department heads of the respective federal state authorities and representatives of the national state. Meetings are two times per year. Related to the Conference of environment ministers.	Supporting decision-making.	The workshop is working as intended. Supports the Conference of environment ministers.	This workshop could help achieve the objectives related to the environment and climate.
	Configuration of the Council of the European Union responsible for agriculture and fishing. Participants are most of the time the respective ministers of the member states. Meetings are normally four times a year.	Coordinating policies and law-making.	The council is working as intended, since it's one of the law-making organs of the European Union and the participating ministers have the power to make decisions.	The council is fundamental for the coordination of agriculture policies in Europe and is necessary for the achievement of the NCOs.

	Configuration of the Council of the European Union responsible for transport, telecommunication and energy. Participants are most of the time the respective ministers of the member states. Meetings are normally four times a year.	Coordinating policies and law-making.	The council is working as intended, since it's one of the law-making organs of the European Union and the participating ministers have the power to make decisions.	The council is fundamental for the coordination of e.g. energy policies in Europe and is necessary for the achievement of the NCOs in the respective sectors.
	Configuration of the Council of the European Union responsible for the environment. Participants are most of the time the respective ministers of the member states. Meetings are normally four times a year.	Coordinating policies and law-making.	The council is working as intended, since it's one of the law-making organs of the European Union and the participating ministers have the power to make decisions.	The council is fundamental for the coordination of e.g. environment policies in Europe and is necessary for the achievement of the NCOs in the respective sectors.
	Council for sustainable development. Appointed by the German Government. Members are fifteen people with positions with significance for the topic from e.g. research and economy. A meeting, at which developments are discussed with politicians, researchers and the economy, is held once a year.	Supporting decision-making and raising awareness.	The council is working as intended.	The council is of importance as meeting point of relevant actors and can support and influence the future decision-making of policy-makers.
Informal	Informal agreement between forest owners regarding forest cultivation. Forest owners support each other to better manage their forests.	Coordinating and supporting forest cultivation.	The agreements work, if the respective partners are dependable and trustworthy. The professional	This arrangement could help the preservation of forests, since it supports the professional handling.

	Some cases lead to the establishment of forestry associations.		handling of forests is only improved, if the owners are capable.	
	Informal cooperation between forest owner organisations and farmer organizations. Objective is the management of issues related to forest usage. Securing professional handling is another objective. Many farmers are forest owners at the same time.	Managing the cooperation of farmers and forest owners.	The cooperation only works, if interests match, otherwise its mostly difficult.	This arrangement could help the preservation of forests, since it supports the professional handling.
	Agreement related to the shared use of bees. Cooperation between farmers and beekeepers. Money is involved in most cases: “rent-a-bee”. Bees are needed for cultivation.	Securing pollination.	The agreement works, especially if the payment of money is involved.	This arrangement could help secure food production and quality.
	Informal agreement between farmers regarding sharing equipment. The sharing makes it possible to avoid significant costs for additional equipment.	Sharing equipment.	The agreement works because the farmer know and trust each other.	This arrangement could help secure food production and quality.
	Informal agreement between farmers regarding the shared storage of biofertilizers. The sharing makes it possible to avoid significant costs for additional storages.	Sharing storages for biofertilizer.	The agreement works because the farmer know and trust each other.	This arrangement could help secure food production and quality.
	Informal agreements between farmers and water boards regarding the protection of	Reduction of groundwater pollution.	The agreement works to a certain degree, if economic interests are not	This arrangement could help reducing groundwater pollution and in

	groundwater. Main topic is the reduction of fertilizer use to avoid groundwater pollution.		significantly endangered, because both sides need groundwater with good quality.	the long term secure food production and quality.
	Informal agreements between farmers and environment organizations mainly regarding wildlife conservation and ecological cultivation. Objective is the change of cultivation practices to better preserve natural habitats and biodiversity.	Planning land use and changing practices.	The agreement only works, if the economic interests are not significantly endangered by the proposed changes.	This agreement could help e.g. by the preservation of biodiversity and the protection of animals.

A description of the formal and informal rules and practices

The formal rules and practices mostly consist of councils and meetings of authorities, mostly regarding the coordination of policies and the support of decision-making. Informal arrangements however are mostly done between small groups of individuals with common interests and trust in each other.

A description of the enabling and hindering factors

The success of informal arrangements mostly depends on the trustworthiness of the respective participants and common (economical) interests. Formal arrangements can suffer or be obsolete, if the participating persons don't have the power to make decisions and the execution of meetings isn't done in earnest.

Reporting of the validation of assessment done with stakeholders

Throughout the preparation of this assessment low-level interactions with stakeholders were continuously maintained. However, we deliberately spared our stakeholders reviewing and commenting about this entire document – such an exercise would not only have courted their resentment but very likely led to contradictory answers as everyone's individual views and spheres of interest cannot be served likewise by an honestly non-partisan analysis.

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6.1. Success stories and failures

This chapter includes the following elements:

- the summary tables
- description of the success stories and success factors in the case study area
- description of the failures and failure factors in the case study area
- Reporting of the validation of assessment done with stakeholders

Table 4 Reporting success stories

Type of successful policy arrangement	Description	Factors of success, do's
Subsidies for the agriculture sector	The subsidies of the EU regarding the support of farmers and the agriculture sector is of great importance. While the consequences for farmers outside of the EU can be debatable it's also a fact that the subsidies play an integral part for the whole agriculture sector. Negative aspects are illustrated under "failures".	The subsidies help to provide farmers with the capacity to compete on the market.
Agreements regarding the usage of fertilizer	The above-mentioned agreements between water works and farmers regarding the reduction of fertilizer usage can be considered successful, since it reduced the pollution of groundwater noticeable (in some cases).	The greatest factors of success are the payment of money and common interest in useable groundwater.
Subsidies for solar energy in the private sector e.g. houses	The support regarding the usage of solar energy by private households mostly as installations on the roof, was quite successful – many houseowners used this opportunity.	To showcase the use for private households and possible long-term gains was a successful way to promote the usage of solar energy.
EU Water Framework Directive	Reaching the objectives will take longer than originally planned, but it can still be considered a successful policy since pollution of water bodies was reduced in many cases.	The implementation in national and federal state laws, as well as the regional management plans play a deciding role for the previous success.

Promotion of renewable energies (in general)	While the methods and the degree can be points of critic, it can't be denied that the importance of renewable energies in Germany has increased significantly and is still growing.	The various laws and regulations are mostly responsible for the success. The increased awareness can also be credited to a certain degree.
EEG apportionment	The objective of the EEG apportionment was reached. The implementation is a source of critic, see "failures".	It was integrated into the electricity tariff, see "failures".
Better monitoring of fertilizer usage in the agriculture sector	The monitoring of fertilizer usage was significantly improved in the last years. This is especially important for the reduction of water pollution. The process has still room for improvements.	More tests and personnel are a reason for the success.
Heating sector and energy usage	The implementation of numerous regulations regarding the construction of houses and the used heating systems reduced the energy usage of new buildings significantly.	The laws and regulations are obligatory (with exceptions).

Table 5 Reporting failures

Type of unsuccessful policy arrangement	Description	Factors of failure, don'ts
Biomass usage in e.g. Berlin	Deadwood often isn't left to rot in forests and doesn't become an important part of the biological cycle. Instead its burned. This happens despite forest protection efforts.	Too much deadwood is used for biomass utilization. There are difficulties in finding a compromise between forest protection and renewable energies.
Taxation in the energy sector	The taxation in the energy sector can be considered a failure. Corporations can be forced to tax their produced power two times, if they need to conduct power temporally into the (internal) network.	The double taxation is a serious issue and punishes corporations.
EEG apportionment	The EEG apportionment is a failure, at least for the population, which must bear most of the costs. Most energy intensive corporations are exempt from the	The population must pay for the industry, which is an unjust distribution of costs.

	apportionment. Reason for that is the avoidance of additional costs for the industry. Its successful regarding the generation of funds for the promotion of the energy revolution.	
Rainwater and usage fees	There are fees on equipment needed for rainwater usage. This hinders the private usage of rainwater.	These fees seem completely unnecessary and hinder rainwater usage.
Less protection for trees and forests in e.g. Berlin	The protection measures and regulations for trees were reduced in 2004 in e.g. Berlin. Less tree species´ are protected.	This goes directly against the efforts regarding the protection of forests.
Allocation process of subsidies in the agriculture sector	The subsidies for the agriculture sector are fine. The same cannot be said about the often-changing allocation process. Farmers and authorities have problems adjusting to the changes, especially since the allocation process is much more complicated than it needs to be.	Regularly changing the allocation process is a problem. The same can be said about the complexity of the process.
Biofuels and land usage	The promotion of biofuels can be considered questionable regarding the achievement of secured food production. Areas formerly used to produce food is needed for the cultivation of plants intended for biofuels.	The relation of biofuels and agriculture must be considered, if negative consequences should be avoided.
Biofuels and water usage	The promotion of biofuels can be considered questionable regarding the achievement of reduced water usage.	The promotion of biofuels must be done under consideration for water related NCOs.
Drainage and soil wetness	The drainage of moor areas led to only shortly fertile areas. The same areas are often confronted with soil wetness, which is a source of concern for residents. Basements are under risk of rotting due to the intrusion of water.	This leads to social e.g. financial problems for the affected population. Support can be inadequate.
No support for greening	Greening cities isn't adequate supported and not deemed important enough to promote it in any significant way. It could	The lack of greening promotion is a sign for inadequate efforts.

	help reduce the status of cities as heat islands and support the water cycle.	
Laws in general	The laws regarding the different sectors are often the problem. There are too many exceptions and unnecessary hindrances. This makes the achievement of NCOs more difficult than it needs to be.	Exceptions that hinder the achievement of NCOs must be reduced. The same is valid for other hindrances e.g. fees.
Solar energy efficiency	The energy efficiency of solar energy is a highly discussed topic. The production of solar energy plants needs a high amount of energy. The demand for land is also high since the efficiency of energy conversion is still quite low.	The installation of solar energy plants as ample solar parks is most likely not an option (see “Land use and solar energy” below). The other option, the installation on buildings, is more compatible with land use, food and environment NCOs.
Land use and solar energy	While not really a failure, the land needed to produce solar energy is most of the time acquired to the disadvantage of agriculture areas. There are limits on how much agriculture areas can be reduced.	The change of land use must be observed and can’t be done lightly without thinking about possible consequences. The loss of agriculture areas could be a problem in the future.
Land use and wind energy	While not really a failure, the land needed to produce wind energy is most of the time acquired to the disadvantage of agriculture areas. The issue is not as grave as it is the case to produce solar energy.	The change of land use must be observed and can’t be done lightly without thinking about possible consequences. The loss of agriculture areas could be a problem in the future.
Noise and wind energy	Not really a failure more a general problem. Wind energy plants produce noise, which is a problem for nearby living people.	Noise production must be considered in planning wind energy plants and their location.
Wind energy and wildlife	Not really a failure more a general problem. Wind energy plants are a risk factor for birds.	This must be considered since it influences animal protection.
Lignite mining in Eastern Germany	The policy itself isn’t a failure, but the decision to further use lignite is, since it goes directly against the energy, land use and climate NCOs and policies.	Obstruction of own policies regarding energy, land use and climate.
Emission rights	The emission rights are far too	The extensive issue of additional

	cheap to actively "force" corporations to reduce their emissions. Their use is limited.	rights must be stopped, since it reduces the price of emission rights too much to still be relevant.

Description of the success stories and success factors in the case study area

The success of policies depends on common interests of the involved parties. Policies are much more likely to be successful, if all parties have a benefit from adherence to the regulations and objectives. Regulations must be controlled and enforced, or they could as well not exist at all. Even policies, which fulfilled their objective, can be considered failures, if the methods and objectives were inadequate to begin with.

Description of the failures and failure factors in the case study area. Failures are often a result of negligence, since the needs and objectives of other sectors are often not appropriately considered. Another problem is the lacking willingness of policy makers to fully commit to a policy change, sometimes out of concern for the economy. The interests of the economy and big corporations are often held in higher regard than the achievement of e.g. climate policy goals. This leads to a significant amount of exceptions (EEG apportionment) and only inadequate support for many possible policies. Policies are often not an actual failure, since the objectives were achieved, but can still be considered one because the objectives and the measures taken to achieve them were inadequate to begin with.

Reporting of the validation of assessment done with stakeholders

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Germany-Czech Republic-Slovakia transboundary case study
Policy analysis
SLOVAKIA

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Executive summary

The main objective of this report is mapping of the nexus related policy in transboundary region of Germany, Czech Republic and Slovakia. This report is mapping the nexus related policy in the Slovak Republic. Focus issues introduce the inherited problems resulting from both past landscape adaptations and current land management. All three states experienced a common period of industrialisation of agricultural lands by collectivization, causing increased field block areas and massive drainage; the ramified hydrological web of the agricultural landscape disappeared. Therefore the main issue is floods and drought mitigation, which is related to landscape structure adaptations, changing agriculture practices and soil quality improvement.

The policy review is aimed mainly at the agriculture, water and landscape management issues, soil protection, climate change mitigation, renewable energy. In this context we have reviewed number of laws, strategies, government decisions, decrees, orders, action plans, etc. Socio-economic aspect complete the report about social issues which have significantly influenced the landscape quality and indicates the current impacts of Common agriculture policy on Nexus related issues, as well as the joint topic of renewable resources. Stakeholders list complete the report on the subjects that may be potentially involved/interested in Nexus concept, or may contribute with their expertise, knowledge, demands.

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1 Identification of the focus issues and related policy sectors for the case study

1.1. Basic Hydrological Characteristic of Slovakia

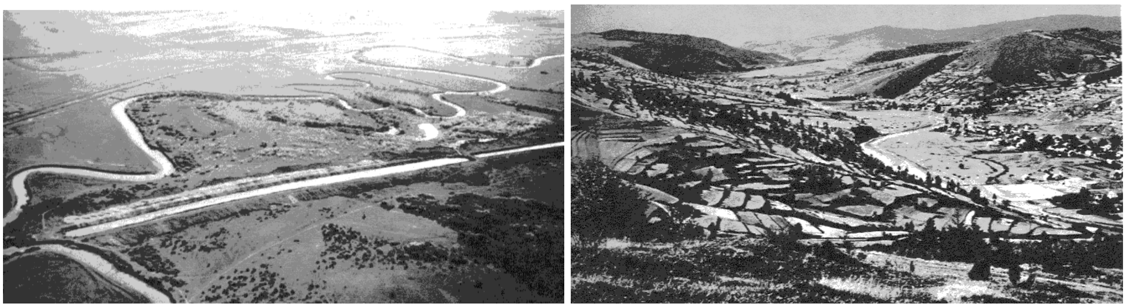
The Slovak republic is a small country in the Central Europe with a total area of 49041 km2. Slovakia is a typical country, the waters flow from here to the north into the Baltic Sea from the Poprad river basin (2080 km2) and in the south into the Black Sea from all other river basins (tributaries of the Danube) with the total area of 46.961 km2. Slovakia has the following basic river basins: Bodrog, Hornád, Bodva, Slaná, Ipeľ, Hron, Nitra, Váh, Morava and Poprad.
The highest point in Slovakia is Gerlachovský peak (the High Tatras – Poprad river basin), with an altitude of 2655 m above sea level and the lowest point is Streda nad Bodrogom (East-Slovakian Lowland – Bodrog river basin). Slovakia lies in the temperate climate zone with expressive changes of four seasons. The coldest month is January and the hottest July. Rainfall yield ranges from 450 mm (South-Eastern part of Slovakia) to 1500 mm (mountainous regions of the High Tatras). Snow fall creates approximately 20% of the annual total. The least rainfall is in January and February and the most from May to July. Approximately 34,3 billion m^3 of rainfall falls on Slovakia annually. Approximately 35% of water flows away from Slovakia to the sea, it means ca 12 billion m^3 flows into the sea and 22,3 billion m^3 stays in the country in small water cycles. This water participates in a small circulation of water in natural ecosystems, it means that it evaporates from the country, it creates water streams and it comes back in the form of rainfall onto the land.

Figure 1 Slovak river basins

	Slovak River basins	Area [km²]	Rainfall [mm]	Outflow [mm]	Difference of rainfall and outflow [mm]
1	Poprad	1.889,21	819	429	390
2	Bodrog	11.355,80	-	306	-
3	Hornad	4.346,31	710	234	479
4	Bodva	890,37	693	194	499
5	Slana	3.198,52	744	207	537
6	Ipel	5.151,04	-	129	-
7	Hron	5.464,56	805	323	482
8	Nitra	5.140,59	665	148	517
9	Vah	10.641,40	926	451	475
10	Morava	2.470,15	-	142	-
11	Dunaj	2.634,28	-	-	-

Note: The areas of the river basins of Bodrog, Ipel, Morava and Danube include the areas of the river basins outside Slovakia and therefore the data about rainfall are not available.
Water which flows away to the sea, comes back to the land as a part of a great water circulation. It condenses above the continent together with evaporated water and it comes back in the form of rain and snow into the natural ecosystems where it replenishes water supplies in the country, and it feeds the springs and rivers. All water in springs, creeks and rivers in Slovakia is originally from rainfall activity and the network of creeks and rivers corresponds to the natural hydrological characteristics of the individual micro-river basins and river basins. The total length of water streams in Slovakia is more than 44.000 km.

1.2. Basic Economic Characteristic of Slovakia

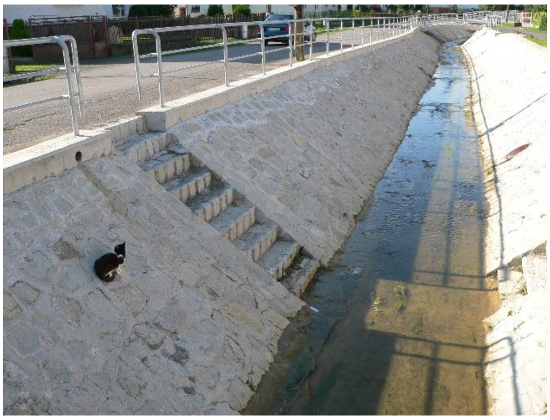


Slovakia is an extensive industrially weakly developed agricultural state with significantly scattered structure of settlement in the river valleys. Historically the settlements naturally developed in dependence on sufficient quantity of natural resources (soil, water, forests). The communist regime after the 2nd World War significantly strengthened the centralized economic structure of the state which was subsequently shown in new forms of economic activities. Typical forest-agrarian scattered landscape structure was industrialized, it was shown in the way of economy in individual areas of water basins. In forest economy, it was shown as transition to clear cutting of forests. In agricultural landscape, it was shown as transition from small peasant proprietors to large scale industrially ploughed land forms of agriculture. It caused a radical change of landscape structure. Original scattered agricultural country with typical Slovak small terrace fields with the area of several acres (0,08-0,20 hectares) was changed by socialist collectivization of agriculture into a great-ploughed land industrial-agricultural country with the area of several tens of hectares (50-200 ha).

Large scale drainage of wetlands, canalization of agricultural landscape and large scale destruction of balks, bogs and groups of trees were accompanying phenomena of the industrialization of the agricultural landscape. Big drainage programs were worked out. The biggest project was the drainage of the East-Slovakian Lowland where more than 100,000 ha of soil were drained and more than 2.000 km of drainage canals were built.

Figure 2 Agricultural soil marked with collectivization – combining of lands and liquidation of balks – Cadaster of Svinka village, district Sabinov and Rozhanovce, district Košice (may 2017)

Projects of water stream canalization, construction of anti-flood dikes and dams were performed in water economy. More than 3 800 km of water streams were canalized. The earth's surface in urbanized areas was roofed, concreted and canalized. The earth´s surface was asphalted and canalized also in the construction of infrastructure (pavements, roads, car parks, motorways). It is a paradox that in the past, water resources were directly in the territory of bigger settlements. At present, water resources for the towns are led by pipelines from the distance of several tens of km. Therefore it is suitable to quantify how these economical activities were shown in a hydrological regime, what changes happened and what follows from it for the future. The question also arises if the results from Slovakia can be generalized to a global level. Planed analyses do not aim to answer all the questions.



The objective is to offer the reader an image of the possible influences of our agricultural activities to water liquidation in space and time. We also want to remark, that it comes in parallel with plenty of other problems (drying, decrease of natural productive potential, loss of biodiversity, climatic changes). It is necessary to try to quantify the causes for the needs of strategic solutions of water economy problems.
If to do so, we have to determine causes of hydrological changes, we should generalize the results. Beforehand it is necessary to answer a lot of questions and present schematic approaches for the quantification of analytical hypotheses do not suffice for the solution of economic, social, cultural and environmental problems in Slovakia. Therefore we submit in this chapter partial results of economic activity influence in river basins on the hydrological characteristic of rivers.

1.3. Consequences of Economical Activities in the River Basins on the Hydrological Cycle

1.3.1. Influence of clear-cutting in the forests

Important changes of stream hydrology through the influence of wood clear cutting has occurred in the last 50 years of industrial economy in the forests. A way of timber cutting came out of the principle of industrial exploitation and it tried to concentrate timber felling from the areas with a cutting period of 80 to 100 years. The total exploitation of the timber in strips on the inclining line caused a lot of negative phenomena (erosion, quick rainfall runoff, decrease of evaporation, wetting with frequent loss of slope stability and subsequent landslides). The result is a decrease of evaporation by more than 100 mm in mountainous areas.

Figure 3 Deforested forest stands on the slopes of the Carpathian mountain range (Levoča moutains 2010, White Carpatians (July 2011) due to timber felling.

Forest stands in Slovakia cover approximately 41 % of the territory. Economical forests create more than 70% of the total forest area 19.800 km^2 (1.980.000 ha). 1% of forest stands was felled annually during an 80-year cutting period. In the Slovak Republic there are about 38 000 km of registered forest roads. The number of unregistered roads (approach lines for wood transport) is about 2-3 times greater. This transport infrastructure has been collecting rain water and diverting it into gorges, from where it is transported through small valleys into the main valley, often contributing to local floods.
Slovakia witnessed three waves of extreme floods in 2010, and it was estimated that forest roads transported to the valleys more than 80 million m3 of rainwater. From a long-term perspective, permanent outflow of rainwater contributes to forest drought, which contributes to the spread of pests. The extent of

forest damage in the Slovak Republic over the last decade is extensive and the original wind calamities have been replaced by calamities.
The cause of this disruption is a sectoral approach to the technical solution of the transport infrastructure. Planning of forest roads in Slovakia is highly oriented towards their protection against erosion. There is no water protection and effort to keep rainwater in forest ecosystems. In Slovakia, the opinion in professional circles prevails that periodic drying of small watercourses and springs in the forests of the Slovak Republic is the reason why we need to build water reservoirs as one of the serious measures against climate change. Serious and systemic changes in forest management in the Slovak Republic are needed. Instead, marginal and ineffective measures are adopted. For example, the issue of a new decree (approved in October 2017) to support non-productive forest functions through close-to-nature forest management. The Decree foresee the assessment of the timeliness and quality of the intervention, and the successful interventions will be rewarded after 5 years will be compensated financially. An investment to implement this decree is 2 million Euro. Forest managers are not motivated to join the program because the compensation is to far delayed in the future.
A system solution would be, for example, that forest owners would be able to produce water for the needs of supplying the population with good water. Such an integrated type of measures would stop forest drying throughout the Slovak Republic, as many forest managers would in addition to the economic use of the forest also focus on water production, thereby improving water protection functions of forests, while not creating new water reservoirs recommended by the economic analysis of the impact of climate change on water scarcity in Slovakia. The forests would be healthier, there would be fewer floods, the pressure on intensive extraction of timber would be reduced and it would be cheaper with the support of the local economy.

1.3.2. Vitality of forest Ecosystems

One of the biggest injuries to water retention in the environment is industrial activity which worsens the health of forest ecosystems and decisively influences water accumulation in the river basins. In Slovakia, the health of forest ecosystems is classified into 5 degrees of damage. 22,1% of them are not damaged. 45,4% are slightly damaged, 29,4% are medium damaged, 2,8% are strongly damaged and 0,3% are dying or died back forest stands. Analysis of a hydrological cycle in areas with the greatest industrial activity in the river basins confirms this. In the river basin of the Slaná river (magnesite industry in Jelšava), maximum flood stages increased almost by 80%. It means that high water stages occur more frequently and with higher flood discharges.
These negative changes are incomparably higher in these river basins than in the other Slovak river basins where the industrial activity is significantly lower. If, in all modesty, we come out of the assumption that strongly damaged and dying forests belong to the category with increased annual runoff of rain water. The worsened quality of forest stands by the influence of industry will cause the loss of more than 700 million m^3 from a small hydrological cycle. It can be supposed that damaged and dead forests cause increased runoff of rainwater of more than 100 mm.

Figure 4 Demaged Forests by Bark beetle (Low Tatras National Park–2010) and by industry (Krompachy 1999)

1.3.3. Consequences of agricultural landscape industrialization

Scattered landscape structure of agricultural country in the past was due to proprietary relations. The size of the fields reached ca 0,12 hectare. After collectivization, with the creation of agricultural cooperatives, a radical change of landscape structure was made. Lots commonly exceeding 100 hectares were formed bz collectivization from originally significantly diversified landscape structure. The size of the lots was increased almost 1.000-times. The original terrace-like, significantly diversified agricultural country was changed into a great ploughed mono-structural country.

It resulted in a change of hydrological regime of agricultural landscape. Runoff of rainwater became many times faster from micro-river basins in the agricultural landscape. The greater speed of rain water runoff from micro-river basins decreases the ability to replenish groundwater supply and on the other hand, it causes extreme occurrence of areal water erosion.

We are often witnesses of marked overland flows of arable soil, mainly in the period of high intensity rainfall. Flood discharge increased in some cases 3- to 4-times at the same rainfall. In the 90-ties we were often witnesses of the floods on small river basins – with great damage on agricultural landscape where the floods did not occur in the past.

In Slovakia there are 2.443.604 ha of agricultural soil, out of which only 1.469.171 ha are arable soil (percentage of ploughing is only 60,12%). Permanent grass stands are on the area of 848. 189 ha. Other soils are vineyards (28.077 ha), hop-fields (1.031 ha), gardens (77.819 ha) and fruit orchards (10.017 ha).

Every year, there is 500 ha of agricultural soils less due to the influence of building and the construction of motorways. Areal water erosion belongs among the most widespread of soil degradation in Slovakia. The most endangered arable soils are in the hills, mountainous and foothill areas in the range of 38,4% (458.081 ha), practically ca 65% of soils are endangered, what is more than 1.000.000 ha are endangered by areal water erosion. Land collectivisation was made exactly on these soils during socialist agricultural industrialization, any barriers (terraces, groups of trees, bogs) were destroyed, which created conditions for higher rain water runoff and for areal water erosion. Practically all arable soils in Slovakia are endangered, except for arable soils in plain and lowland areas. The change of landscape structure in the range of 1 mil hectares of agricultural soil causes a decrease of water sources in the river basins. Such an estimate may cast doubts on the quality of the results. The aim is to unveil the connections of drying out. More accurate results, as well as the influence of other interferences into the landscape which decrease water supply, should be a subject of research assignments, but nobody undertakes them.

1.3.4. Consequences of non-investment policy in agriculture

Non-investment policy in agriculture (use of heavy mechanisms when tilling soil as well as agriculture industrialization) is a further negative factor. The soils are extremely compacted and so the absorption ability of soils decreases and the infiltration of rain water under ground is limited too. This situation supports the increased surface runoff from the river basin and subsequent drying of agricultural landscape with a long-term increase of earth surface temperature. E.g. for the last 20 years temperatures in summer months (July, August) have increased.

The East-Slovak lowland has been intensively drained since 1960. Between 1900 to 1970 the average temperatures in The East-Slovak Lowland did not change in the long term. This average temperature does not reflect temperature variation e.g. between day and night. It is well-known that a dried up surface is subject to temperature variation both during the day and the whole year. It follows from this that temperatures at the climax of the day increase in the long-term and at night decrease in the long-term.

1.3.5. Consequences of investment policy in agriculture

The program of collectivization of the agricultural landscape had also other very negative impacts on the hydrological regime. It is presented by construction of drainage systems on the soils which were considered to be continuously or periodically swamped or flooded. In the 60-ties a drainage program was started in the whole country. A lot of money was invested into this program and nearly 40% of agricultural soil was drained.

All this was made for the reason of intensification of agricultural mass production. From more than 500 thousand hectares of drained agricultural soil, 125 mil. m^3 of water is lost annually. This water stayed in the landscape in the past and it participated in water circulation in natural ecosystems. So the water resources in agricultural landscape will decrease by 5 billion m^3 within a period of 60 years. If we convert it to the discharge, it is more than a respectable $4m^3/s$ and in areal expression it is 1 m high water column from drained agricultural lands.

It is interesting to compare it with the volume capacity of constructed reservoirs in Slovakia, the capacity amounts today to ca 2,8 billion m^3. It means that the constructed volume capacity does not cover even 56% of water loss caused by investment policy of drainage of agricultural soils in Slovakia. The waters which have flown away to the seas, participated in the past in the hydrological cycle. It means that they got into the air, evaporating from the plants and soils and so they helped with creation of rainfall.

1.3.6. Consequences of technical interference with water streams

The canalization of water streams is one of the serious problems of the worsening quality and quantity of water in streams and in the adjacent alluvial plain ecosystems. It quickens the runoff of water from the river bed (smooth river beds) and decreases water quality in the streams because self-purification processes in the river beds of canalized rivers were damaged.

Figure 5 “Necks” of regulated streams in settlement agglomeration – the town of Prešov

It was for that time the simplest image of mathematical expression of water movement in the river bed (the time being neglected). The image did not give the possibility of real expression of transition of flood waves in the river beds. Regulations of the river beds were therefore proposed in such a way, that a discharge e.g. with probability of occurrence once in 100 years (according to the statistic expression) flew in the bed constantly all time. In Slovakia, there is more than 8.000 km of regulated river beds out of 44.000 km of the entire river network.

It is necessary to remark that regulation of the river beds was proposed on the basis of the theory of steady flow of water in the stream (speed field and oscillation of the levels do not change or change a little). At these theoretical assumptions, the flow is considered to be steady and roughness of the bed has an expressive influence on pouring of water out of the bed. The increase of roughness in the bed causes a slowing down of the speed and so also a rise of the level, and at low stages it is positive for more reasons.

Flood states occur only in a period of intensive rains, or in a period of the melting of snow after the winter period. Then the speeds in the river bed significantly change. The problem is the unsteady flowing of water in the bed. Using dynamic numeric models which describe transition of a flood wave in space and time, it is shown that the roughness of the bed does not have a decisive influence on the water table regime. A rough

bed has an influence on the flattening of discharge during the flood, that is positive. A longer period of higher water stages has a positive influence on the completion of water reserves in riparian alluvia,and at the same time speeds of water flow in the river bed are lower by which erosion processes in the river bed decrease.
The use of dynamic numeric models for level regime modelling in the streams gives good assumptions for the start of ecological programs of technical interference in water streams (it does not allow liquidation of meanders, it does not support straightening of the streams, it does not allow to pursue costly investment programs of stream regulation for any reason).
The Gabcikovo water work is the most expressive impact into the river bed in Slovakia, mainly it is the construction of the derivation canal that diverts Danube waters from Hrušovský reservoir to hydro-electric power station in Gabcikovo. It can be seen from hydrological observations (see the following Table) that Danube waters periodically infiltered in the underground between Bratislava and Gabčíkovo at periods of high water stages and they returned back at low water stages (natural accumulation underground positively influences flattening of flood wave on the Danube).

Profile	Area of Watershed	Q_{max} for observ. period	Q_{min} for observ.period
	km^2	m^3/s	m^3/s
Bratislava	131 331,10	10 400	570
Gabcikovo	171 625,50	8 290	660

Table 1 Comparison of maximum and minimum occurrence of discharges in two water-measuring profiles on the Danube river

Those were the most quality water resources on Zitny Island on both sides of the Danube. At low stages, the water returned to the Danube 10 – 40 m^3/s. It is not valid now because of Hrusov Reservoir and the 22 km long derivation canal totally changed the hydrology of the groundwaters.

1.3.7. Consequences of Water Reservoir Construction

The construction of water reservoirs in Slovakia is specific because the whole water economic policy is technically oriented to water and water resources. The decisive situation of the dams in water economy politics in Slovakia needs evaluationof this strategy from several standpoints (economical, social, environmental).
The most serious changes of the river ecosystem are due to the influence of the dams. Construction of dams changes bed-forming discharges that were shaping the river beds for hundreds of years. Not a less serious influence of the dams is on the environment – the dams cause creation of e.g. rain shadows in the surroundings of the dams.

Figure 6 *Water dams (drouth and waste)*

1.3.8. Influence on the river ecosystems

Interrupting of the continuity of levels and discharges in the river ecosystem causes the following negative phenomena:

- change of discharges by means of water accumulation in the dam changes the denudation regime. Grain structure of the bottom is changed which can have a negative impact on fauna and flora in the river ecosystem. It is especially sensitive in protected landscape areas, e..g. in the national parks. A sad example may be the water works at Czorsztyn-Niedzica on the river Dunajec on the border of PIENAP (Pieniny National Park). The dam was filled in 1994-96 and the first negative signs have already been shown. The originally clean river with a gravel bottom is changing into a river with a coating of weeds on the bottom and so the color of the bottom is changing. The Dunajec is a gravel-bearing river with a periodical dynamic movement of the gravels in the river bed. Washing of gravels has been stopped by the construction of the water works. It is especially unpleasant because the Dunajec is a part of The National Park PIENAP and it also belongs to a significant recreational zone for tourists.

- Not only the abiotic part of the river ecosystem, but also the biotic components are changed by an interruption of the river continuity caused by the construction of water works on the rivers. Migrating water animals are prevented from migrating along routes which existed before dam construction. It comes to a degradation of mainly fish population.
- Analyses of rainfall balance changes in Slovakia and their spacial distribution confirm that rain shadows occur in the area of the dams. For instance, in Zemplin area there is a trend of 30 – 70 mm decrease in rainfall in this century (it increases from the north to the south). But in Michalovce and Sobrance, the decrease is up to 150 – 170 mm. Similar results are also in the area of Liptov and Orava. In the north of Slovakia a trend of rainfall increase can be observed (we will describe the causes of the changes later). In contrary, in the surroundings of Liptov and Orava damsa trend of rainfall decrease can be observed.

1.3.9. Influence of Urbanization on the Hydrological Cycle

Interesting analyses were performed in the area of Prešov. It follows from them that urbanization of the surroundings (environment) has had an immensely serious impact on the decrease of water resource supplies in the river beds. Roofing, asphalting, concreting and canalizing of the surface of urbanized areas in the territory of the towns causes radical increase of rain water runoff. E.g. increase of rainfall runoff in the area of Prešov exceeded 7 mil.m3 a year for the last 50 years. Problem is that the population concentration in the Prešov area caused the building of concrete habitations and associated services. Dense built-up space of blocks of flats with access roads, pavements, car parks and shopping areas caused an increase in rain water runoff from 34% at more than 70%. In volume terms, it is the runoff of water from 1 m2 of area from the natural state of 230 l to 460 l every year! If it happens in great areas, it comes to an annual limitation of replenishing of soil and groundwater in great volumes.
There are three distinctive negative impacts in Prešov case that are known to us: The negative impact on quality of waters in Torysa Basin (in the past, the town of Prešov was provided with water from the wells within its own area). Preventing groundwater storage through natural infiltration slows down the groundwater flow and its regular exchange and so it comes to worsening of groundwater quality and the subsequent setting off of the wells for drinking water. It caused increased claims of the town of Prešov to new water resources from the East-Slovak Region. Historical settlements originated directly in the places where there was enough water. E.g., along the Torysa river the size of settlements naturally increases. The extremely unnatural increase in the size of a settlement causes plenty of negative phenomena, which are very dangerous from the point of view of the environment and are economically immensely.

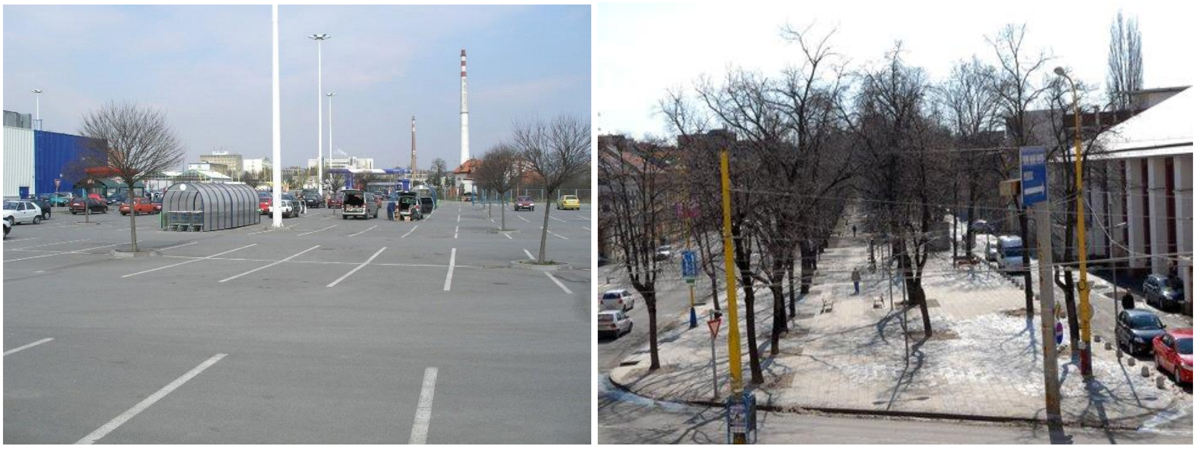


Figure 7 Concreted earth surface in urbanized cities

1.3.10. Influence of Infrastructure (roads, motorways) on drying (drainage)

If in Slovakia there are e.g. 20 000 km of roads with an average width of 10 m, then 46 million m^3 of water will run off Slovakian land from these roads irretrievably every year, (average rainfall 700 mm and at increase of runoff from 38% to 70% from fallen rain). When we express this as a river discharge, the result is 1,46 m^3/s. During 60 years of such conditions, ca 2,300 billion m^3 of rain water will run off this land which in the past participated in a small hydrological cycle. In cases of extreme flood rains, the flood discharge increases by more than 2000 m^3/s.

Figure 8 Construction of impermeable surfaces of asphalt roads quickens rain water runoff

The figures given are an aid to us so that we could imagine what a man can do with water and what changes might happen by changing the runoff characteristics of rainfall waters. This notice does not want to reach negative evaluation of road construction influence, it just wants to remark what consequences may happen and that it is inevitable to seek solutions. Slovakia is urbanized, approximatelyin area of 1% (roofs, pavements, car parks, roads, motorways, and other impermeable surfaces). This means that water resource supplies decrease in volume by more than 100 million m^3 every year. Within 40 years the water resource supplies will decrease by more than 4 billion m^3

1.3.11. Total Range of Decrease of Water Resource Supplies in Slovakia

In the following table the results of individual economic activities leading to river basin drainage and decrease in water resource supplies in Slovakia are presented. It is obvious from the results that all economic activities drain the river basins. Areal decrease of water resource supplies exceeds more than 125 million m^3 water. About 2,80 billion m^3 were retained by construction of water retention structures in Slovakia. The percentage is informative.
It is obvious from the Table that the greatest interference with the structure of the landscape is the drainage of agricultural land and urban areas. The influence of agriculture is greater than 50 % of the total drainage. Urbanization has also very negative impact on drainage and it exceeds 25%. Clear cutting of forestscontributes 13,2% of the total drainage. The increase in the water-retention capacity of the land by means of water reservoir construction is only 20% from the total capacity of lost water from Slovakia.

Table 2 Interference with the structure of the landscape

Kind of economic activity	Decrease of water resource supplies in the river basins in m^3	Ratio in %	Increase of water resource supplies in the river basins in m^3
Influence of clear-cutting in the forests	- 1 980 000 000	13,20	
Health state of forest ecosystems	- 700 000 000	4,67	
Consequences of collectivization of agricultural landscape	- 2 500 000 000	16,67	
Consequences of non-investment policy in agriculture	- 500 000 000	3,33	
Consequences of investment policy in agriculture	- 5 000 000 000	33,33	
Consequences of technical interference to water	-320 000 000	2,13	

streams			
Consequences of construction of water reservoirs			+2 800 000 000
Influence of urbanization on hydrological cycle	- 4 000 000 000	26,67	
Total	-15 000 000 000	100%	+2 800 000 000

It came to a large scale decrease of water resource supplies in natural ecosystems by means of economic activities. If the conception were built only on water reservoir construction, then it would be necessary to create accumulative volumes of ca 15 mld.m^3. By that the water economic industry in Slovakia would need 5-times more funds than in the distant and recent past when the funds were obtained from the state budget.
We will see that this reflection is not healthy because water is not only a physical substance accumulated in certain point in the reservoirs. If the hydrological cycle is disturbed, then also the regime of the water reservoirs built by the water economic industry will be disturbed.
On one hand we cause the drainage of river basins and the loss of water resources, and on the other hand we call out for more frequent occurrence of floods, so far unknown natural disasters and extreme rains. If we can influence rainfall activity with our thoughtless steps, then we can even cause such a state that it will stop raining at all. It is obvious that these changes are coming. There has been a change of rainfall distribution in Slovakia. Simply said, there is more rain in mountainous regions and less rain in the lowlands than it was in the past. This phenomenon is shown not only in Slovakia, but also in other areas of the Blue Planet.

Figure 9 Demaged landscape and local floods
Results from the questionnaire is aimed at gaining feedback from stakeholders (representatives of state administration, entrepreneurs, local authorities, experts, water managers, associations and civic associations), perceiving the context of the reality of climate change and removing the problems that arise in strategic decision making.

2 Mapping of stakeholders

- Strategy for the protection, use and management of water resources, water and climate policy.

Responsible by Ministry of Environment

- **Water management section of Environment Ministry -** flood protection, quality and quantity protection of waters and their rational use and fisheries, excluding aquaculture and sea fishing,
- Climate and air protection section of Environment Ministry - air, ozone layer and climate system

- Research, development for strategic decision making
- **The Water Research Institute** (Ministry of Environment) provides comprehensive scientific water management research. The Institute carries out conceptual, legislative, methodical, development, expertise, normalization, educational, publishing. It provides consultancy in the field of water management and water-ecological problems, long-term prospects of water development. The Institute is the highest methodological center for water quality control and expert assessment of water treatment and treatment activities. responsible:
- Strategy and implementation of the Water Framework Directive
- Water plan of Slovakia
- River Basin Plans
- Flood risk plans
- Water monitoring
- Plans for sewerage and water supply
- Plans to exploit the hydro-energetic potential of watercourses
- **The Slovak Hydrometeorological Institute (SHMÚ)** (Ministry of Environment) is a specialized organization performing hydrological and meteorological service at national and international level. The SHMU monitors quantitative and qualitative parameters of the state of air and water in the Slovak Republic, gathers, verifies, evaluates, archives and interprets data and information on status and air and water regime, describes atmosphere and hydrosphere, forms and issues meteorological and hydrological forecasts, alerts and information.
- **The Institute of Hydrology of the Slovak Academy of Sciences** (ÚH SAV – Ministry of Education, Science, Research and Sports of Slovak Republic) transforms the knowledge from individual parts of the world hydrology into our conditions and acquires original knowledge about the characteristics of the hydrological cycle in the conditions of the Slovak rivers. By generalizing and publishing research findings, the Institute contributes to the development of hydrology as a science. Problem solving is focused on the interaction between surface, ground and groundwater in their time and space.
- Water resources management
- In the Ministry of environment
- **Slovak Water Management Company** - management of all watercourses on the territory of the Slovak Republic outside State forests of the Slovak Republic and outside of some small watercourses, which are managed by municipalities and municipalities and significant watercourses in the Slovak forest area where commercial water resources are used. Responsible for implementation of:
- River Basin Plans
- Flood risk plans
- In the Ministry of Agriculture
- **State forests of the Slovak Republi**c - management of small water courses on the territory of forests in the Slovak Republic, except water-related significant watercourses
- **State Forest of the Tatra National Park** - Administration of Small Watercourses in the Tatra National Park
- **Hydromeliorace š.p.** - management of hydromelioration facilities in agricultural and urban areas
- **Municipalities** - management of some small watercourses and some parts of urban areas
- In the Ministry of Defense of the Slovak Republic
- **The Military forests of the Slovak Republic** - management of watercourses in the territory of the military forests of the Slovak Republic
- Investments in water management

- In The Ministry of Environment
- **Vodohospodárska výstavba š.p.** - State Water management investment company
- Use of water resources
- For the supply of cities and towns, established joint stock companies, which are shareholders of cities and municipalities - the responsibility for distributing water from the source to the customers
- BVS - Bratislavská vodárenská spoločnosť, a.s.
- TAVOS - Trnavská vodárenská spoločnosť, a.s.
- ZSVS - Západoslovenská vodárenská spoločnosť, a.s.
- OVS - Oravská vodárenská spoločnosť a. with.
- TVS - Trenčianska vodohospodárska spoločnosť, a.s.
- POVS - Považská vodárenská spoločnosť, a.s.
- TURVOD - Turčianska vodárenská spoločnosť, a.s.
- VSR - Vodárenská spoločnosť Ružomberok, a.s.
- LVS - Liptovská vodárenská spoločnosť, a.s.
- PVPS - Podtatranská vodárenská prevádzka spoločnosť, a.s.
- STVPS - Stredoslovenská vodárenská prevádzková spoločnost, a.s.
- KOMVAK – Komarňanske vodárne a kanalizázácie, a.s.
- SEVAK - Severoslovenské vodárne a kanalizace, a.s.
- VVS - Východoslovenská vodárenská spoločnosť, a.s.

- Education, expert advice and expertise for the management, use and protection of water resources
- Ministry of Environment SR
- Slovak Environmental Agency
- Slovak Environmental Inspection
- Ministry of Agriculture SR
- Institute for Education and Training of Forestry and Water Management Workers of the Slovak Republic
- Ministry of Education, Science, Research and Sport of Slovak Republic
- **Department of Water Management of the Landscape - STU Faculty of Civil Engineering** provides teaching, postgraduate education, research and expertise in the field of landscape engineering and landscape water management. In the pedagogical and scientific-research area, the Department is active mainly in the fields of hydrology and water management, hydropedology, hydrometeorology, irrigation and drainage, treatment and revitalization of streams, erosion and landscape protection, landscape ecology, river basin management, ponds and small water reservoirs, information systems in landscape engineering
- **Faculty of Horticulture and Landscape Engineering The Slovak University of Agriculture Nitra** focuses primarily on the education of professionals focused on gardening, fruit growing, viticulture, vegetable and floriculture, designing garden and park treatments, green restoration and maintenance, landscape planning and creation, water, air, landscaping, waste management, construction and rural renewal.
- Department of Landscape Ecology of the Faculty of Natural Sciences of Comenius University Bratislava
- **The Institute of Ecological and Experimental Architecture** has a central role in architectural design in terms of environmental and ecological principles, it deals with architectural and environmental relations. This also involves the use of alternative building technologies and alternative building materials. These components are taught on individual subject areas of the institute.
- Professional Associations
- **The Association of Employers in Water Management in Slovakia** is an independent, non-profit, voluntary, interest organization that brings together legal and natural persons employing the employment of employees in the water industry in Slovakia.
- **Associations of water companies associating businesses** active in the field of providing water management activities related to the operation of public water mains and public sewers, promotion and application of the qualified professional requirements of members of the Association, association of experts from members of the Association to provide expert, advisory and consulting services in the field of water management activities.

- **Trade Union WOOD, FORESTS, WATERS The Trade Union WOOD, FORESTS, WATERS** (hereinafter referred to as "OZ WFW" or "Trade Union") is an open, independent and voluntary organization of citizens who work or worked in the wood, water management and other sectors
- Slovak Fisherman Association
- Greenpeace, Living River, People and Water, Sosna, Forest protection Association VOLF, Ekopolis Foundation, Bratislava Protect Association, Slovak Society for Sustainable Life, Carpathian Foundation - Non-profit Organizations, association and Foundation - Spread organizations of different types and different interests that no one takes seriously, or no one accepts them competently, but they are often used to create civic participation

Forest owners (2 014 731 ha - **41** % of land cover in Slovak Republic): state (40,58%), municipalities 9,95%, church associations 3,46%, association of owners 24,76, other private owners 21,25 %.
The highest representation is forest beech (33.2%), spruce common (23.4%) and oak summer and winter (10.6%). Leafy woody plants predominate with 62.2%. The share of coniferous trees is decreasing; this is particularly evident in the spruce, which has decreased by 2.9% as a result of the impact of harmful agents since 2005.
The real cooperation may be established with:

- Ministry of Agriculture – interest in drought mitigation strategies
- Regional Offices
- Slovak water management company, State public enterprise - cooperation in the field of spatial water retention in landscape

Ministry of Environment		
Stakeholder´s role	Strong power in policy decision and legislation; responsible for strategies and acts (climate, water)	Public stakeholder responsible for environmental, water and climate policy
Stakeholder´s interests	Water	The universal objective of the national water management policy is to create conditions for integrated water management, flood protection and water sources creation in the Slovak Republic. The key principles of the water management policy are derived from the EU Water Framework Directive, other water management directives and the renewed EU Sustainable Development Strategy. The Water Protection Department of the Ministry of the Environment is the central water management authority in particular with respect to the following issues: • conservation of quantity and quality of surface water and groundwater • flood prrotection, • water planning at the national and international levels, including programmes of measures, • international co-operation in water protection, • economic, financial and administrative instruments in water protection, • drafting of legislation and standards in water protection.
	Climate	Is responsible for Climate Protection Policy of the Slovak Republic, Strategy on Adaptation to Climate Change in the Slovakia Republic, National Action Plan on Adaptation to Climate Change
	Land	Protection of nature and landscape
Policy and	-State environmental	The principal purpose of environmental policy is to provide a

Instruments	policy -Environmental impact assessment -Integrated pollution prevention and control - environmental education and consultations - research	framework and guidelines for decision-making and activities at the international, national, regional and local levels aimed at further improvements in the environmental quality as a whole and in the quality of environmental components. Environmental policy focuses on enforcement of sustainable development principles, continuing integration of the environmental perspective into sectoral policies, and increasing the economic efficiency and social acceptability of environmental protection programmes, projects and activities.

Ministry of Agriculture		
Stakeholder ´s role	Responsible for policy decision and legislation; responsible for strategies and acts (agricultural, food and market, soil, rural development regional development, forest, wood, hunting)	The Ministry of Agriculture is a central authority of state administration for agriculture excepting preservation of agricultural land fund
	Land	• Land structure, landscape features • Soil protection, mitigation of erosion • Soil strategy documents, information system
	Food and agriculture	• Food safety • Plant, animal, organic production, sustainable use of pesticides, ecological farming • Biofuels production
	Forest and hunting	• Forest and forest animals protection
Policy and Instruments	• state agriculture policy • controls and monitoring • education and consultations • research	

Slovak Water management company, state public enterprise		
Stakeholder´s role	Formal power – implementation of relevant policies, advisory activities	The GSP is nationally applicable. Through the four branch plants: OZ Banská Bystrica, OZ Bratislava, OZ Košice and OZ Piešťany, established on the basis of natural catchment areas (branch farms - ie independent state enterprises of the Danube River Basin, Váh River Basin, Hron River Basin and Bodrog and Hornád River Basin) 33,673 km long, 295 water reservoirs, 3,158 km of protective dams and 1 605 km of canal network. The total catchment area is 49 034 km2.
Stakeholder´s interests	Water	• manages the entrusted watercourses and waterworks and responsible with them • performs security work to protect against adverse effects of water on watercourses and water works, solves tasks during floods • performs construction-assembly and maintenance work, river material extraction, extraction and production of aggregate and the excavation of trees growing outside the forest • ensures effective protection of water, watercourses and water management • monitors and evaluates the quality of water of watercourses,

		water abstraction and other water management
	Climate	• oriented on climate change adaptation
	Energy	• secures the supply of water from watercourses and tanks, including its use for the production of electricity
	Land	• Damaged landscape structure changes in order to increase water erosion
Policy and Instruments		• execution of rights and obligations • management and maintenance of state-owned waterworks • water management in waterworks • providing of expert opinions • ensuring flood protection • river basin administrator and owner of water works • providing professional advice to water-right authorities at decision-making process • developing river basin management plans • surveying and evaluation of surface water and groundwater status, monitoring of surface water quality • Development of conditions for a reasonable, considerate and environmentally sustainable use of surface water and groundwater and water courses. • Providing water management and hydrological information

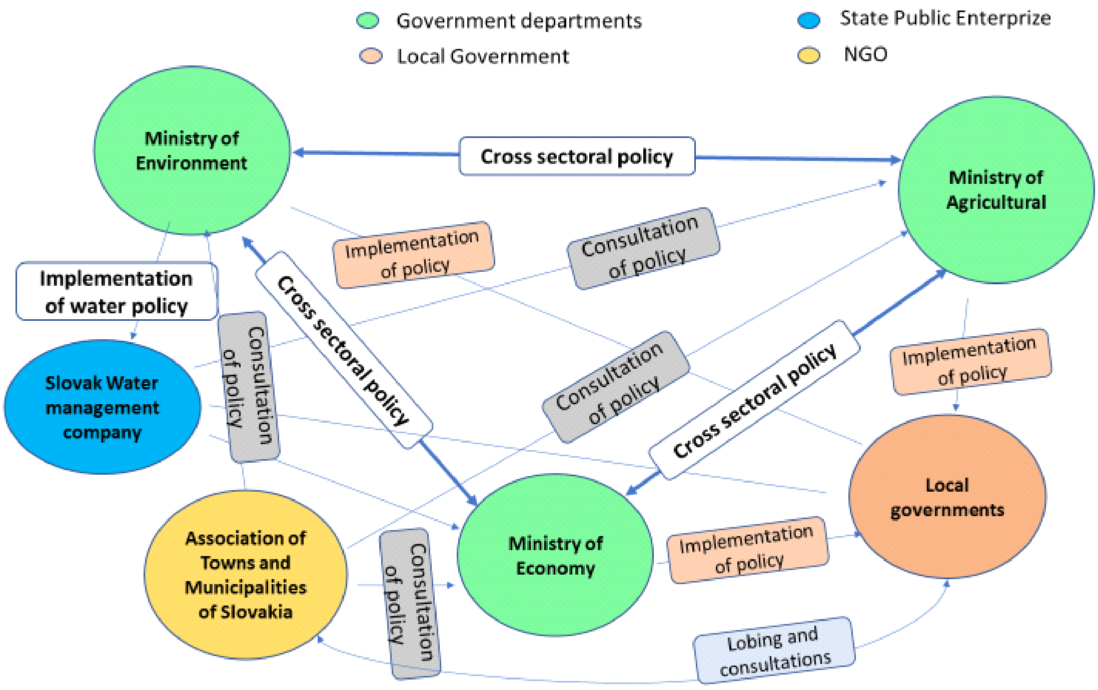
Ministry of Economy		
Stakeholder´s role	Responsible for policy decision and legislation; responsible for strategies and acts (energy industry, paining industry production, support of industry production from natural sources	The Ministry of Economy is a central authority of state administration for energy development
	Energy	• Industry with the exception of wood processing, biotechnology, food and construction products, • energy, including nuclear fuel management and radioactive waste storage and energy efficiency, • heating and gas industry,
	Industry from natural sources Food and agriculture	• extraction and treatment of solid fuels, oil and gas extraction, • Support small business and medium-sized businesses, including support for food products • a strategy for creating an entrepreneurial environment and supporting the business environment including the support of the food business environment
Policy and Instruments		• state energy policy • controls and monitoring • education and consultations

Association of Towns and Municipalities of Slovakia		
Stakeholder´s role	The Association is the representative and speaker of the cities and	• in relation to the National Council of the Slovak Republic in the negotiation and approval of draft laws and in the preparation of parliamentary draft laws, • in relation to the Government of the Slovak Republic and the central state administration bodies

	municipalities that are its members	• in preparing and commenting on draft legislation and other documents concerning the rights, duties and laws of the protected interests of towns and municipalities and their authorities, • in proposing the representation of the local self-government of the Slovak Republic in the bodies of international organizations to which the Slovak Republic is a member, • in relation to other organizations, associating legal entities operating in cities and municipalities, respectively. associating natural persons who operate in local government as a co-ordinator of activities leading to the development of cities and municipalities, in relation to international organizations.

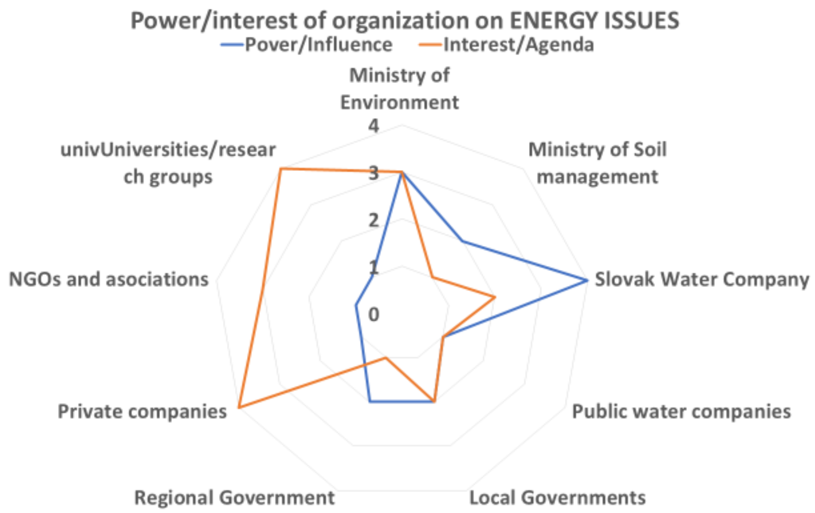
Local Governments authority		
Stakeholder´s role	Decision making process and implementation on local level	The Local Authority fulfils the tasks in a separate competence imposed by its council and assists the activities of committees. The Council may impose tasks on a local authority only in the scope of its powers conferred by law. The loca authority shall exercise delegated powers, except for matters that are legally conferred on the council or a special body.
Stakeholder´s interests	Water	Conception of flood protection, water supply systems in urban zones
	Climate	General awareness of climate change
Policy and Instruments		• implementation of acts, strategies, and other policy documents • strategic conception drafts of land development in urban zones for municipalities and their implementation

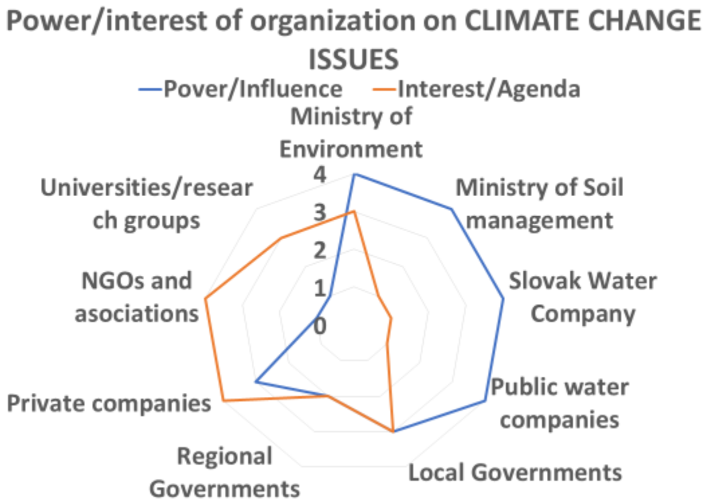
Stakeholders'map briefly describes the role and responsibility of relevant stakeholder as well as the relationship among them. In a stakeholder map the size of the circle shows the importance of stakeholder, the colour of the circle represents different groups (government, state enterprise, local authorities, NGO). The relationship between the groups is indicated by the distance and overlap of the circles (the closer the circles the closer the relationship between the groups; overlap means that the stakeholder is a member of another group). Arrows indicate the main direction of the relationship; the textbox specifies the nature of the relationship.



2.1. Stakeholders´ power / interest grids

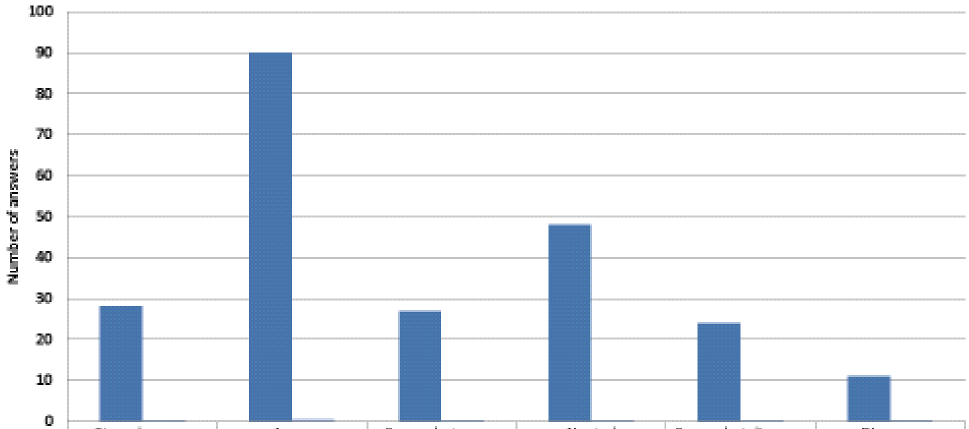
The stakeholders´power/interest grid has been automatically generated from the stakeholder's register, after filling all relevant data; represents the power/interest in all nexus sectors of the most important stakeholders´. Stakeholders' influence and interests have been rated in a scale from 1 (weak influence / weak interest) to 4 (very strong influence / very strong interest). From the 228 mapped stakeholders in the area of water, energy, agriculture, climate change, the impact of the use of natural resources over the interest in protecting them prevails. This is what the following 4 charts say.





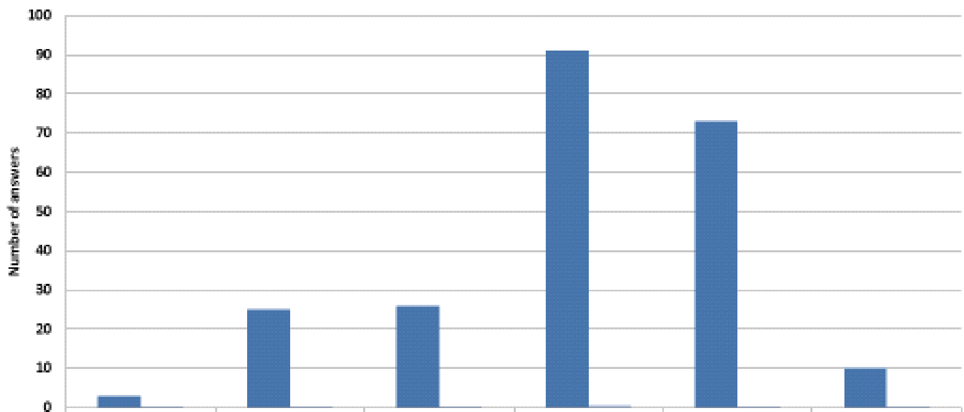
This has confirmed the responses of stakeholders on eleven relevant questions on the state of integrated landscape management in relation to water, energy, food and climate change. The results are summarized in the 11 graphs.

2. I have a clear understanding of the links between integrated natural resource management and climate protection, water, food and energy security and know what to do



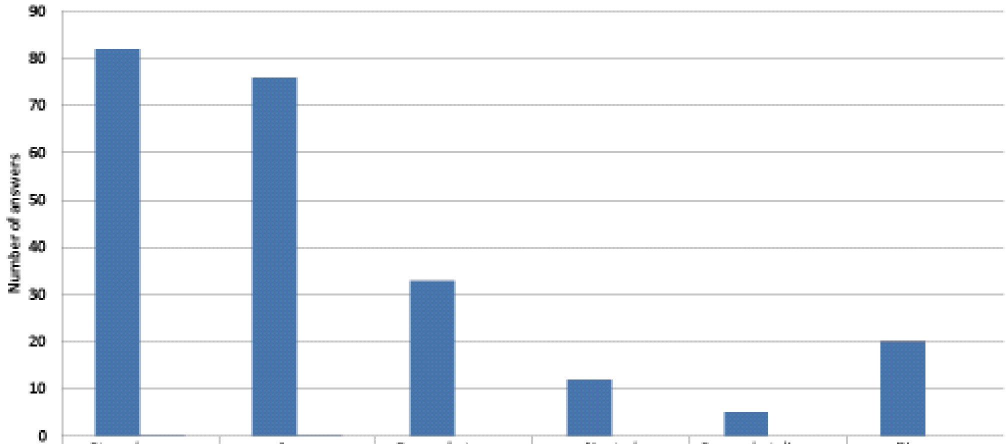
	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree
Počet	28	90	27	48	24	11
%	12,28%	39,47%	11,84%	21,05%	10,53%	4,82%

3. I have enough information on how to deal with climate, water, energy and food security issues in the neighboring countries (Czech Republic, Poland, Hungary, Austria, Germany) and in the EU



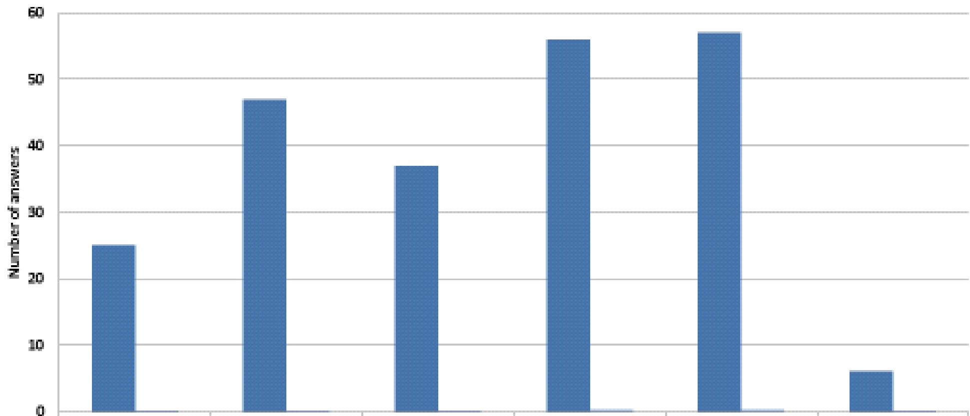
	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree
Počet	3	25	26	91	73	10
%	1,32%	10,96%	11,40%	39,91%	32,02%	4,39%

4. The practice of using natural resources in Slovakia threatens the environment in the neighbouring countries



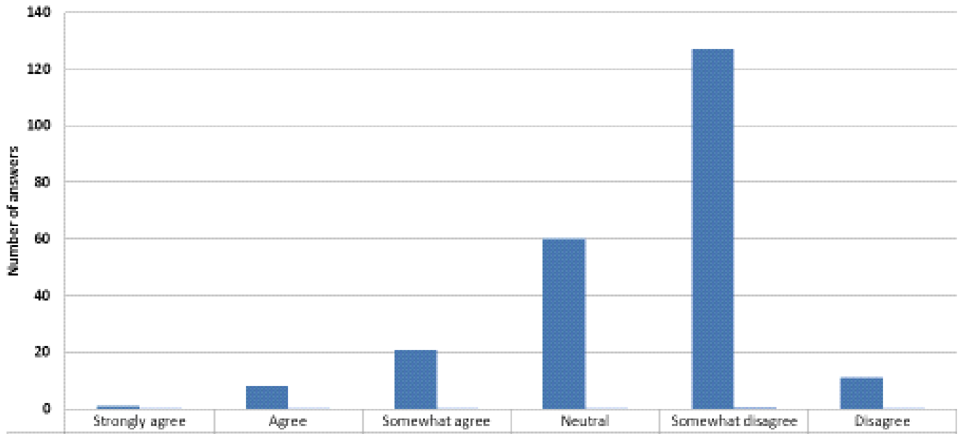
	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree
Počet	82	76	33	12	5	20
%	35,96%	33,33%	14,47%	5,26%	2,19%	8,77%

5. I have enough information on the climate, water, food security and energy security in my village and know how I can get involved



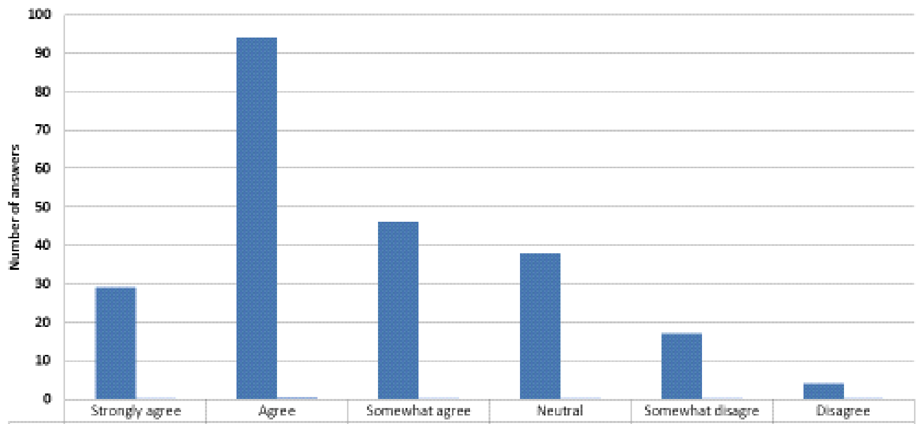
	I fully agree	I agree	More or less agree	I disagree more	I do´t agree at all	I don´t know to answer
Počet	25	47	37	56	57	6
%	10,96%	20,61%	16,23%	24,56%	25,00%	2,63%

6. Relationship between economic development of the state and the protection of natural resources and social needs in the state are well set and the risks of climate, water, food and energy crisis do not negatively impact us



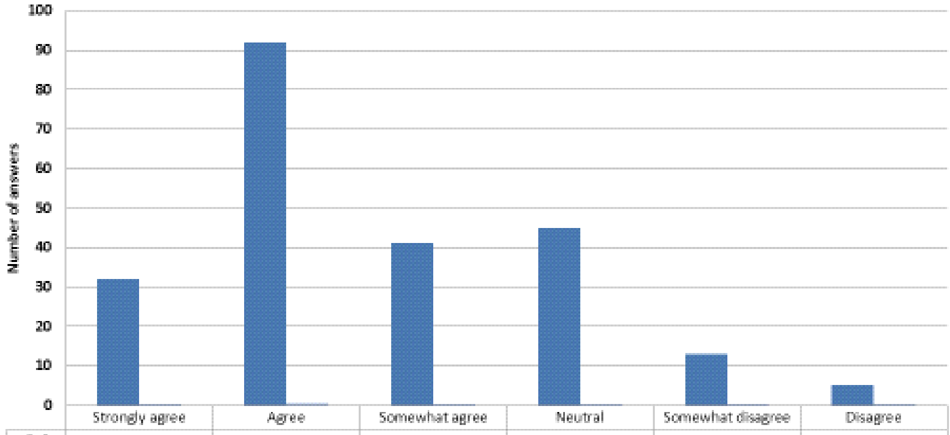
	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree
Počet	1	8	21	60	127	11
%	0,44%	3,51%	9,21%	26,32%	55,70%	4,82%

7. I have enough information and knowledge about the causes of urban temperature rises, increasing weather extremes, air quality degradation, and the growth of civilization diseases in cities



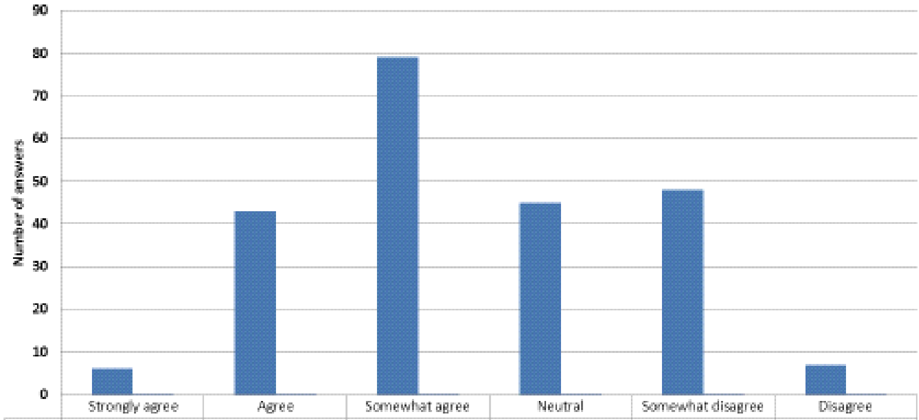
	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagre	Disagree
Počet	29	94	46	38	17	4
%	12,72%	41,23%	20,18%	16,67%	7,46%	1,75%

8. I have enough knowledge on the importance of conservation, the use of natural resources and the restoration of natural resources in Slovakia



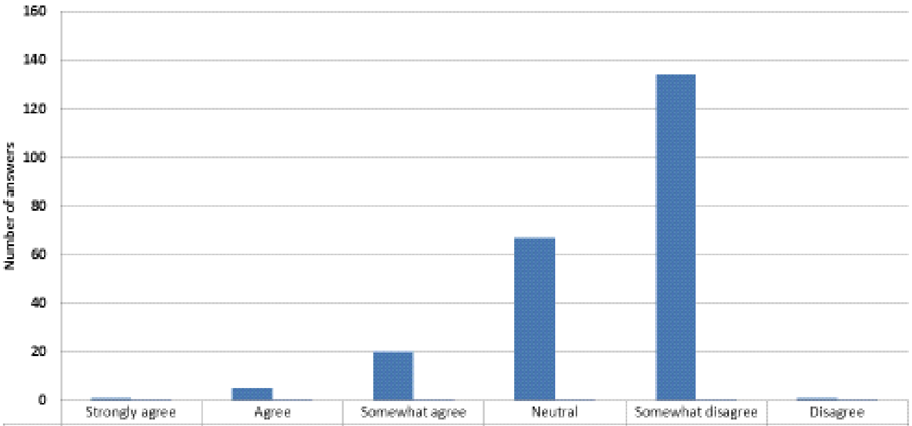
	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree
Počet	32	92	41	45	13	5
%	14,04%	40,35%	17,98%	19,74%	5,70%	2,19%

9. I have enough information on the possibility of public involvement in the protection against climate change



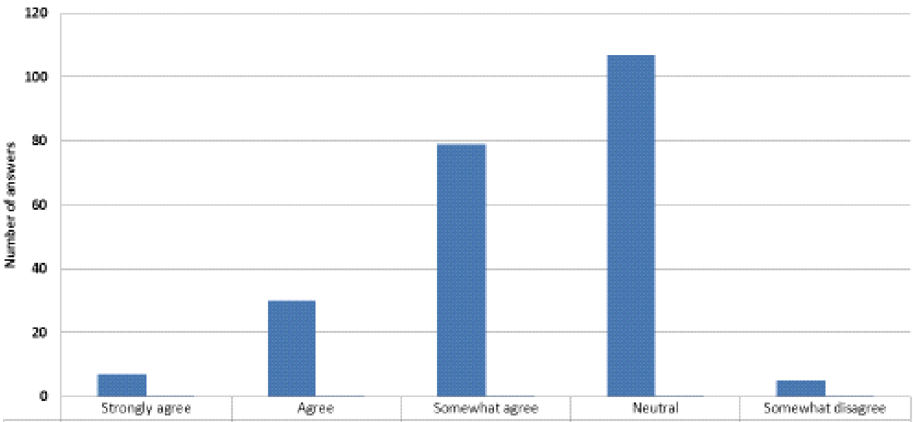
	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree
Počet	6	43	79	45	48	7
%	2,63%	18,86%	34,65%	19,74%	21,05%	3,07%

10. The occurrence of floods, drought and climatic change in Slovakia are sufficiently solved



	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree	Disagree
Počet	1	5	20	67	134	1
%	0,44%	2,19%	8,77%	29,39%	58,77%	0,44%

11. The State provides sufficient opportunities for stakeholders (business entities, experts, the public) to collaborate on climate, water, nature protection and water security



	Strongly agree	Agree	Somewhat agree	Neutral	Somewhat disagree
Počet	7	30	79	107	5
%	3,07%	13,16%	34,65%	46,93%	2,19%

3 Socio-economic context

Water, air, biodiversity, landlessness andpopulation health are crucial life values. Society is formally recognized, it considers these values, of course, independent of the landscape management. Healthy soil is the basis for the existence of life and permanent food security. The landscape that has a healthy soil can bring basic crops to the livelihood of its inhabitants even in the most difficult times. From this point, Slovakia is a rich country.

However, Slovak agriculture and whole villages are troubled by several problems. The country's landscape is scarcely diversified and, in particular, the agricultural landscape contributes to further risks, such as the loss of nutrients from the soil, excessive soil erosion, floods, drought, and the frequent alternation of weather extremes. Slovak agriculture is poorly prepared to withstand the ongoing climate change, which is a significant risk to Slovakia's economy as well as to food security.

Slovak agriculture is also not attractive for young people. That's why the whole country of Slovakia is falling and taking care of the agricultural landscape in the outskirts of the Slovak countryside. The proportion of farmers under 35 years of age has fallen. In general, the number of people working in rural areas is declining in the long run, thereby reducing the quality of life in the countryside, the destruction and decline of agricultural primary production facilities, livestock farming facilities are dying.

While in the European Union (15), employment in the agro-sector has fallen by a third (31%) over the past 20 years, Slovakia has lost up to three quarters (73%) of agricultural jobs in the same period (more than 150,000). Agriculture accounts for about 25% of total unemployment in Slovakia, but accounts for less than 3% of jobs.

In Slovakia we also import the food we have received in the past. Most of the food we import from Germany, Bohemia and Poland. A similar country like Slovakia, once backward rural mountain Austria is now among the most advanced economies of Europe. Gross domestic product per capita exceeds 128% of the EU average, a highly developed, diversified forestry infrastructure with an average farm area of 19.2 hectares. Of these farms, 37.3% of farms have diversified activities in their business agenda.

Slovakia with a high intensity of agricultural production with a 4-fold higher farm scale (77.5 ha) has only 5.9% farms in its business agenda, which is more than a 6-fold lower level of diversification compared to Austria. The size of farms of legal entities in Slovakia is even more than 36 times higher than in Austria. The size of legal entities farms in Slovakia reaches almost 700 hectares. More than a quarter of diversified activity in Slovak farms has leisure activities, which is completely insignificant in terms of employment.

From the above-mentioned reality, the structure of the agricultural landscape and the level of diversification of activities on farms show that Slovak agriculture is systemically badly set and needs a fundamental reform. Because in this, Slovak agriculture is a pendant of Slovakia's economy and not an added value. In a state where it is unable to create employment opportunities, the natural potential of the Slovak Republic is not used and the rural regions literally die.

In Slovakia, there are 10.5 million co-operative unit certificates with a nominal value of approximately € 350 million for approximately 1.5 million people. A regular team has several hundred to a few thousand units. A vast majority of them is without the possibility of a real impact on how to use the agricultural landscape.

The average subsidy from public resources per farmer is doubled in the Slovak Republic compared to the EU average. Annual agricultural subsidies per job in agriculture represent a subsidy of around € 15,000 in 2015. One of the reasons is that the reform of the use of the agricultural land and the countryside has not taken place, but we are lagging behind in the effective setting of incentive rules and competitiveness for farmers. Therefore, the state subsidy is twice as high as the average wage in agriculture, and twice as much as, for example, in investment incentives for industry, at a rate of about 6000 euros a year. So, in the countryside, all employees are financed by state subsidies and farmers have "free" employees, which actually demotivates the efficiency of the agro sector in Slovakia in order to add value to Slovakia's economy and not a pendant.

As far as soil management is concerned, Slovakia has a historically large fragmentation of land ownership, which aggravates the business environment and makes it particularly difficult to start up business and investment. The statistics show that the average number per parcel is 11.11 co-owners (1 parcel = 11.11 co-owners) and the average number of parcels per owner is 20.59 (1 owner = 20.59 parcels).

A particular problem is also the inadequate system of providing support in connection with the demonstration of tenancy relationships between landlords (tenants) and owners of cultivated land.
Slovak republic has a sad 25 year long story where we transformed from a regionally developed and food self-sufficient country with rich traditions, developed agriculture, processing industry and lively regional development, to a food dependent country with low levels of processing of local food resources, poor regions and depopulated countryside.

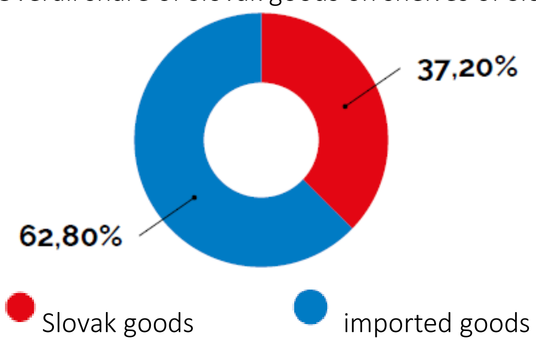
This 25 year long story of irresponsible approach of the state to natural resources lead us to the state of dangerous dependency not only upon food, but practically upon everything connected to processing of our natural resources. Slovak Republic became a source of cheap resources and simultaneously an importer of completed goods with added value staying abroad.

Slovak Republic is no longer a self-sufficient country from nutrition security perspective and the ability of our country to provide adequate food security is falling every year.
The cause of today's state isn't any cataclysmic change or natural disasters. The cause is the lack of concept, bad administration and the inability of governments of Slovak Republic to secure workings and prosperity of the agricultural resort that is responsible, in every other thriving country of the world, apart from Slovak Republic, for production of food and by extension for securing the quality of nutrition for its citizens.

Previously healthy and rich countryside was replaced by half-empty villages, incomplete families and low standards of living of rural population, which drove out mainly our young people far away from their motherland, where they are finding their homes and adequate conditions to develop their personal and career skills.

HOW ARE WE DOING?/Share of Slovak goods
Share of Slovak goods on the shelves of our shops fell just from the year 2011 by almost 13 percentage points and overall by 37.4%. We can describe the current state from the perspective of representation of our goods as a state of emergency.

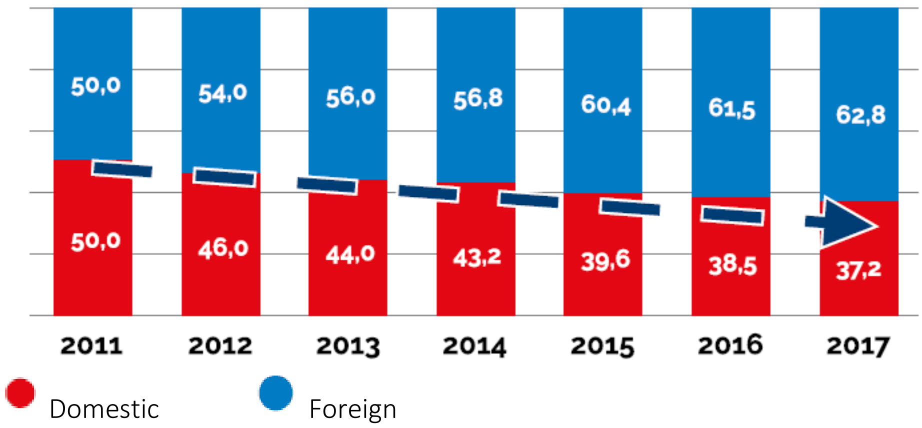
Overall share of Slovak goods on shelves of Slovak shops



- Pricing availability of groceries Current pricing levels of groceries in our shops are at least 10 to 30% higher compared to neighbouring countries. Slovakia has 90% share of groceries sold in shopping chains and so with dependency on foreign producers for import and on foreign vendor chains for sale, we're clearly in pricing jaws of foreign producers and foreign vendors without significant domestic competition that would create pricing pressure benefiting the citizen.
- Employment Slovak countryside, especially in economically underdeveloped regions of northern, eastern and southern Slovakia, suffers the lack of financially and socially interesting career opportunities. The result is a mass exodus of mainly young people abroad or at least to regions closer to the capitol city Bratislava. Meanwhile agriculture and food production is the main source of income and guarantor of job creation everywhere in rural Europe.
- Regional development With agricultural production based purely on agrobarons and small producers of grain and without wide ranging specialized plant and animal production we will never reach the levels of regions we admire on television and during foreign sport events.

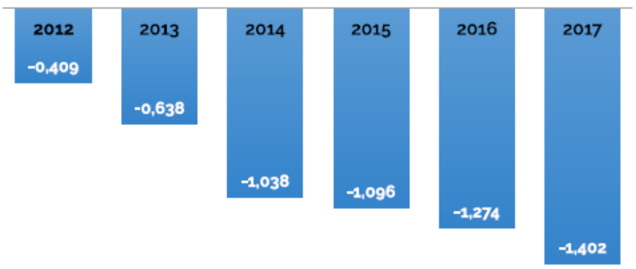
- Landscaping and tourism In half depopulated countryside, where fields change into bushes and on the fields we see only wheat, rape and corn, we can hardly expect significant development of agritourism and country full of grazing sheep and cows, hillsides full of apple, apricot and cherry orchards.
- Crisis and security risks Current state of food self-sufficiency has after 29 years changed into a state of dangerous dependency and dangerous food hazard. Slovak Republic can't guarantee, in case of a crisis caused by some form of infectious or security risk, an adequate amounts of base groceries for its citizens to fulfil their nutritional requirements.

Figure 10 Share of Slovak goods on shelves of our shops



Where are we in proportion of export and import? From a previously self-sufficient country, Slovak Republic has become a country that mainly exports agroresources and imports complete food, often produced from our resources, which are sold for significantly higher prices compared to neighbouring countries. However, added value is on the side of foreign producers of complete goods.
The result of administration in agricultural resort is a long term fall in foreign trade balance, in trade with agricultural commodities and groceries, that reached the record level of 1.402 billion Euro.

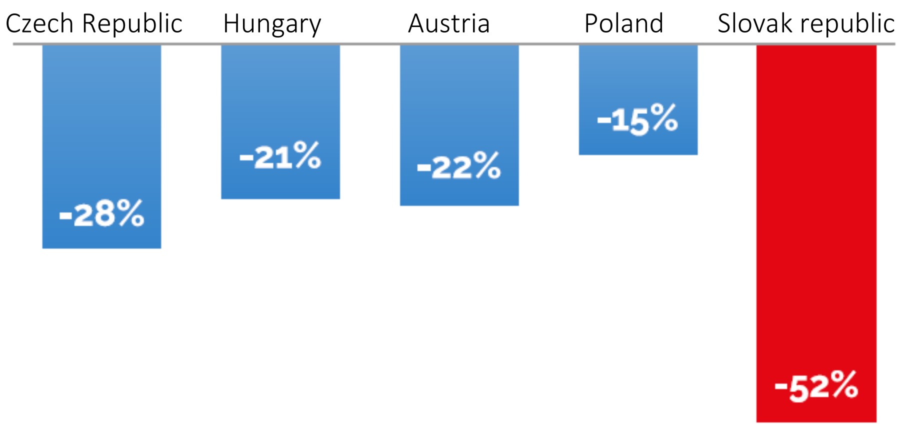
Negative balance of foreign trade with agrocommodities in bil. Euro



Since 2012, the negative balance of foreign trade in agricultural sector rose by 343%.

The most bewildering fact is the reality that the management of Ministry of Agriculture and rural development of Slovak Republic and the government of Slovak Republic did not adopt any systematic measure that would abate this catastrophic development.
Up to 60% of imported products are goods imported from neighbouring countries with comparable climates.
Employment Slovak Republic is a typical rural country with 47% share of rural population. The main job opportunity of rural population lies in agriculture and food processing. Previously the main pillar of rural employment with a 17% share of overall employment of Slovak Republic started falling in 1989 all the way to current level of 2.8%.

Figure 11 Fall of employment in agriculture 2004 – 2016 (In thousands of employees (EUROSTAT))



Cause of current state is:

- **Lack of framework** in agricultural resort in agricultural production and food production.
- **Lack of transparency and effectivity** in public resource management paid into the agriculture resort since 2004, including resources from EU funds
- **Lack of personal responsibility** for management of the agricultural resort for the state of food risk and food dependency. **The ministry has become an institution for bizarre allocation of subsidies** and EU fund resources and has lost its mission, which should be the production of food and securing food self-sufficiency for Slovak citizens.

4 Mapping of policy goals and instruments

This chapter focuses on the identification of policy goals and policy means included in the policy documents (laws, directives, ministerial decisions, national strategic plans, etc.) that were collected during the policy inventory phase.

The policy areas investigated in the context of the present case study concern:

- The agriculture sector
- Water laws
- River basins management plans
- Renewable resources
- Climate change strategies
- Drought and floods protection
- Land management
- Soil protection
- Transportation
- Industry and energy
- Managing extraordinary events and protecting the population and the environment

The results of the policy content analysis (policy goals and policy instruments) are described in the Table 3 Short description of the policy documents.Selection of important policy documents touching the issue of water retention in the landscape and mitigation of drought and climate change is briefly described in Tables 4 – 8, which is the list of documents with short explanation how these documents touch the water objective across all nexus related sectors. It appears in legislation and strategic documents on agriculture, environmental protection, water management, climate protection, mitigation and adaptation to climate change.

Table 3 Short description of the policy documents

Policy area	Type of the document	Title of the document	Short description of the document content	Life span of the policy
Rock environment and geology	Act	Act no. 258/2011 Coll. on the permanent storage of carbon dioxide in the geological environment and on the amendment and supplementation of some laws, as amended by Act No. 147/2017 Z. z.	Legislative framework setting conditions for the capture, transport and storage of carbon dioxide. Establishment of a business entity, storage itself, its monitoring and conditions for its conclusion and transfer obligations.	2011
Natural environment and biodiversity	Act	Act no. 543/2002 Coll. on the Nature and Landscape Protection as amended	The Act regulates the competence of state administration bodies and municipalities as well as the rights and obligations of legal entities and natural persons in nature and landscape conservation in order to ensure in the long term the preservation of natural balance and protection of the diversity of conditions and forms of life, natural values and beauties and to create conditions for sustainable use natural resources and the provision of ecosystem services, taking into account economic, social and cultural needs as well as regional and local circumstances.	
Water regime in the	Act	Act no. 364/2004 Coll. on Water and on	Legislative framework for effective river basin management and improvement of the	

landscape and water management.		Amendments to the Act of the Slovak National Council no. 372/1990 ZB. on Offenses as amended (Water Act)	quality of the environment and its components within the Slovak Republic in accordance with the RSV principles and the procedures of the EU countries. Versatile water protection, including aquatic ecosystems, and from the waters of directly dependent ecosystems in the country. Preservation or improvement of water status. Useful, economical and sustainable water use. Ensuring the safety of water structures.	
Water	Act	Act no. 7/2010 Coll. on Flood Protection, as amended	It provides for the development of the first flood risk management plans and their subsequent review and updating in coordination with the review and updating of the Danube River Basin Management Plans as a comprehensive strategic framework for integrated river basin management of the Slovak Republic taking into account intersectoral aspects.	
Water	Act	Act no. 442/2002 Coll. on Public Water Supply and Public Sewerage and on Amendment to Act No. 276/2001 Coll. regulation on network industries	It regulates the establishment, development, operation of public water supply systems and public sewage systems, defines the rights and duties and powers of public authorities in the field of public water supply and public sewage.	
Land/Water		Resolution of the Government of the SR no. 744 of 27 October 2010	Landscape Rehabilitation Program and Integrated River Basin Management ("PRK IMP") and PRK IMP 2010 Implementation Project. Government Program for Prevention of Floods, Drought and Climate Change	2010, canceled in 2012
Land/water		Resolution of the Government of the SR no. 183 of 9 March 2011	First Implementation Project of the Landscape Revitalization Program and Integrated River Basin Management of the SR 2011. Developing the nature of close water-based measures to prevent floods, drought and climate change, with a capacity of about 6 mil. m3 in the territory of 190 municipalities of the Slovak Republic	Realized 2011
Land/water		Resolution of the Government of the SR no. 590 of 7 September 2011	Second Implementation Project of the Landscape Revitalization and Integrated River Basin Management Program 2011 Implementation of the nature of close water measures to prevent floods, drought and climate change with a capacity of about 4 mil. m3 in the territory of 344 municipalities of the Slovak Republic	Realized 2011-2012
Land use	Act	Act no. 50/1976 Coll. on the Territorial Planning and the Building Code (Building Act), as amended	It establishes in the territorial plans of the municipalities and zoning plans of the zones the principles and rules of functional use of the territory, through which it is possible to provide protection against the adverse	

			effects of the climate (eg protection for floods, landslides, greenery in the settlements).	
Health of the population	Act	Act no. 355/2007 Coll. on the Protection, Promotion and Development of Public Health and on Amendments to Certain Acts as amended	It regulates the procedure of public health authorities in case of extraordinary events, floods, bulk incidence of communicable diseases. Public health authorities monitor the relationship between determinants of health and public health, monitor the health status of the population and its groups in relation to living conditions and working conditions, the way of life and work, and people's health awareness.	
Agriculture	Act	Act no. 220/2004 Coll. on the Protection and Use of Agricultural Land and on the Amendment of Act No. 245/2003 Coll. on integrated pollution prevention and control and on the amendment of certain laws, as amended	Protection of properties and environmental functions of agricultural land. Ensuring Sustainable Management and Land Use.	
Land	Act	Act no. 145/2013 Coll., Supplementing the Act of the Slovak National Council no. 330/1991 Coll. on land adjustments, arrangement of land ownership, land offices, land fund and land associations, as amended	Land consolidation, which is a comprehensive tool for addressing environmental protection and the territorial system of ecological stability and the related spatial arrangement of land ownership.	
Agriculture		Government Regulation no. 342/2014 Z. z. laying down the rules for the granting of agricultural aid in respect of the direct payments schemes, as amended	Good agricultural and environmental condition (GAEC) conservation, which is ensured through the control mechanism and sanctions resulting from cross-compliance. Cross-compliance is a payment system for agricultural primary production linked to compliance with EU farming rules and good agricultural and environmental condition standards. Cross-compliance rules concern the environment, climate change, good agricultural land, public health, animal and plant health and animal welfare.	
Agriculture	Regulation	Government Regulation no. 75/2015 Z. z. establishing the rules for the granting of support in connection with rural development programming.	Government Regulation no. 75/2015 Z. z. laying down rules for the provision of compliance with the sustainable use of agricultural land through conditions for the granting of support. Agroenvironmental - climate payments targeted in particular on organic farming, protection against erosion of agricultural	

			land, arable farming and habitat protection.	
Agriculture	Act	Act no. 543/2007 Coll. on the competence of state administration bodies in providing support in agriculture and rural development as amended	It establishes the Program of Agricultural Activities in declared vulnerable areas.	
Agriculture	Act	Act no. 136/2000 Coll. on fertilizers as amended	It lays down the conditions for: the placing on the market of fertilizers, growing substrates and soil auxiliaries, the conditions for the storage and use of fertilizers, fertilizers, secondary nutrient sources and composts, conditions for agrochemical testing of agricultural land and the identification of soil properties of forest land,	
Forestry	Act	Act no. 326/2005 Z z. on forests as amended	Conservation, enhancement and protection of forests as a component of the environment and natural resources of the country to fulfill their irreplaceable functions; ensuring differentiated, professional and sustainable forest management; reconciling the interests of the company and the forest owners; creating economic conditions for sustainable forest management; implementation of a specific regulation on the legal origin of timber harvested on forest land.	
		Act no. 138/2010 Coll. on Forest Reproductive Material as amended	Requirements for reproductive material of forest tree species and their hybrids intended for artificial forest renewal, afforestation and other forestry purposes, resource requirements, their protection, harvesting conditions, marketing, uses, rights and obligations of persons in activities related to forest reproductive material , conditions for trade between the Member States of the European Union, import and export from non-member states of the European Union, the competence of the state administration bodies and the state professional control body, supervision, sanctions for violation of obligations.	
Transportation				
Recreation and tourism				
Industry and energy		Act no. 555/2005 Coll. on the Energy Efficiency of Buildings and on Amendments to Certain Acts, as amended		

Energy		Act no. 309/2009 Coll. on the promotion of renewable energy sources and high-efficiency cogeneration and on the amendment and amendment of certain laws as amended		
Environment		Act no. 39/2013 Coll. on integrated pollution prevention and control and on the amendment of certain laws, as amended		
Managing extraordinary events and protecting the population and the environment		Act no. 42/1994 Coll. on Civil Protection of the Population as amended	The regulation of the conditions for the effective protection of life, health and property from the consequences of extraordinary events, as well as the assignment of tasks and competence of state administration bodies, municipalities and the rights and duties of natural persons and legal entities in order to ensure civil protection of the population, requires the elaboration of a territorial analysis in view of possible extraordinary events	
		Act no. 387/2002 Coll. on state management in crisis situations beyond the time of war and the state of war as amended	Managing risk sources reports that can cause a crisis situation, analyzing these risks, and taking action to address their causes; crisis management bodies such as the Government of the Slovak Republic, the Security Council of the Slovak Republic, ministries and other central state administration bodies, the National Bank of Slovakia, the Regional Security Council, the district office, the District Security Council and the municipality; ministries and other central authorities of the state administration establish a crisis staff and a special unit. The Crisis Team as an executive crisis management body analyzes the risks of a crisis situation, proposes measures to address it, and coordinates the activities of its components.	
		Act no. 129/2002 Coll. on an integrated rescue system as amended	Modification of the organization of the integrated rescue system, scope and role of the state administration and rescue units within the integrated rescue system, rights and obligations of municipalities and other legal entities, natural persons authorized to enter into business and other natural persons in the coordination of the activities related to the provision of assistance, endangered life, health, property, or the environment.	

		Act no. 179/2011 Coll. on economic mobilization and amending Act no. 387/2002 Coll. on state management in crisis situations beyond the time of war and the state of war as amended	Adaptation of the tasks of economic mobilization entities in the preparation and solution of the crisis situation, adjustment of the conditions for the procurement of vital products or vital goods for the survival of the population and the needs necessary for the operation of the armed forces, armed security corps, information and intelligence services and life- rescue system.	

Table 4 Short description of the policy documents

Policy area	Type of the document	Title of the document	Short description of the document content	Life span of the policy
Rock environment and geology	Act	Act no. 258/2011 Coll. on the permanent storage of carbon dioxide in the geological environment and on the amendment and supplementation of some laws, as amended by Act No. 147/2017 Z. z.	Legislative framework setting conditions for the capture, transport and storage of carbon dioxide. Establishment of a business entity, storage itself, its monitoring and conditions for its conclusion and transfer obligations.	2011
Natural environment and biodiversity	Act	Act no. 543/2002 Coll. on Nature and Landscape Protection as amended	The Act regulates the competence of state administration bodies and municipalities as well as the rights and obligations of legal entities and natural persons in nature and landscape conservation in order to ensure in the long term the preservation of natural balance and protection of the diversity of conditions and forms of life, natural values and beauties and to create conditions for sustainable use natural resources and the provision of ecosystem services, taking into account economic, social and cultural needs as well as regional and local circumstances.	
Water regime in the landscape and water management.	Act	Act no. 364/2004 Coll. on Water and on Amendments to the Act of the Slovak National Council no. 372/1990 ZB. on Offenses as amended (Water Act)	Legislative framework for effective river basin management and improvement of the quality of the environment and its components within the Slovak Republic in accordance with the RSV principles and the procedures of the EU countries. Versatile water protection, including aquatic ecosystems, and from the waters of directly dependent ecosystems in the country. Preservation or improvement of water status. Useful, economical and sustainable water use. Ensuring the safety of water structures.	
Water	Act	Act no. 7/2010 Coll. on Flood Protection, as amended	It provides for the development of the first flood risk management plans and their subsequent review and updating in coordination with the review and updating of the Danube River Basin Management Plans as a comprehensive strategic	

			framework for integrated river basin management of the Slovak Republic taking into account intersectoral aspects.	
Water	Act	Act no. 442/2002 Coll. on Public Water Supply and Public Sewerage and on Amendment to Act No. 276/2001 Coll. regulation on network industries	It regulates the establishment, development, operation of public water supply systems and public sewage systems, defines the rights and duties and powers of public authorities in the field of public water supply and public sewage.	
Land/Water		Resolution of the Government of the SR no. 744 of 27 October 2010	Landscape Rehabilitation Program and Integrated River Basin Management ("PRK IMP") and PRK IMP 2010 Implementation Project. Government Program for Prevention of Floods, Drought and Climate Change	2010, canceled in 2012
Land/water		Resolution of the Government of the SR no. 183 of 9 March 2011	First Implementation Project of the Landscape Revitalization Program and Integrated River Basin Management of the SR 2011. Developing the nature of close water-based measures to prevent floods, drought and climate change, with a capacity of about 6 mil. m3 in the territory of 190 municipalities of the Slovak Republic	Realized 2011
Land/water		Resolution of the Government of the SR no. 590 of 7 September 2011	Second Implementation Project of the Landscape Revitalization and Integrated River Basin Management Program 2011 Implementation of the nature of close water measures to prevent floods, drought and climate change with a capacity of about 4 mil. m3 in the territory of 344 municipalities of the Slovak Republic	Realized 2011-2012
Land use	Act	Act no. 50/1976 Coll. on the Territorial Planning and the Building Code (Building Act), as amended	It establishes in the territorial plans of the municipalities and zoning plans of the zones the principles and rules of functional use of the territory, through which it is possible to provide protection against the adverse effects of the climate (eg protection for floods, landslides, greenery in the settlements).	
Health of the population	Act	Act no. 355/2007 Coll. on the Protection, Promotion and Development of Public Health and on Amendments to Certain Acts as amended	It regulates the procedure of public health authorities in case of extraordinary events, floods, bulk incidence of communicable diseases. Public health authorities monitor the relationship between determinants of health and public health, monitor the health status of the population and its groups in relation to living conditions and working conditions, the way of life and work, and people's health awareness.	
Agriculture	Act	Act no. 220/2004 Coll. on the Protection and Use of Agricultural Land and on the Amendment of	Protection of properties and environmental functions of agricultural land. Ensuring Sustainable Management and Land Use.	

		Act No. 245/2003 Coll. on integrated pollution prevention and control and on the amendment of certain laws, as amended		
Land	Act	Act no. 145/2013 Coll., Supplementing the Act of the Slovak National Council no. 330/1991 Coll. on land adjustments, arrangement of land ownership, land offices, land fund and land associations, as amended	Land consolidation, which is a comprehensive tool for addressing environmental protection and the territorial system of ecological stability and the related spatial arrangement of land ownership.	
Agriculture		Government Regulation no. 342/2014 Z. z. laying down the rules for the granting of agricultural aid in respect of the direct payments schemes, as amended	Good agricultural and environmental condition (GAEC) conservation, which is ensured through the control mechanism and sanctions resulting from cross-compliance. Cross-compliance is a payment system for agricultural primary production linked to compliance with EU farming rules and good agricultural and environmental condition standards. Cross-compliance rules concern the environment, climate change, good agricultural land, public health, animal and plant health and animal welfare.	
Agriculture	Regulation	Government Regulation no. 75/2015 Z. z. establishing the rules for the granting of support in connection with rural development programming.	Government Regulation no. 75/2015 Z. z. laying down rules for the provision of compliance with the sustainable use of agricultural land through conditions for the granting of support. Agroenvironmental - climate payments targeted in particular on organic farming, protection against erosion of agricultural land, arable farming and habitat protection.	
Agriculture	Act	Act no. 543/2007 Coll. on the competence of state administration bodies in providing support in agriculture and rural development as amended	It establishes the Program of Agricultural Activities in declared vulnerable areas.	
Agriculture	Act	Act no. 136/2000 Coll. on fertilizers as amended	It lays down the conditions for: the placing on the market of fertilizers, growing substrates and soil auxiliaries, the conditions for the storage and use of fertilizers, fertilizers, secondary nutrient sources and composts, conditions for agrochemical testing of agricultural land and the identification of soil properties of forest land,	

Forestry	Act	Act no. 326/2005 Z z. on forests as amended	Conservation, enhancement and protection of forests as a component of the environment and natural resources of the country to fulfill their irreplaceable functions; ensuring differentiated, professional and sustainable forest management; reconciling the interests of the company and the forest owners; creating economic conditions for sustainable forest management; implementation of a specific regulation on the legal origin of timber harvested on forest land.	
		Act no. 138/2010 Coll. on Forest Reproductive Material as amended	Requirements for reproductive material of forest tree species and their hybrids intended for artificial forest renewal, afforestation and other forestry purposes, resource requirements, their protection, harvesting conditions, marketing, uses, rights and obligations of persons in activities related to forest reproductive material , conditions for trade between the Member States of the European Union, import and export from non-member states of the European Union, the competence of the state administration bodies and the state professional control body, supervision, sanctions for violation of obligations.	
Industry and energy		Act no. 555/2005 Coll. on the Energy Efficiency of Buildings and on Amendments to Certain Acts, as amended		
		Act no. 309/2009 Coll. on the promotion of renewable energy sources and high-efficiency cogeneration and on the amendment and amendment of certain laws as amended		
		Act no. 39/2013 Coll. on integrated pollution prevention and control and on the amendment of certain laws, as amended		
Managing extraordinary events and protecting the population and the environment		Act no. 42/1994 Coll. on Civil Protection of the Population as amended	The regulation of the conditions for the effective protection of life, health and property from the consequences of extraordinary events, as well as the assignment of tasks and competence of state administration bodies, municipalities and the rights and duties of natural persons and legal entities in order to ensure civil	

			protection of the population, requires the elaboration of a territorial analysis in view of possible extraordinary events	
		Act no. 387/2002 Coll. on state management in crisis situations beyond the time of war and the state of war as amended	Managing risk sources reports that can cause a crisis situation, analyzing these risks, and taking action to address their causes; crisis management bodies such as the Government of the Slovak Republic, the Security Council of the Slovak Republic, ministries and other central state administration bodies, the National Bank of Slovakia, the Regional Security Council, the district office, the District Security Council and the municipality; ministries and other central authorities of the state administration establish a crisis staff and a special unit. The Crisis Team as an executive crisis management body analyzes the risks of a crisis situation, proposes measures to address it, and coordinates the activities of its components.	
		Act no. 129/2002 Coll. on an integrated rescue system as amended	Modification of the organization of the integrated rescue system, scope and role of the state administration and rescue units within the integrated rescue system, rights and obligations of municipalities and other legal entities, natural persons authorized to enter into business and other natural persons in the coordination of the activities related to the provision of assistance, endangered life, health, property, or the environment.	
		Act no. 179/2011 Coll. on economic mobilization and amending Act no. 387/2002 Coll. on state management in crisis situations beyond the time of war and the state of war as amended	Adaptation of the tasks of economic mobilization entities in the preparation and solution of the crisis situation, adjustment of the conditions for the procurement of vital products or vital goods for the survival of the population and the needs necessary for the operation of the armed forces, armed security corps, information and intelligence services and life- rescue system.	

Table 5 Inventory of objective in the water issue in nexus to the food/agriculture

Overarching objectives	Specific objectives	Reference documents
Land use specification and conditions	The Act defines agri-environmental conditions nothing about water retention in soil nothing about carbon sequestration and related to the climate	Act no. 543/2002 Coll. on Nature and Landscape Protection
Land consolidation	water management measures that protect the landscape from floodwaters and waterlogging and provide a source of water to cover the deficit of water (tanks, polders, drains and irrigations),	Act no. 145/2013 Coll., no. 330/1991

	The law does not specify the conditions necessary for climate change	
Support for agro-environment	The Regulation defines the principles of support for direct payments for agricultural activity on land Payment for agricultural practices beneficial to the climate and the environment shall be granted to an applicant who adheres to farming practices that are beneficial to the climate and the environment	Government Regulation no. 342/2014
Support for agriculture, rural development and fisheries	The law defines the payment method for granting aid for processed agricultural products in agriculture, rural development and fisheries	Act no. 543/2007

Table 6 Inventory of objective in the water issue in nexus to the land/soil

Overarching objectives	Specific objectives	Reference documents
Landscape protection	anti-erosion measures to protect soil from erosion and water erosion and related structures (checkdams, afforestation, breakwind, vetlands, water retention measures, terraces, precincts and galleries);	Act no. 145/2013 Coll., no. 330/1991
Reducing the risk of groundwater degradation in the and reducing erosion and increasing water supplies in specific re	Agroenvironmental Climate Action: • Protection of water resources - Protected landscape area of Žitný ostrov • Aid for first afforestation of agricultural land	Government Regulation no. 75/2015

Table 7 Inventory of objective in the water issue in nexus to the climate

Overarching objectives	Specific objectives	Reference documents
Adaptation to the climate change	The need to reflect the legislative frameworks in the planning of the municipality, region, river basin and territorial units with the enhancement of the use of rising rainwater in the intensive water in order to thermoregulate of the landscape Promoting the principles of climate change in regional development plans, building green infrastructure and job creation	Resolution of the Government of the SR no. č. 148/ 2014
	The need to develop a methodology and quantification of rainwater use tools for its evaporation from the country through the green infrastructure and vegetation	

Table 8 Inventory of objective in the water issue in nexus to the water

Overarching objectives	Specific objectives	Reference documents
Law on comprehensive water protection, including aquatic ecosystems, and from waters of directly dependent	reducing the adverse effects of floods and drought efficient, economical and sustainable use of water preservation or improvement of water status cooperation in the elaboration of the Program of anti-erosion measures, measures for increasing the retention capacity of sub-basins and coordination in their implementation	Act no. 364/2004

ecosystems	Defining conditions for owners, administrators or tenants of agricultural land and forest land is required to manage them in a way that not only maintains appropriate conditions for the occurrence of water but also helps to improve water conditions; it is particularly required to prevent harmful changes in drainage, soil drainage and to ensure the maintenance of soil water and to improve the retention capacity of the area. (lack of conditions for urban and municipalities)	
Flood Protection Act and Obligations to Evaluate and Manage Flood Risks to Reduce the Adverse Effects of Floods	development of flood risk management plans	Act no 7/2010
Protection against floods, drought and climate change	The Program's content is to create, activate and create in the long term conditions for a socially useful and macroeconomically efficient operation of a comprehensive and integrated system of measures to ensure flood prevention, to reduce their risks, the risks of landscape drying and other risks of sudden natural disasters.	Resolution of the Government of the SR no. 744 from October 2010
Implementation of the close nature measures in the damaged landscape to protect against floods and droughts with climate prevention	Developing the nature of close water-based measures to prevent floods, drought and climate change, with a capacity of about 6 mil. m3 in the territory of 190 municipalities of the Slovak Republic and creation jobs for uneployment people (4.200 jobs) It was implemented around 58 000 close nature water retention measures. It was implemented aroun 45 000 close nature water retention measures in 348 communities with creation 3.800 jobs for poor people Need to obtaine knowledges of impact of water measures on floods, drouth and climate.	Resolution of the Government of the SR no. 183/2011 and . 590/ 2011
Water conditions in the landscape	Land managers are not responsible for increasing the water drainage from their land. We need to strengthen the responsibility of land managers for the state of water in the area the legislative principle is not anchored by the principle of the impact of the use of the landscape on the changes of the water regime of the landscape. We need legislative instruments to apply the land-use impact principle to the permanent restoration of water resources in the river basins There is no protection of groundwater, replenishment of groundwater reserves. We need to define both methodological and legislative how users can participate in the restoration of water resources in the landscape	Act no. 364/2004 (Water Act)
	Flood protection is still focused on creek and river regulation, widening of troughs and ditching. We need to orient the flood protection to the principle of slowing runoff of rainwater from the landscape into watercourses	

	In the flood risk strategy water rainwater systems are recommended, we need to quantify the impacts of the measures and their scope to mitigate floods and prevent drought and climate change	
Water management in catchment	The principles of water protection against pollution are defined, we need to quantify the principle of maintaining a sustainable water balance in the river basin and the permanent restoration of water sources in the catchment areas The scope of use and protection of water resources is defined, it is necessary to define the impact of human activities on the change of water sources in the territory and it is necessary to define the principles of permanent water restoration in the territory. The need to be based on the principle that water is not a disposable wealth, but is part of a permanent restoration in small water cycles. We need to implement model examples (best practices) of integrated protection and rehabilitation of water resources for different uses of the landscape. It is necessary to carry out research for implementation needs for practice	River basins plans
	We need to define the principles and tools of the implementation of erosion protection in the river basins. We need to develop a methodology for the implementation of integrated river basin protection from drought, floods and climate change	
	It is necessary to project methodological procedures into the quantification of the moderated, respectively. reducing the rainwater runoff from thelandscape used. We need to quantify regulations for users and landowners to participate in the conservation of water resources in the land.	
Drought mitigation	In Central Europe, drought is often underestimated, because its impacts are not so obvious, they are developing slowly and are spread over much of the geographic area than the damage that results from other natural disasters. In contrast to most of the European states, almost all the water that comes from the Slovak Republic comes from the rainfall.	The Ministry of the Environment is preparing a strategy to combat drought The plan is to be approved by the Government in February 2018
	Solving drought as a natural disaster has not yet been legally grounded in the Slovak Republic. The drought assessment is based on various model scenarios, the common denominator is the water saving and construction of reservoirs. Evapotranspiration is taken as a loss of water, not as a tool for climate change mitigation and important factor in hydrological cycle. Higher temperatures result in higher vapor and thus loss of water. But for cities, where the change in hydrological balance is attributed to the predominance of impermeable surfaces (the same is sealed agriculture land) leads to reduction of available water to evapotranspiration, while at the same time reduce latent heat flux and increasing turbulent flow (sensible heat). In cities, evapotranspiration is taken as a mean of cooling the urban environment, so why is it considered so harmful for the landscape?	

	We need to integrate integrated flood risk plans with drought plans and plans to combat climate change	
	Reject the principle "zero rainwater runoff from land" from all types of landscape. Specific objectives that occur in connection with retention of water in the landscape. To minimize drought, flood, climate change mitigation are (selection of the targets): Protection and restoration of the natural water regime in forests Improving the effectiveness of landscape consolidation with respect to climate change Stop soil degradation, sealing, excessive erosion, loss of nutrients, loss of organic matter Ensuring the sustainability and production function of agriculture in order to reduce the negative impacts of climate change Limiting the emergence and impacts of agricultural drought Improvement of the management of stormwater in urban areas Improving the natural retention capacity of watercourses and floodplains Effective protection and use of water resource Enhance environmental stability and reduce the risks associated with temperature and air quality in urban areas Improvement of ecological stabilization functions and landscape permeability	
Drought mitigation	Main principles (selection): To develop a comprehensive system of sustainable land management in the agriculture landscape and in the forests to enhance the soil and landscape rainwater retention capacity In the areas of long-term water scarcity, the water supply should be targeted to increase the water supply by restoring the natural accumulation of water (floodplain forests, wetlands), increasing the capacity (reconstruction) of existing artificial accumulations (reconstruction of old water reservoirs) and implementing measures to restore or enhance natural retention of water in the landscape to implement the measures contained in the River Basin Plans and the measures proposed in the framework of the land consolidation, thereby contributing to the restoration and increase of the retention capacity of the landscape	

BLOCK 2
Assessing policy coherence

1 Assess interactions between nexus critical objectives

This sub-chapter includes the following elements:
- **Table** with the description of the nexus critical **objectives** and **explanation** of the reason why these instruments are considered particularly critical or interesting to investigate in a nexus perspective
- **Scoring matrix** illustrating the interactions among the selected objectives
- **Justification** of the scoring (Appendix I.)
- **Description** of the overall assessment: what are the most relevant/striking **results**
- Reporting of the **validation** of assessment done with **stakeholders**

The aim of the transboundary case study is to solve the problem of surface water retention in the landscape, to improve the hydrological situation in the river basin and thus to improve the local climate and mitigate climate change. The common denominator is therefore an increase in the water retention ability of the landscape, which is related to compaction and occupation of agricultural land, change in the landscape structure, increase of organic matter in the soil, minimization of soil erosion. The selection of individual objectives was based on the analysis of relevant policy documents from the block 1 (Policy analysis). The key document (Adaptation Strategy of the Slovak Republic to the adverse impacts of climate change[1]).
Individual objectives are intertwined, complementary, or even identical, some are inconsistent. Some are precisely defined (e.g. To reduce greenhouse gas emissions within the EU ETS by 20% to 1990); some objectives could be used in more sectors (e.g. Land / soil, water) and could not be unambiguously categorized.

Table 9 contains the description of the nexus critical objectives and explanation of the reason why these instruments are considered particularly critical or interesting to investigate in a nexus perspective.

Table 9 **Nexus critical objectives**

Energy		
Code	Headings (short description)	Detailed description
E1	Increase biofuel production	Increase biofuel production in order to cover 14 % of all energy sources from renewable2
Food/Agriculture		
Code	Headings (short description)	Detailed description
F1	Support of agriculture biomass as a renewable resource	Support maize and rape production in order to cover 8% of all energy sources from renewables; grassland – biofuel for biogas stations
F2	Support non-production functions of agriculture	Support of non-production functions of agriculture in order to protect soil, water quality, air, maintenance of cultural landscape. Plan is 5% from Agrolands
F3	Establish soil blocks evidence	Information about drainage systems on field blocks, adjacency to water reservoirs, if suitable for greening because of concentrated drainage
F4	Set up conditions of agri-environmental and climate measures implementation in	Improve agriculture land quality

[1] http://www.minzp.sk/files/oblasti/politika-zmeny-klimy/nas-sr-2014.pdf
[2] http://www.atlasoze.sk/legislativa-pdf/NAP_OZE.pdf

	agriculture	
F5	keep agriculture procedures favourable to climate	Improve agriculture land quality (increase organic content, stop erosion, etc.) – these procedures are related to water retention and thus influence climate
Land		
Code	Headings (short description)	Detailed description
L1	Stop rainwater runoff frol agrolands and decrease soil erosion	create a concept for rainwater harvestin in agrolands implementation of anti-erosion measures to decrease erosion in the landscape and prepare legislative and financial instruments to implement the proposed measures.
L2	Increase fotosyntesys process on agrolands and organics content in soil	In order to improve soil fertility, ability to retain water and improve water infiltration
L3	Increase soil water capacity and underground water	In order to retain water, refill groundwater level
L4	Decrease runoff from road infrastructure in agroland and prevent the soil sealing	Significantly restrict urbanization of agriculture land – barrier for water retention
L5	Decrease soil compaction	Improve water infiltration and retention
L6	Restrict taking out arable land from agriculture land fund	Arable land is often built up and used for new industrial buildings or residential areas – support for soil sealing (e.g. the industrial parks in Slovakia)
L7	Increase landscape structure diversity and state property	In order to realize technical measures for soil water retention improvements
L8	Support land ownership	Decrease the share of leased land of agriculture subjects (max. 70 %), support private ownership of agriculture land in order to improve soil management practices. Transfer ownership of agricultural land to cities and municipalities
L9	Support for the implementation of land consolidation	In order to change landscape structure and modify land ownership; Land consolidation as a tool for improvement the environment, protecting and regeneration the soil fund, improving forestry and water management, especially in the field of minimizing the adverse effects of floods and drought and increase the ecological stability of the landscape.
L10	Heterogeneous landscape structure	Minimize field blocks area by their dividing into smaller ones by landscape features (balks, groves, grass and shrubs belts, wetlands, ponds, etc.) in order to minimize erosion, matter losses, improve soil quality, mitigate climate change, restore small water cycle. Adopt the principle of "zero drainage of rainwater" from agricultural land
L11	Develop a comprehensive system of sustainable land management	To develop a comprehensive system of sustainable land management in the agriculture landscape and in the forests to enhance the soil and landscape retention capacity. Adopt the principle of a maximum of 50% of grain crops on the farm
L12	Ensure national evaluation of ecosystem services	Ecosystem services help to quantify (financially) all services that ecosystems provide (e.g. air conditioning, water

		retention, anti-erosion etc. functions, biodiversity) and may serve as a powerful tool to protect ecosystems not only from the biodiversity point of view
L13	Restoration of sowing procedures	Current land management completely distorted the sowing procedures – crop rotation, diversity of crops (now approx. 8 preferred crops instead of 15, no undergrowth crops, etc.)
Water		
Code	Headings (short description)	Detailed description
W1	Support expanding of greening areas in catchments – zásada 50% zelených plôch na farme	Greening in catchments – mix of permanent grassland and crops to improve water retention
W2	Keeping of sufficient buffer zones and vegetated strips along water courses- the min. 5% of the area of the farm area of water and water retention area	In order to decrease pollution, improve infiltration . - to strengthen the water, nutrients and soil retention, the principle - zero drainage of rainwater, nutrients and farmland
W3	Promote natural retention and water uptake into the soil	In order to retain water, refill groundwater level
W4	Restore landscape water regime	Create a concept for implementation of measures to increase water retention in the landscape and prepare legislative and financial instruments to implement the proposed measures. The principle - agrofarms do not increase the risk of floods, drought and heal the climate
W5	Increase natural retention ability of water courses and floodplains	Increase natural retention ability of water courses and floodplains (natural and technical revitalization of water courses)
W6	Construction of small water reservoirs and irrigation systems	As water reserves for drought periods – principle - all rain water remains on the farm
W7	Reduce spatial and concentrated runoff of surface water	Reduce spatial and concentrated runoff of surface water by spatial water retention or by slowing the runoff by optimizing landscape structure and using both natural and technical measures to slow down the runoff.
W8	Apply "good agricultural, climate and environmental condition" requirements and "cross compliance"	Apply "good agricultural, climate and environmental condition" requirements and "cross compliance" requirements to increase water infiltration - restore and enhance the retention capacity of the landscape (grassing of spring areas and river meadows, planting forests and trees, opening of major drains, renaturation of channels and fortified streams, setting up of pools in sites with increased groundwater levels, etc.)- Principle - to strengthen the intensity of photosynthesis and organic fertilizer production on farms
W9	Define the land property as a major barrier for the optimizing and restoration of water regime	define the land property as a major barrier for the optimizing and restoration of water regime (the measures should be realized on state property land); as well as missing legislation and financial support for large changes of landscape

		structure, construction and maintenance landscape features and measures for increasing water retention – principle - "zero runoff of rainwater from the farm"
W10	Establish landscape planning as a tool for water retention	Water retention is directly related to landscape structure changes – those can be reached by landscape planning- Principle - Rainwater is the basic food of all foods
W11	Protection and restoration of the natural water regime in forests	By healthy forests, appropriate species composition and forest structure, good soil condition, adjustment of drainage systems etc. Revision of measures for forestry meliorations, streams and forest roads with a focus on protection and restoration of natural water regime in forests; Minimizing technical drainage of forest land using natural and seminatural procedures; Applying procedures and measures for harvesting and restoring forests to avoid or slow down surface drainage and soil erosion; Stabilizing the forest types affected by water and protection of wetlands in forests. Principle - zero drainage of rainwater from forests
W12	Limiting the emergence and impacts of agricultural drought	Measures to mitigate and prevent drought; support in new legislation amendment of Water Act no.254/2001 Coll. Principle - the farm is made up of water when it rains for periods without rainfall
Climate		
Code	Headings (short description)	Detailed description
C1	Climate change mitigation	The strategy for climate change mitigation is mainly based on decrease of greenhouse gasses in different sectors
C2	Climate change adaptation	Based on government decision No.15433/2014, The Adaptation Strategy of the Slovak republik on climate changes and its implementation no. 34/2017, National adaptation plan– set of objectives, adaptation measures and tasks from agriculture, water, forestry, urban, biodiversity, industry, energy, health, transport, tourism in order to suggest strategies for climate change adaptation
C3	To reduce greenhouse gas emissions within the EU ETS by 20% to 1990	The strategy for climate change mitigation mainly based on decrease of greenhouse gasses with specified target of emissions reduction

Table 10 Scoring matrix illustrating the interactions among the selected objectives

	E1	F1	F2	F3	F4	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	C1	C2	C3
E1		0	-2	0	-3	0	0	1	1	1	0	0	0	-1	-1	-1	-2	-2	-1	-1	1	1	0	0	-1	-3	0	0	0	1	0	0	3
F1	2		-3	-1	-2	1	1	0	0	1	0	0	-1	-1	-1	0	0	-2	-1	-1	1	1	0	0	-2	-3	0	0	-1	1	0	0	3
F2	1	1		0	1	-1	0	0	0	0	2	2	-1	0	1	0	0	1	2	2	1	1	1	1	0	0	0	0	0	2	3	3	-3
F3	-1	-1	1		-1	2	-1	-1	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F4	-2	-1	1	1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	2	3	3	-2
L1	-2	_2	1	0	2		2	0	-1	0	-1	-1	1	0	1	2	0	1	3	3	1	1	0	0	3	3	0	2	2	3	3	2	-3
L2	-3	-2	1	0	2	1		0	0	0	-1	-1	-1	-1	0	0	0	0	3	3	2	1	0	0	3	3	0	1	3	3	3	3	-3
L3	-3	-2	1	0	2	1	2		2	2	-1	0	0	0	2	2	0	1	3	2	2	3	2	1	2	3	0	0	3	3	3	3	-3
L4	0	0	1	0	2	0	0	0		-1	2	-1	0	0	0	0	0	0	2	1	0	0	0	0	3	2	0	0	1	2	3	3	0
L5	-3	-3	1	-1	2	1	2	1	2		0	0	0	-1	0	0	0	0	1	2	0	1	0	0	3	2	0	0	1	2	3	3	-3
L6	-1	0	0	2	-1	-1	-1	0	0	0		0	1	0	-1	0	0	0	1	0	0	1	2	0	1	1	0	0	0	1	3	0	0
L7	0	0	0	0	0	0	0	0	0	0	0		-2	-1	-1	-1	0	0	0	0	0	0	3	0	1	0	2	0	0	1	0	0	0
L8	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
L9	-3	-3	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	1	2	0	0	0	0	0	0	2	0	0	3	3	0
L10	-3	-3	1	0	0	0	0	0	0	0	0	0	0	0		0	0	1	2	2	1	2	0	1	0	0	0	2	0	3	2	3	-3
L11	-1	-3	1	1	1	0	0	0	0	0	0	0	0	0	0		0	0	2	1	2	2	1	0	0	2	1	2	1	3	2	3	-3
L12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		-1	1	0	0	1	1	0	0	0	0	9	2	3	3	3	0
L13	-3	-2	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0		0	0	1	1	0	0	0	2	0	1	0	3	3	2	-3
W1	-3	2	2	0	0	1	0	0	0	0	0	0	0	1	1	1	1	2		2	2	0	3	0	0	2	2	1	2	3	3	3	-3
W2	-3	-3	1	1	1	1	0	0	0	0	0	2	1	1	2	1	1	2	2		2	0	2	0	0	2	2	1	1	2	3	3	-3
W3	-3	-3	1	0	0	2	2	2	2	3	0	0	0	2	1	2	1	2	2	2		0	2	0	0	2	2	2	3	2	3	3	-3
W4	0	0	1	0	0	2	2	3	3	2	1	2	1	2	2	1	1	2	2	2	2		2	3	0	3	2	3	3	3	3	3	-3
W5	0	0	1	1	0	0	0	2	2	2	1	1	1	1	1	1	1	1	2	2	0	2		0	0	1	1	1	3	3	3	3	-3
W6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0		0	0	0	0	0	3	3	3	1
W7	-3	-1	1	0	0	1	1	2	3	2	0	0	0	1	2	1	1	2	0	0	2	2	3	1		2	1	0	3	3	3	2	-3
W8	-3	-1	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	2	0	0	2	0	0	0	0		0	0	0	3	3	2	-3
W9	-1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0		0	0	2	0	0	0
W10	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	1	2	2	0	0	0	0	0	0		0	0	1	0	0
W11	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	2	0	0	0	0	0	0		3	2	3	-2
W12	-3	-2	2	2	2	3	3	3	2	3	3	0	2	1	3	3	0	2	3	3	3	3	3	3	2	2	2	3	3		2	3	-3
C1	0	0	2	0	2	1	2	3	3	3	2	1	0	0	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		3	-3
C2	0	0	2	0	2	1	2	3	3	3	2	1	0	0	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3		-3
C3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	

Energy objectives were represented only by one – increase biofuel production in order to cover 14 % of all energy sources from renewables (E1). In the Slovakia it can be achieved by increased production of biomass (maize, rape) (F1, against L13). Up to 90% of arable land is used for cereals and oil production. We need to substantially reduce cereal production by at least 40% through the principle of a maximum of 50% of the land use for the production of cereals and oil on the farm.

These crops are planted on large field blocks (against L10), subsidized by open-handed state budget that directly support big companies, farming mostly on leased land (against L8). These two objectives (E1, F1) are in the discrepancy with almost all objectives targeted on water, land/soil, partly on agriculture. In the food/agriculture case the situation is ambiguous. In one hand there is a production of energy crops as renewable resources, on the other side there is a discrepancy with GAEC and agro-environmental and climate measures. There is an ambiguous relationship also with climate objectives; there is a support for biofuels in order to mitigate climate change; on the other hand, the effect of biofuels (maize, rape) on water regime, climate, soil characteristics and quality go directly against.

Food/agriculture objectives (F2, F4) are defined not very clearly (agriculture procedures favourable to climate, NPFA, etc.), however they are often enabling, reinforcing and often indivisible parts of the land objectives (L1 – L5, L10, 11, 13), as well as water objectives (W1-W5, 7, 8, 12) targeted on landscape water regime and drought mitigation. Because of their unclear definition directly correlates with formulas of climate change mitigation (C1) and adaptation (C2). The objective of establishing soil blocks evidence (F3) can provide information supporting better development of land consolidation (L9), together with landscape planning in terms of heterogeneous landscape structure (L10) and improvement of water regime (W1-W5, 7).

Land/soil objectives are targeted on improving soil characteristics (L1 – L5); land ownership (L7, L8, L9) and landscape structure (L6, L9, L10, L13). Soil quality may improve conditions for planting biomass/biofuels (E1, F1) and NPFA. Because of direct relation of soil quality and water retention, the highest impact is on water objectives (W3-5, 7, 12). Because water retention is also directly connected with landscape structure and land use, the positive relation is on W10. The land property rights (L7, L8) influence the land management. Farming on private land will motivate farmers to improve soil and landscape quality (L1-5, L10,11), restoration of traditional sowing procedures and increase crops diversity (depending on crops price), improve water regime (W1-W8, W12); state land property (L7) usually has an adverse effect; however, will enable construction of water retention features and measures in landscape (W1-7, W9, W12). Ensure national evaluation of ecosystem services (L12) is the objective with "enabling" character that may help to preserve or improve the natural characteristics of landscape and helps to protect (e.g. floodplains, forests, etc.) against harmful activities and therefore has relation nearly to all other objectives. Restoration of sowing procedures and crops diversity (L13) is a key objective for improving soil quality (LL1-L5) and water retention (W1-W8, W12), as well as requirements for sustainable landscape management (F2-F4) and climate issues (C1, C2). Current land management completely distorted the sowing procedures – crop rotation, diversity of crops (now approx. 8 preferred crops instead of 15, no undergrowth crops, etc.) with all negative effects on water, climate regime and soil quality. Crops diversity will contribute to heterogeneous landscape (L10, L11). We should start to respect our ancestors experience.

Water objectives are targeted mainly on restoration of landscape water regime and small water cycle thus are directly related to land and soil objectives. Greening/grassing in catchment (W1) and buffer zones (W2) will decrease soil erosion (L1) by landscape fragmentation (L10), by soil edaphon (soil fauna), increase of groundwater level, soil water capacity (L3, L4) and slowing down surface runoff (W7); in addition, will improve water quality (F6), support NPFA – F2 (by increasing humus content), help to restore small water cycle (F4, F5, L11). Grassland development may be supported by ecosystem services (L12) and part of restoration of traditional sowing procedures (L13). Restoration of water regime and water uptake into soil (W4, W3, W11, W5) is directly related to landscape objectives L1, L2, L3, L4, L5, L10, L11, L13 that concern soil improvement and landscape structure adaptation. Private land property (L8) should ensure better soil management. Dividing of large field blocks (L10) can be realize through land consolidation (L9). Realization of water retention measures should be realized by complex arrangements, mainly on state land (L7). Drought mitigation (W12) is crucial for realization nearly all objectives E1 – C2; however the relationship is like a feedback – if we do not realize F2 – C2 objectives, we cannot reach drought mitigation. Construction of more irrigation systems and reservoirs (W6) is not a right way how to achieve restoration of sustainable landscape water regime, as well as the revitalization of water courses (W5) that are targeted only on "water in stream beds". These measurements can be easily realized and supported; spatial water retention measures, which have highest efficiency, encounter incomplete and uncomplex solutions, the problems like drought, floods, erosion, etc. are solved individually.

Climate change mitigation and adaptation (C1 and C2) are overall, not clearly and precisely defined objectives. Except objectives (F3, L8 and W9) are positively related to all other food/agriculture, land, water objectives. In climate mitigation/adaptation strategies nearly all landscape, water, agriculture management practices and activities are usually mentioned in a connection to climate change. Everything we do, is in the name of climate change. Climate change mitigation / adaptation is usually directly related to reduction of greenhouse gases (C3). This objective draws attention in terms of low carbon activities and decrease of carbon dioxide and methane emissions and disguise greenhouse gases reduction as a remedy for climate changes. In reality preference of this objective suppresses the real measures that can lead to more effective climate change mitigation, thus is spatial water retention in landscape – restoration of small water cycle, soil quality improvement, sustainable land management, heterogeneous landscape. Therefore, the impact of C3 objective on land and water was labelled as counteracting or cancelling (F2, F4, L1-3, L5, 10,11,13, W1-5, W7,8,11,12). The exceptions are E1 and F1 objectives supporting biomass production for renewables.

2 Assess interactions between nexus critical instruments and nexus critical objectives

This sub-chapter includes the following elements:

- the **table** illustrating the selected nexus critical **instruments**, including an **explanation** of the reason why these instruments are considered particularly critical or interesting to investigate in a nexus perspective
- **scoring matrix** illustrating interactions between nexus instruments and objectives
- the **justification** of the scores (Appendix II.)
- the **description** of the interaction between NCIs and NCOs, including an **explanation** how individual (one instrument) or multiple (more instruments together) interactions may hamper or support the achievement of the nexus critical objectives.

Table 11 **Nexus critical instruments**

Energy		
Code	Headings (short description)	Detailed description
Ea	National programme on subsidies for planting crops for biofuels	Support of maize and rape planting; Rape on 10 % of arable land in 2016;
Eb	Subsidies for biomass production within Common agriculture policy	Set up the conditions for the providing subsidies for permanent grassland and less-favoured areas to motivate the use of harvested material for further purposes
Ec	Support of new, more sustainable energy crops	Define energy crops that will be able to adapt to climate change while not contributing to a worsening of the soil and water regime and not requiring high inputs of additional energy, industrial fertilizers or biocides; to encourage the cultivation of these crops on less fertile soils in less favoured areas
Food/Agriculture		
Code	Headings (short description)	Detailed description
Fa	Statutory management requirements (SMR)	SMR 1-13 (are grouped into 3 categories - Environment, climate change, good agriculture and environmental soil conditions; Public, animal and crops health; Animal welfare) The statutory management requirements form part of cross- compliance and are laid down in a number of European Union directives and regulations. They concern public health, animal and plant health, identification and registration of animals, environment and animal welfare. These requirements apply independently of cross compliance (which only establishes the link between the full payment and the respect of such requirements).
Fb	Single area payment scheme (SAPS)	System of direct payments of CAP - The single area payment scheme provides a flat-rate decoupled area payment paid for eligible agricultural land and replaces almost all payments. Applied until 2020.
Fc	Good agricultural and environmental standards (GAEC)	Revise good agricultural and environmental standards (GAEC) in order to better protect and increase biodiversity of land and soil; ensuring that more organic matter is added to the soil, motivation to greater use of

		soil protection technologies. GAEC 1 (surface water protection against pollution), 4 (min. vegetation cover of soil) 5 (minimizing erosion), 6 (organic matter in soil), 7 (landscape features protection) Farmers are obliged to maintain their land in ‵ good agricultural and environmental condition ’. This concept includes the following: the protection of soil against erosion, the maintenance of soil organic matter and soil structure, and the safe-guarding of landscape features. It is the member states - not the European Union - which decide the exact specification of these parameters. Stopping soil degradation by excessive erosion, depletion of nutrients, loss of organic matter and soil sealing Measures to reduce water and wind erosion of agricultural land by 65 % by direct payments for greening, strict application of AECM, GAEC Maintaining and increasing the ability of the soil to bind water Strengthening and effective application of Cross Compliance / GAEC rules in relation to the use, protection and improvement of agricultural land - in particular: -projection of real erosion risk into the respective LPIS layer and interconnection with the prescribed mode of landuse while providing sufficient soil protection technologies -major strengthening of the GAEC standards for improving the quality of soil - in particular under GAEC 4 (ensuring minimum land cover), GAEC 5 measures for erosion by introducing and requiring protection of soil from wind erosion), GAEC 6 (preservation of the content of organic matter) and GAEC 7 (in 2016 extension of landscape elements by a new one - wetland, in the following years efforts to further enlargement of landscape elements e.g leakage, or other anti-erosion measures, in particular technical ones). - major strengthening of the GAEC standards for improving the quality of water - in particular under GAEC 1 and 3 (water protection by delimitation of non-fertilized streams along water courses and protection of groundwater against pollution)

Fd	Greening in the EU Common Agricultural Policy / green direct payment	Greening in the EU Common Agricultural Policy - introducing a new mandatory eco-funded direct payments component; The 2013 reform of the Common Agricultural Policy introduced several instruments to promote environmental sustainability and combat climate change. These instruments comprise a green direct payment, enhanced cross-compliance obligations, an obligation to allocate 30% of the Rural Development budget to projects and measures that are beneficial for the environment and climate change (including voluntary agri-environmental climate measures), training measures and support from the farm advisory services. The 2013 reform of the Common Agricultural Policy introduced a green direct payment which is paid to farmers on the condition that they undertake practices that are beneficial to the climate and to the environment. Member states must allocate 30% of their direct payment envelope to green direct payments. The basic practices that farmers must undertake are: maintaining permanent grassland, crop diversification, having 5% (later 7%) of their land as ecological focus area. Subject to a decision by member states a farmer can, instead of applying these basic practices, undertake practices which are considered equivalent (such as crop rotation instead of crop diversification).
Fe	Agri-environment-climate measures (AECM) M10	Measure M10 (Rural development programme) – support of fruit, grapes, vegetable production, permanent grassland management, grassing of arable land, bio-belts, green plover protection, grassing of runoff corridors Targeting of AECM payments to ensure support and contribution of AECM to the structural change of Czech agriculture landscape with an emphasis on enhancing the ecological stability and biodiversity (through the appropriate setting of eligibility criteria, in particular the correct targeting of environmental measures on agriculture land (appropriate seed treatment, permanent grassland management.) These are practices, undertaken voluntarily by farmers, over a set period. Support may be provided through Rural Development programmes. The practices bring environmental benefits and /or help to mitigate and adapt to climate change. The payments compensate farmers for the extra costs that they incur and the income that they forego when they undertake these

		practices. The practices must go beyond a number of obligations which apply to farmers in any case – including (but not limited to) cross-compliance and relevant national legislation. A given practice which is funded through the greening provisions of pillar I may not also be funded through an agri-environmental climate measure.
Ff	Ecological farming M11 (AECM)	Measure M11 (Rural development programme); ecological farming - 6 % of agriculture land fund in the Czech Republic
Fg	Forest areas development M08 (AECM)	Measure M08 Reforestation (Rural development programme)
Fh	Tangible assets investments M04 (AECM)	Measure M04 (Rural development programme) – may support of inappropriate use of heavy mechanisation/machines
Fi	Small farms support	To prioritize small farms in the framework of agricultural subsidies; Rural development programme
Fj	Support of young farmers	Under Rural development programme
Fk	Supporting program - soil protection against erosion, degradation and excessive drying	In the context of evaluating the current tools in the area of protection of the agricultural land fund ("Preparing for the implementation of measures to mitigate the negative impacts of drought and water scarcity"), prepare a multiannual training program and free consultations for farmers, with the aim of putting forward desirable practices in practice.
Land		
Code	Headings (short description)	Detailed description
La	Arrangements to secure a state land reserve	Implement the necessary legislative and financial arrangements to secure a state land reserve;

Lb	Landscape planning instruments (complex land consolidation; plan of common facilities)	To set landscape planning as an instrument for water retention Complex land consolidation Landscape consolidation provides conditions for improving the quality of life in rural areas, including diversification of economic activities and improving agricultural competitiveness, improving the environment, protecting and regeneration the soil fund, improving forestry and water management, especially in the field of minimizing the adverse effects of floods and drought and increase the ecological stability of the landscape. The land reform results serve for the renewal of the cadastral project and as a basis for spatial planning. Implementation of complex land consolidation in terms of increasing the retention capacity of the landscape; need for organizational support for the implementation of land consolidation In the plan of common facilities, the whole land consolidation will also be assessed in terms of soil erosion and flood risks, as well as the possibility of water retention in relation to the slowdown of surface runoff. The use of the individual protection measures depends mainly on their efficiency; requires reduction in soil washout, the reduction of maximum flows and the protection of water resources, watercourses, water reservoirs and built-up parts of the municipality. The plan of the common facilities must be completed by a proposal of agro-technical and organizational measures, with which landowners will be demonstrably acquainted; Furthermore, the plan of the common facilities includes an evaluation of the change of the runoff parameters as a basis for the solution of the runoff in the catchment area. Within the common facilities, combining technical and semi-natural measures to increase the retention capacity of the landscape
Lc	Financial incentives for reduction the share of leased land to 70%	Reduce the share of leased land to 70% by incentives to realize the investments in land purchase and continue support of the implementation of land consolidation. At the same time, an improvement in the relationship to the land is achieved.
Ld	Strict application of the Act of the Slovak National Council no. 220/2004 Z. z. Coll., on agriculture soil protection	Strict application of the Act of the Slovak National Council no. 220/2004 Coll., on agriculture soil protection - reduce soil sealing, improve soil structure, increase the organic matter content of soil Farmers or land tenants should manage the land so that they do not pollute soil and thus the food chain and drinking water sources with harmful substances that

		threaten the health or life of humans and the existence of living organisms, do not damage the surrounding land and the favourable physical, biological and chemical properties of the soil, and protect land under approved land consolidation projects.
Le	Ministry of Environment subsidies	Three nearly complementary programmes of Ministry of Environment: a) Environmental operational programme 6.3 - green planting in the landscape and soil protection according to approved complex land consolidation, restoration of shore stands, ... 6.4 – antierosion protection and reduction of negative consequences of surface runoff, restoration of shore stands, revitalization of watercourses and floodplains, ... b) Landscape protection programme Free landscape - renovation and stabilization of erosion consequences outside the watercourses and creation of biological anti-erosion measures as mowing, pasture c) Support for restoration of natural landscape functions: Anti-erosion measures, restoration of shores vegetation, revitalization of watercourses and floodplains, mowing, grazing, ...
Lf	Historical landscape structures data	Review and modify a set of land-analytical phenomena in order to capture historical landscape structures whose regeneration can contribute to increasing landscape retention and minimizing erosion threats. Historical data from Imperial Imprints of the Stable Cadastre of Slovakia
Water		
Code	Headings (short description)	Detailed description
Wa	National plan of Slovak river catchment	- to protect and improve the status of surface and groundwater and aquatic ecosystems, - to reduce the adverse effects of floods and drought, - the management of surface and groundwater and the sustainable use of these waters for providing water services and - to improve water conditions and to protect the ecological stability of the landscape. Also contain summaries of programs of measures to achieve these objectives and set out a strategy for their funding.
Wb	Concept of the solution of flood protection in the Slovakia using both technical and nature measures	It sets out ways how to implement preventive flood control measures after 2015, including optimization procedures for individual measures. The system of flood protection measures also includes landscape measures as well as the new requirements of European legislation.
Wd	Act no. 364/2004 Coll. on water	Landowners are obliged, unless otherwise provided by special legal regulation, to provide such management so as not to worsen the water conditions. In particular, they are required to ensure that the drainage conditions are not deteriorating, the soil is not discharged by erosive water activities and the improvement of the retention capacity of the landscape. The amendments is targeted on drought mitigation and protection measures.
Instruments in preparation /recommended – based on climate change mitigation/adaptation		

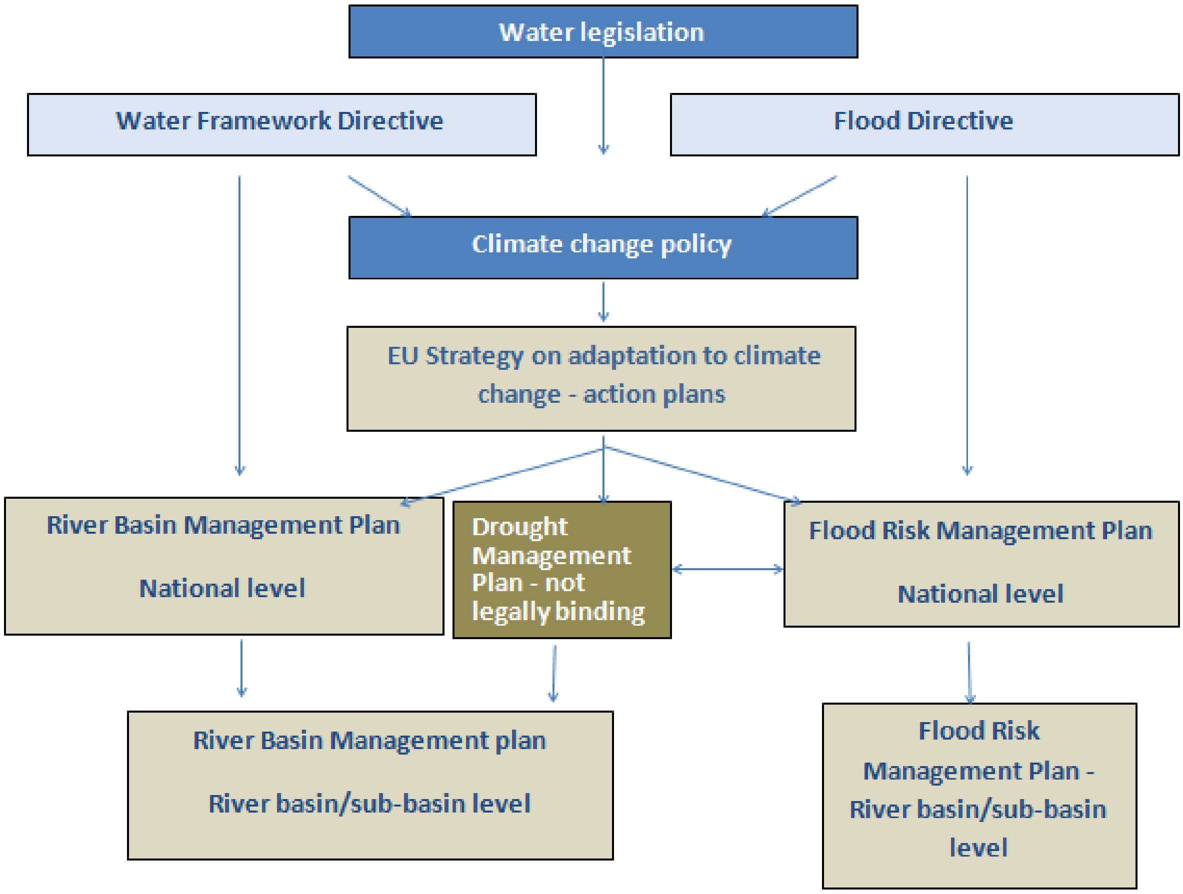
strategy, stakeholders consultations		
We	Plans of water resources protection in Europe	Create more detailed plans of water resources protection, including the concept of wetland restoration and revitalization of watercourses Water retention measures, flood and drought protection is based on green infrastructure (as part of 1. pillar of CAP, areas of ecological interest)
Wf	Action plan against drought and water scarcity	Develop a comprehensive concept for drought and water scarcity and to prevent emergencies caused by long-term water scarcity
Wg	Technical and natural measures for spatial water retention	to improve and restore the retention ability of the landscape by: 1. Implementation of comprehensive measures (type A - according to catchment area management plans) on the agricultural land 2. Maintenance and management of technical and nature measures for the retention, accumulation and improvement of water quality on agricultural land 3. Support for the purchase of land for the implementation of these measures 4. Reimbursement of economic damage from loss of production from the areas designated for the implementation of these measures Based on the National plan of Labe catchment
Wh	New financial and subsidies programme – intended	To prepare a new financial and subsidies programme to support water retention in the landscape by strengthening the retention capacity of the soil, construction of new ponds and small water reservoirs, support for the restoration of extinct ponds and the restoration of wetlands. Increase wetlands area and retention dams on agriculture land by private investments and specific financial support; Increase the area of state land property by (private) investments and specific financial support
Climate		
Code	Headings (short description)	Detailed description
Ca	Emissions trading	Climate change mitigation through emissions trading; CO2 and anthropogenic emissions as only factors responsible for climate change; climate protection
Cb	Reduction of greenhouse gasses emission	so-called mitigation (i.e. reduction measures) in different sectors
Cc	Carbon sequestration and nitrogen retention	Adaptation, mitigation of climate change: agro-environmental – climate measures in agriculture are mainly based on carbon sequestration and nitrogen retention; GAEC – partly influence stock carbon stock by farming management practices

Table 12 Scoring matrix illustrating interactions between nexus instruments and objectives

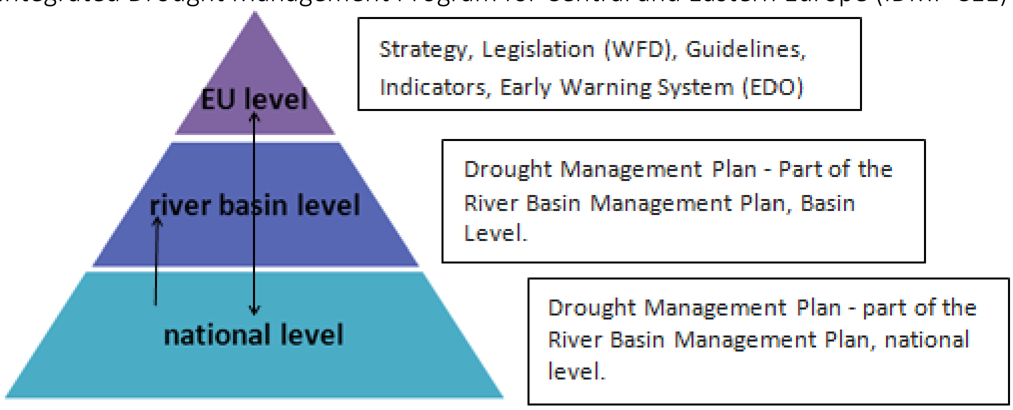
	Ea	Eb	Ec	Fa	Fb	Fc	Fd	Fe	Ff	Fg	Fh	Fi	Fj	Fk	La	Lb	Lc	Ld	Le	Lf	Wa	Wb	Wd	We	Wf	Wg	Wh	Ca	Cb	Cc	T.n. (+)	T.n. (-)	T.n. (-/+)
E1	2	1	-1	0	0	-1	-1	0	0	0	0	0	0	0/1	1/0	0	0	-1	-1	0	-3	0	0	0	-2	0	0	2	0	0	3	7	2
F1	3	3	3	0	0	1	0	0	0	0	0	0	1	0/1	0	0	0	0	0	0	0	0	0	0	-2	0	0	0	0	0	5	1	2
F2	-2	3	2	0	0	1	1	1	0	0/1	0/1	0/1	0/1	0/1	0	1	0	1	2	0	0	0	0	1	0	1	1	0	0	1	12	1	5
F3	0	0	0	0	0	0	0	2	0	-1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0
F4	-2	1	1	0	-2	1	0	0	0	0	0	0/1	0/1	0/1	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	1	7	2	3
L1	-3	2	1	0	-1	1	3	1	1	3	-3	0/1	0/1	0/1	0/1	3	0/1	3	2	1	1	1	0	1	3	3	1	0	0	1	18	3	5
L2	-3	2	0	0	-1	1	1	1	1	0	0	0/1	0/1	0/1	0/1	-1	0/1	3	1	0	1	1	0	0	3	1	1	0	0	1	13	3	5
L3	-3	3	1	0	-1	1	1	1	1	2	-3	0/1	0/1	0/1	0/1	3	0/1	3	1	1	1	1	0	0	3	0	1	0	0	1	16	3	5
L4	1	2	1	0	-1	0	0	1	1	0	0	0	0/1	0/1	0	2	1	3	0	0	1	1	0/1	0	3	0	0	0	0	0	11	1	3
L5	-2	2	1	0	-2	0	0	0	1	0	-3	0	0/1	0/1	0/1	-1	0/1	3	1	0	1	1	0	0	3	3	1	0	0	0	10	4	4
L6	1	1	1	0	0	0	0	0	1	-2	0	0/1	1	0/1	0	3	1	3	0	0	-1	-1	0	0	3	0	0	0	0	0	8	3	2
L7	0	0	0	0	0	0	0	0	0	0	0	0/1	-2	0	3	-1	-3	0	0	0	3	0	0	0	3	3	0	0	0	0	4	3	1
L8	0	0	0	0	0	0	0	0	0	0	0	-1	1	0/1	-3	1	2	0	0	0	-3	1	0	0	3	-2	0	0	0	0	5	4	1
L9	0	0	1	0	0	0	0	0	0	0	0	-1	1	0/1	0/1	1	2	0	3	2	3	1	0	0	3	2	0	0	0	0	10	1	2
L10	-3	2	2	0	-3	0	0	0	0	2	-1	1	1	0/1	0/1	3	2	1	3	2	3	1	1	3	3	2	0	0	0	0	16	2	2
L11	-3	2	3	0	0	0	1	0	1	1	0	0/1	0/1	0/1	0/1	3	1	1	2	1	1	1	0	0	0	1	0	0	0	0	13	1	4
L12	0	0	0	0	0	1	0	0	1	0	0	0	-1	-1	0	1	0	0	0	1	-1	1	1	1	0	0	0	0	0	0	7	3	0
L13	-3	3	2	0	-2	1	1	0	1	0	0	0/1	0/1	0/1	0	1	0/1	0	0	0	2	1	0	0	1	0	0	0	0	0	9	2	4
W1	-3	3	0	0	-1	1	2	1	1	0	0	0/1	0/1	0/1	1	3	0/1	0/1	3	3	3	1	0	3	3	3	1	2	0	1	17	2	5
W2	-3	3	1	0	-1	1	2	1	1	0	-1	0/1	0/1	0/1	1	3	0/1	0/1	3	3	3	1	0	3	3	3	0	2	0	1	17	3	5
W3	-3	3	1	0	-2	1	2	1	1	2	-2	0/1	0/1	0/1	1	3	0/1	0/1	3	1	3	1	0	0	3	3	3	1	0	0	17	3	5
W4	-3	3	1	0	-2	1	3	1	1	2	-1	0/1	0/1	0/1	1	3	0/1	0/1	3	3	3	1	0	3	3	3	3	0	0	0	17	3	5
W5	0	2	1	0	0	1	3	1	0	0	-1	0/1	0/1	0/1	1	3	0/1	0/1	3	2	3	0	1	3	2	3	2	0	0	1	16	1	5
W6	0	0	0	0	0	1	0	-1	0	0	-1	0/1	0/1	0/1	1	1	0/1	0/1	0	2	0	2	1	3	0	0	2	0	0	1	8	2	5
W7	-3	3	1	0	-1	0	3	0	1	3	-1	0/1	0/1	0/1	1	3	0/1	0/1	2	2	3	2	1	2	2	2	2	0	0	0	16	3	5
W8	-2	2	1	0	0	0	0	1	1	0	0	0/1	0/1	0/1	1	-1	0	0/1	2	0	3	2	0	-1	0	-1	0	0	0	0	8	4	4
W9	-1	0	0	0	0	0	0	0	-1	0	0	0/1	0/1	0/1	2	2	0/1	0/1	0	0	3	0	0	0	2	2	1	0	0	0	6	2	5
W10	0	0	0	0	0	0	0	0	-1	0	0	0/1	0/1	0/1	0	0	0	0/1	1	0	2	2	0	0	2	2	0	0	0	0	5	1	4
W11	0	0	0	0	0	0	0	0	0	2	0	0/1	0/1	0/1	0	2	0/1	0/1	1	2	1	1	0	0	2	2	0	0	0	1	9	0	5
W12	-3	3	2	0	-2	0	2	0	1	3	-2	0/1	0/1	0/1	2	3	2	0/1	2	3	1	0	2	3	3	3	0	0	0	0	15	3	4
C1	-3	3	1	0	0	0	3	3	1	2	-2	0/1	0/1	0/1	1	1	0	0	2	0	1	1	1	1	2	2	1	-1	-1	1	17	4	3
C2	-3	2	1	0	0	0	3	1	1	2	-1	0/1	0/1	0/1	1	1	1	0	2	0	1	1	1	1	2	2	1	0	0	1	17	2	3
C3	0	0	0	0	0	0	0	0	0	2	-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	4	1	0
T.n. (+)	4	23	19	0	0	13	15	14	18	12	0	1	5	0	13	22	8	10	21	15	23	23	8	14	24	20	14	5	1	13			
T.n. (-)	19	0	1	0	14	1	1	1	2	2	14	2	2	1	1	4	1	1	1	0	4	1	0	1	2	2	0	1	1	0			
T.n. (-/+)	0	0	0	0	0	0	0	0	0	1	1	23	23	29	8	0	14	12	0	0	0	0	1	0	0	0	0	0	0	0			

3 Identify success stories and failures

Scheme for Implementation of Integrated River Basin Management - Planning Process in the context of the Water Framework Directive and the Floods Directive (Source - Guide to the Integrated Drought Management Program for Central and Eastern Europe (IDMP CEE) - in press)



Drought Strategy - Interaction between EU, River Basin and National Levels. (Source - Guide to the Integrated Drought Management Program for Central and Eastern Europe (IDMP CEE) - in print)



At Community level, a Common Strategy for the implementation of the Water Framework Directive (CIS) was put in place in 2001 to promote a common approach to the implementation of the WFD and the Floods Directive in the Member States. This process is coordinated by the Strategic Coordination Group (SCG) under the supervision of the European Commission. As part of the CIS process, a number of technical and methodological documents have been developed and approved by the Water Directors (nominated representatives of the Member States).

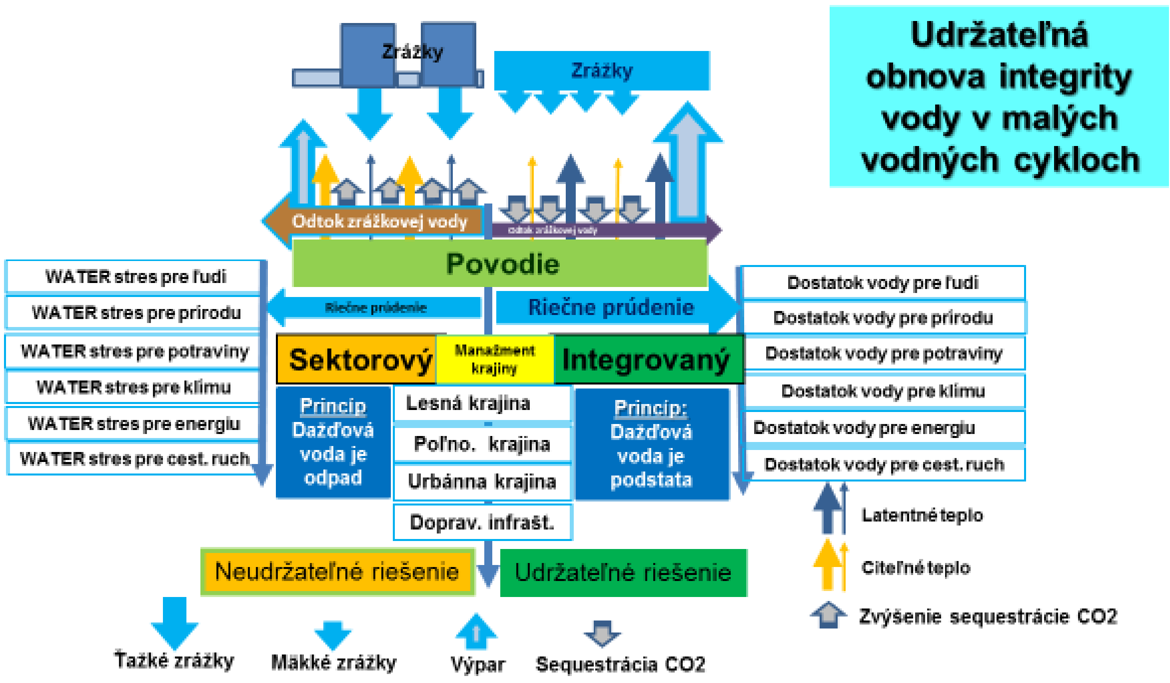
The CIS process continues to develop new dry-related components such as definitions, drought indicators, water bills and ecological flows. All team members lack the interconnection between policies that would be reflected in the integrated management of water resources. There is no clear link between landscape management and individual sectors (water, energy, agriculture, food safety and the climate). It is all based on sectoral approaches, and if coherence is being prepared between European legislation and national legislation in Slovakia, it is always about how to comply with EU regulations without a clear connection between the influence of political decisions in legislative instruments to maintain the mutual good status of water resources, food security in the ongoing climate change. This trend is also observed in the National Climate Program, which is projected into strategic climate adaptation goals.[3]

All these strategic decisions lack the integrity link between water, energy, agriculture, food production and the climate. The strategies assess the impacts of climate change on individual sectors without defining a clear link between land use, water status, energy efficiency, food security and climate change with the possibility of a change in an integrated, holistic approach. As these contexts are not defined, there is little chance of proposing legislative instruments that would halt the trend of deteriorating stocks of water resources, reduced energy efficiency, and threats to food security in ongoing climate change. This research is lagging behind in Slovakia.

That is why the legislative instruments are more focused on how to protect at least basic indicators of the protection of natural resources. Paradoxically, such an approach produces decisions that can bring benefits in one sector but bring risks to other sectors, the protection of which requires a great deal of effort and investment. This was also the reason why the Slovak Academy of Sciences for Ecology and Landscape Planning proposed a new research role for the new research role of WATERS of the Slovak Academy of Sciences for financing and the research role of the "Integrated Permanent Water Recovery in Small Water Cycles", which should assess the use of rainwater for the permanent restoration of water in the ecosystems of the country for the sustainable development of Slovakia, because the territory of Slovakia, due to the long-term damage of the forest and the urban landscape, is drying up, it is prone to flash floods, severe torrential rain and extreme temperatures.

It is argued in the rationale that the sectoral approach of the past, the principle of which is that rainwater is considered to be the waste that we need to remove as quickly as possible from the basin, and this is the opportunity to use rainwater to replenish water supplies in the country's ecosystems the energy potential of rivers and rivers, how to increase photosynthesis in country I, reduce the production of sensible heat so that Earth does not dry out. The result of this research role is to change the use of the landscape so that water stress in Slovakia for people, nature, food, climate, energy and tourism (the left side of the scheme) turns into a permanent supply of water for people, nature, food, energy, climate recovery.

[3] http://www.minzp.sk/files/oblasti/politika-zmeny-klimy/nas-sr-2014.pdf



have recommended this research because water management systems need to set up landscape management so that land use does not jeopardize the regeneration of water resources for the present and the future.
The research role should provide a response to how to organize the forestry and urban landscapes in order not only to conserve the current state of water resources but also to gradually restore the water we have lost from Slovakia so that there is enough water for people, food, climate, and tourism, as shown on the left side of the scheme. There is some evidence that increased rainwater retention in landscape ecosystems results in increased groundwater supplies, increased photosynthesis intensity, and thus sequestration of carbon into biomass, increased latent heat production, and heat drainage from the ground layer to higher tropospheric layers.
With this process, it is possible to anticipate the strengthening of the vapor and the formation of precipitations, which are formed from the evaporated water from the country.
To clarify this context, it is a good example of how the temperature in Slovakia changes, for example, where agriculture is oriented to cereal grains. Of the 1 425 943 hectares of arable land, 1 216 817 hectares (85.33% of total arable land) are used to grow grain and oil production. The ministry looks at the impacts of agriculture on climate change by producing CO_2 and argues that Slovak agriculture is a smaller producer of greenhouse gases (8%) and therefore the impact on climate change.
However, the Slovak agro-resorte does not assess the impact of land use on the production of dry land temperature. In the summer period, the average temperature reaches 35 degrees Celsius in Slovakia after July 15, precisely because more than 1.2 mil. hectares of harvested crops.
Less than 2 mm of water evaporates from the mowed and dried slices. The daily evaporation of this dry stubble in the summer without clouds in the sky can reach up to 10 mm. This means that one hectare could be up to 100 m3. It evaporates barely 20 m3.
The difference between potential and real vapor is actually the sensible heat that is produced by the fact that solar energy does not need to be exhausted. From one hectare, therefore, daily heat production can

reach up to 56 MWh. This means that from the surface of all snakes, about 42 TWh will be produced daily in the atmosphere. It is 700 times the daily production of all power plants in Slovakia.
Cultivation of agricultural crops is therefore subject to dramatic fluctuations in the temperature regime and it is evident that properly sowing techniques can mitigate the growth of extremely high temperatures at the height of the summer. Once there is extreme drought, and elsewhere agricultural production threatens the floods. One of the possible solutions in the agricultural landscape is to set up a system for storing rainwater directly in the agricultural land. From natural water cycles we know that about 1/3 of the rainwater flows into the underground (gravitational water) and 2/3 remains in the soil (capillary water) and evaporates into the atmosphere through the vegetation. This portion of water in the process of evaporation causes the transformation of solar energy into latent heat that is pumped from the lower to higher layers of the troposphere, and there is released, under the law of conservation, when a dew point occurs.
Consequently, more water in the ecosystems (in the soil), more water evaporates, which reduces the production of sensible heat in the lower layer of the troposphere. It is also the opposite. If the landscape is dried, it evaporates less, and less heat is drained from the lower and upper layers of the atmosphere, and the heat remains in the ground layer of the troposphere and overheats it. The question is, how to increase the water vapor when it is lacking in the summer.
A potential source of water in ecosystems for the purpose of vapor may be rainwater, which drains from the damaged landscape without benefit at times of intense precipitation. All rainwater that flows away from the drainage areas of the forest and urban landscapes without benefit can be a potential source for:

1. Drainage of heat through the evaporation of water from the earth's surface to the higher layers of the troposphere (landscape thermoregulation)
2. Enhancement of biological and chemical processes by increased intensity of photosynthesis (sequestration of carbon into biomass and into soil)
3. Increase of underground water supplies, restoration of sources and improvement of hydrology of streams (water resources generation, flood protection, drought, improvement of the energy efficiency of streams and rivers)
4. Increasing the natural production potential of the soil - protecting food security and biodiversity
5. Expected mitigation of weather extremes, decline in natural disasters, increased cloud formation, decreased sunlight and slowing of warming and cooling of the landscape

Therefore, for the strategic decision-making and the definition of the legislative instruments, we need to have the proven impact of the rainwater retention in the country for the needs of protection of water resources, soil fertility, energy efficiency, sustainable development in the ongoing climate change. For this reason, we have calculated from the available data in Slovakia how increased rainwater retention in landscape ecosystems and increased evaporation through vegetation can increase heat drainage from the bottom to the upper layer of the troposphere. We assumed that an air volume of 80,000 cubic meters can reduce the temperature by 1 ^{0}C by evaporating one cubic meter of air. Based on this assumption, we calculated how much heat would be drawn from the bottom to the upper layer of the troposphere and how much the temperature would change for two variants:
I. Alternative - 3 mm ecosystem for increase vapor
II. Alternative - 6 mm ecosystem for increase vapor

The results of the calculations are summarized in the following table:

Table 13 Results

ground cover lands	total area		Actual state		Increassed vapor by 3 mm			Increassed vapor by 6 mm		
			Latent heat production	Sensible heat production	volume of evapor.	Sensible heat production	decrease temp.	Volume of evapor.	Sensible heat production	decrease temp
	HA	%	TWh	CT(TWh)	mil.	CT(TWh)	^{0}C	mil.	CT(TWh)	^{0}C

					m3			m3		
Grain crops	753 846	15,39	5,277	36,938	22,615	26,385	-2,4	45,231	15,831	-4,8
Oil plants	251 171	5,13	1,758	12,307	7,535	8,791	-2,4	15,07	5,275	-4,8
Grain maize	211 800	4,32	2,965	10,378	6,354	7,413	-2,4	12,708	4,448	-4,8
Field corn	78 054	1,59	1,093	3,825	2,342	2,732	-2,4	4,683	1,639	-4,8
Sun-flower	90 500	1,85	1,267	4,435	2,715	3,168	-2,4	5,43	1,901	-4,8
Berry plants	11 772	0,24	0,247	0,412	0,353	0,247	-2,4	0,589	0,082	-4
potatoes	9 000	0,18	0,189	0,315	0,27	0,189	-2,4	0,54	0,063	-4,8
sugarbeet	19 800	0,40	0,416	0,554	0,594	0,277	-2,4	0,792	0	-3,2
vineyards	27 313	0,56	0,765	0,574	0,819	0,191	-2,4	1,639	0	-4,8
gardens	77 351	1,579	2,166	1,624	2,321	0,541	-2,4	2,321	0	-2,4
Fruit gardens	17 952	0,366	0,503	0,503	0,539	0,251	-2,4	0,718	0	-3,2
Meadowland	883 506	18,036	18,554	30,923	26,505	18,554	-2,4	44,175	6,185	-4
Forest land	2 004 100	40,912	70,144	56,115	60,123	28,057	-2,4	80,164	0	-3,2
Waterlands	92 895	1,896	3,902	0	0	0	0	0	0	0
built-up areas	224 671	4,586	0	14,154	6,74	11,009	-2,4	13,48	7,863	-4,8
Roads	144 844	2,957	0	9,125	4,345	7,097	-2,4	8,691	5,07	-4,8
	4 898 575	100	109,244	182,182	144,17	114,903	-2,35	236,23	48,356	-3,86

The research question is how the processes of thermoregulation, evaporation, photosynthesis, carbon sequestration, intensity of biological and chemical processes in soil with increased rainwater retention, and last but not least the formation of microclimate are affected.

Research topics:

1. Know the impact of changes in water balance on landscape temperature, biodiversity, soil fertility by increasing rainwater retention in agricultural and urban landscapes.
2. Elaboration of scenarios of the possible influence of rainwater retention on the climatic development of the territory of Slovakia until mid-21st century with mapping and modeling of hydrological processes in the catchments of Slovakia.
3. Assessment of groundwater quality changes due to surface rainwater retention in agricultural and urban landscapes and description of extremes of mitigation trends.
4. Simulation of the influence of landscape temperature regime on cloud formation and precipitation activity in space and time.
5. Assessment of impacts of landscape damage on water balance status and temperature regime with impact on spatial changes in rainfall distribution
6. Assessing the impact of drying the landscape on the rapid rise of high temperatures in the spring period.
7. Develop a methodology for the use of the country for the permanent restoration of water resources

Slovakia has already come up with this innovative initiative in 2010, when after the historic floods, the Government of the Slovak Republic has adopted a rehabilitation program for the damaged country. Here is a survey of the program: The Landscape Revitalization and the River Basin Management Program in Slovakia (2010-2012)

The Programme of Landscape Revitalisation

The Landscape Revitalisation and the River Basin Management Programme (further the Landscape Revitalization Programme or Programme) was approved by the Slovak Government in October 2010. The Programme responded to catastrophic floods which occurred during 2010 in Slovakia repeatedly. The Programme defined the rainwater retention treatments to be used as the main tools of solving ecosystems problems, but first of all for decreasing risks of floods, droughts and erosion. 488 cities and villages participated in the Programme between October 2010 and March 2012. Thanks to the European Social Fund, it was possible to create 7 700 seasonal jobs for long term unemployed (mostly for 6 months). People employed during the Programme implementation have created about 100 000 various rainwater retention land treatments mainly in the upper parts of individual river basins. Part of the water management community opposed the Programme. The incoming Slovak Government decided not to continue in the implementation of the Programme. The Programme, its benefits and limitations, however, were never really evaluated.

Survey

On December 13, 2012 we distributed a questionnaire to mayors of all 488 municipalities. The aim was to collect views, experience and comments from those who participated in the Programme directly, experienced it and were presumed to get benefit from it. The questions to mayors reflected positions of both the supporters as well as opponents to the Programme. Until March 20th 2013, the survey organisers received 218 filled questionnaires (45%).

More details about the survey (in Slovak) are available at People and Water

Main conclusions of the survey

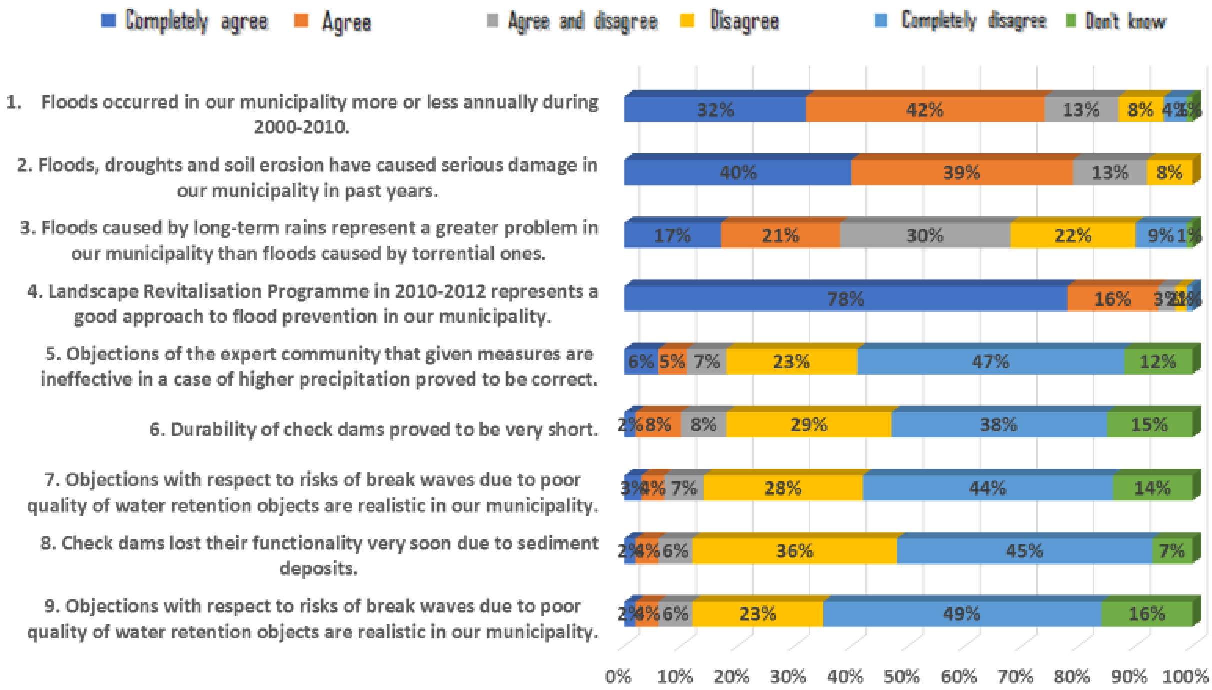
Two years after launching the Programme it is possible to resume:

1. More than three quarters of mayors see the Landscape Revitalisation Programme in 2010-2012 as the right approach to flood and drought prevention as well as anti-erosion protection.
2. Majority of mayors (70 %) values the Programme as useful and attractive way for creating jobs for the unemployed.
3. Majority of mayors (89 %) would like to continue the sort of the land revitalisation.
4. Support to the Programme was expressed by mayors regardless their individual political party affiliation.

Response of mayors in brief

Responds from mayors confirmed the fact that the Programme was implemented in municipalities with high frequency of flooding in previous years (Question 1). Floods, drought and soil erosion have caused a serious damage in given municipalities (Question 2). Mayors attributed approximately the same threat to torrential rains as to long-term rains (Question 3). Mayors rejected efforts of the Programme's opponents to marginalise torrential rains. Official prognoses inform about the increased frequency of droughts and torrential rains in coming decades. Regardless of response to the previous question, majority of mayors (94 %) viewed the implemented water retention measures as a good approach to flood prevention in their municipality (Question 4).

Mayors don't agree that given measures are ineffective in case of higher precipitation. Such objections come from experts critical to the Programme (Question 5). Average annual precipitation was low in the tested period. That makes the testimony of mayors weaker. On the other hand, torrential rains occurred even during the given dry period (2012). Disagreement of mayors with the critical statements of some experts certainly doesn't mean they view the implemented measures as perfect protection against any precipitation. Majority of mayors didn't confirm a very short durability of check dams (until the first rain only) predicted by expert critiques (Question 6). No doubt that some, out of several thousand check dams, did collapse. Nevertheless, responses indicate that the number of collapsed check dams represents an insignificant portion.

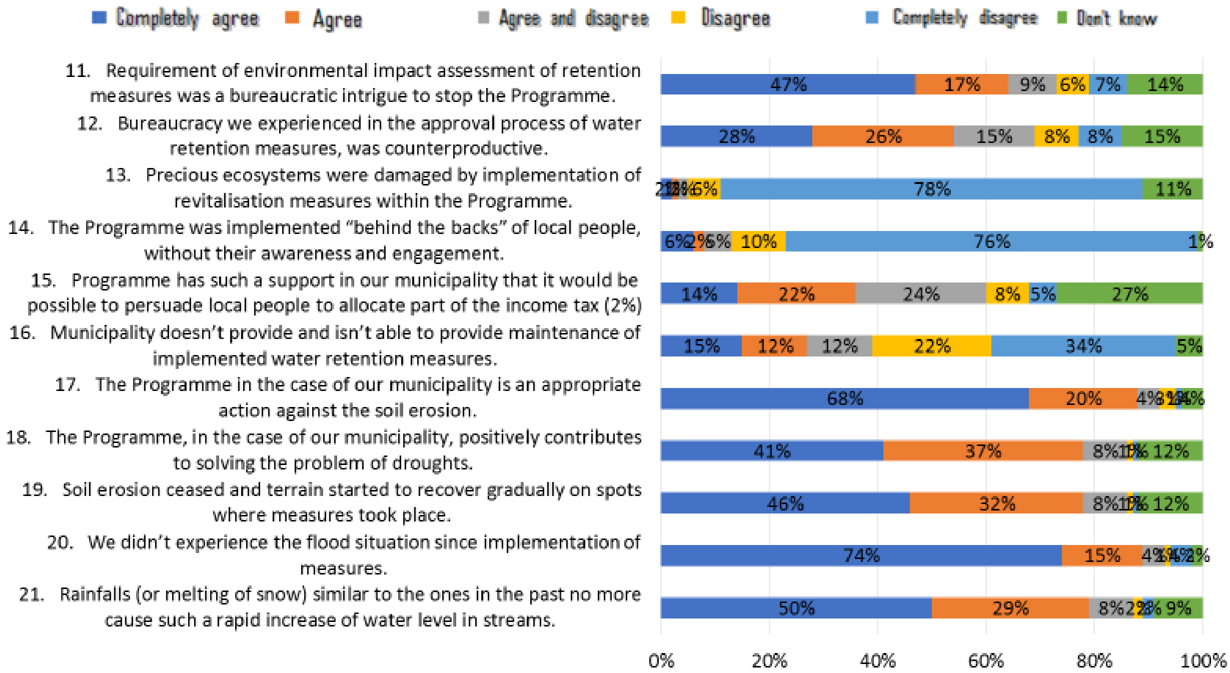


Mayors neither confirmed risks of break waves due to the poor quality of check dams (Question 7). Such responses rather reflect typical situations of having a large number of decentralised small-scale implemented land treatments. Failure of just one out of many measures represents no threat to the municipality. Respondents didn't confirm that implemented objects lost their functionality due to sediment deposits (Question 8) or that sediment deposits in check dams would increase risk of flooding due to backwater level (Question 9). Dangerous backwater curve happens if culverts are blocked by the debris due to the *absence* of check dams in the upper part of the stream. Sedimentation in check dams doesn't mean a failure. It protects large water reservoirs around electric plants from accumulation of sediments. It is possible to mine the sediments from check dams. Sediments moderate a lateral slope if left in place. The objection that municipalities don't care and/or aren't able to provide maintenance of water retention measures has caused some hesitation among mayors (Question 16). The reason is probably the poor financial situation of municipalities. Employing the unemployed is a possible solution for ensuring land treatments maintenance, according to some mayors.

Other type of objections was directed against implementation of retention measures without administrative permissions such as zoning permits or final inspection. Most mayors reject this charge (Question 10). Most municipalities followed the law and regulations. Though, permissions were often arranged/administered in process of building them or after construction, namely during the first starting Programme projects which were implemented in situation of fearing next floods to come. Legislation tolerates such practice in emergency situations. Proceedings with respect to administrative permissions were a condition for obtaining the state subsidy during the implementation of the follow up phase - the second Programme implementation projects. Only a small number of municipalities were required to get the "waterworks" building permit by respective district environmental departments. Departments – offices in charge usually checked the project documentation and claimed that revitalisation measures are not liable to the diction of "water construction" legislation.

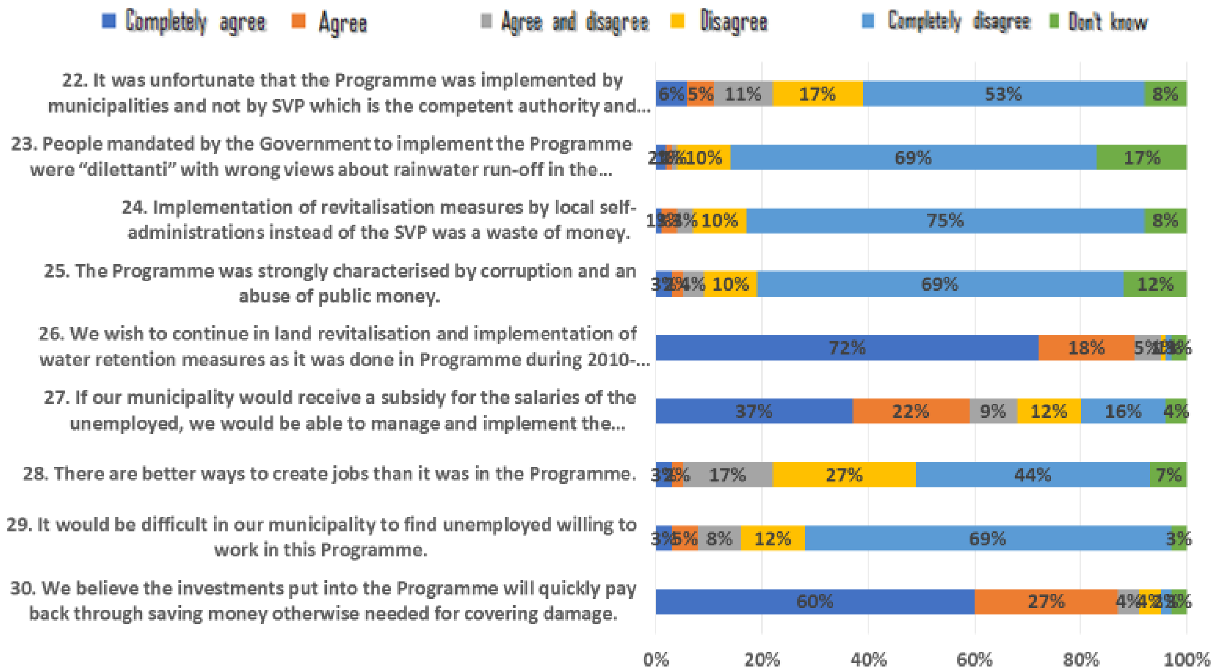
Majority of mayors believe that bureaucratic intrigues were applied by opponents of the Programme in order to stop it (Question 11). They experienced counterproductive bureaucracy during the approval process as well (Question 12). Respondents sharply rejected hints of critics that precious ecosystems were damaged during the implementation of revitalisation measures (Question 13). They equally rejected claim that Programme was implemented without awareness building, engagement and participation of local people (Question 14). Let us recall that supporters of the Programme easily collected 6619 signatures in favour of its extension in only five days (which was a reaction to opponents' effort to abolish the Programme in January

2012). Support of local public is indicated also by a relatively high portion of mayors who suppose that it would be possible to persuade people in their village to allocate part (2%) of the income tax in favour of continuing the landscape revitalisation activities (Question 15).

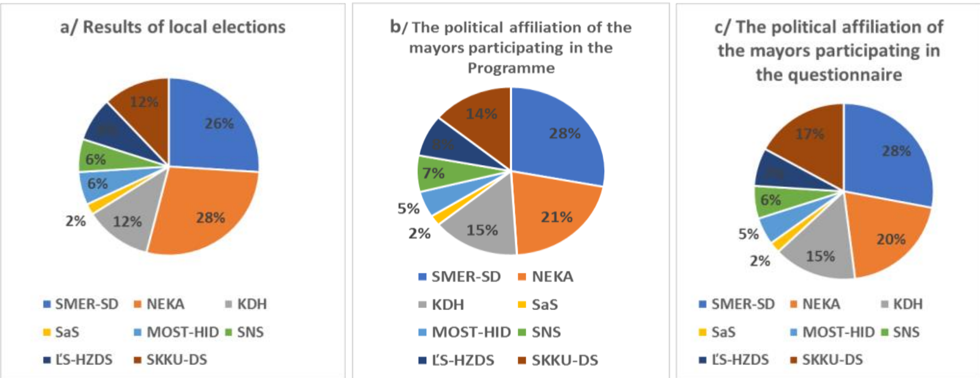


Vast majority (86%) of respondents claimed that revitalisation measures implemented in the Programme represent an appropriate action against the soil erosion (Question 17) and against the drought (Question 18). Implemented water-holding measures release water in dry periods gradually. Most people remember the Programme as the "check dams' programme." Though, check dams represent only minor part of implemented measures. Most measures aimed to slow down rainwater run-off were implemented out of streams: scarification of useless forest roads, surface cross drains, restoration of erosional gullies, contour trenches, infiltration pits, etc. Majority of mayors observed that the soil erosion ceased on spots, where measures took place, and the terrain started to recover (Question 19). Most municipalities (89 %) didn't experience flood situation since implementation of measures (Question 20). Rainfalls (or melting of snow) similar to the ones in the past no longer cause such an increase of water level in streams (Question 21– 79%).

Respondents exhibited very low expectations for their problems to be solved by the state owned SVP – the Slovak Water Management Enterprise (Question 22). Several of mayors expressed opinion that centralised state owned enterprises (SVP or Slovak Forests) have their roles in the river management. Nevertheless, revitalisation of 60.000 km of water-courses, including the tiniest ones (plus surrounding areas within river basins) go far beyond their capacity even in SVP having more finances available. Mayors have high opinion about people responsible for the Programme whom part of expert community often labels "dilettanti" (Question 23). Apparently, mayors trust expertise of the Programme management in rainwater run-off issues, not necessarily in all matters they express opinion on. Mayors reject objection that revitalisation measures were a waste of money (Question 24). Revitalisation measures are cheaper by a rank in comparison to solutions traditionally applied by the state water management enterprises. Just for a comparison – the government's Official Bulletin No. 1/2013 announced a tender to implement anti-flood measures in 10 villages totalling 30 million EUR. For a similar amount the Programme would treat 350 villages. Mayors saw the Programme as cheap, highly decentralised and transparently managed rather than corrupted (Question 25). Most mayors (89%) wish to continue in land revitalisation and implementation of water retention measures (Question 26). Majority of them believe that if they received a financial contribution to cover salaries of the unemployed, they would be able to manage and implement the measures by themselves (Question 27). This way of employing the unemployed is attractive for municipalities and for the unemployed as well (Questions 28, 29). The investments into the Programme will pay back through elimination of expenses needed to cover damage which will no longer occur, if treatments are built, according to opinion of mayors (Question 30).



Survey processed the political affiliation of mayors who participated in the survey. Political affiliation of mayors who responded to the questionnaire correlates with the results of local elections (Charts a, b, c). This illustrates that mayors are supporting the Programme implementation regardless of their political party affiliation.



The continuation of this program and, in particular, the study of the effects of increased rainwater retention in ecosystems would bring new knowledge from both the theoretical and practical level of climate change and the ability to address water, food, energy and climate security by good management of the land use.

4 Validation of the assessment of policy interactions

The results of policy coherence assessment and analysis have been discussed with stakeholders at various cases – personal meetings, conferences, workshops, etc.

The most important source of information was a stakeholders' workshop on 7. – 9. March 2018 in Třeboň (Czech Republic), where the stakeholders from all three states of transboundary study met under a discussion on common topics.

The stakeholders were represented by:

Czech representatives (14 participants)

- representative of Ministry of Environment CZ, municipality offices from Třeboň, entrepreneur (biogas, agriculture, water supply), State water management/Povodí Vltavy, hydrometeorological institute, landscape architect and planner, association of private and municipal forest owners, research: agriculture economy, soil and water conservation, environmental law – cooperating with the Czech Parliament and owners of small agriculture lands managed by large companies.

German representatives (5 participants)

- Federal Institute for Research on Building, Urban Affairs and Spatial Development, Urban Climate, Brandenburg State Authority for the Environment – Water Bodies of Brandenburg, Vattenfall GmbH – Energy

Slovak representatives (6 participants)

- Agency for Regional Development East Slovakia, PEWA - Polymer Research and Application, KREAPROJEKT – Research and Development of systems for environmental monitoring, NGO People and Water, Rain for Climate, Biomasa

Under a broad discussion all three partners of transboundary case study have agreed on following issues concerning the interactions between NCOs, NCIs, interactions between policies and success stories, that have been already deeply analysed in previous sections.

The conclusions are following:

- The Czech Republic, Eastern Germany, and Slovakia experienced a common period of collectivization, causing increased field block areas and large-scale drainage; the ramified hydrological web of the agricultural landscape disappeared.
- To fulfil the EU aim of 20 % of renewable energy sources till 2020, governments in CZ and SK support plant biomass production: rape for biofuel, maize for biogas, wood for wooden chips etc.
- Germany 30% renewable energy now, 40% in 2020 (wind power)
- Consequences for water and energy supply, food supply and local/regional climate. Is it sustainable use of resources?

A) Czech parallel session

What are the most critical challenges?

- drying out of landscape
- soil degradation

- We do not have specific and tailored legislation for these two topics in order to solve serious environmental problems resulting from drought and soil degradation
- No national landscape politics and conception
- Landscape heterogeneity in terms of property rights
- Conceptions and strategies are under one ministry (no communication between ministries – agriculture and environment)
- Economics interests prevents the changes in landscape structure (large fields blocks, exceptions to CAP cross-compliance and greenings)
- Government is not willing to set up strict conditions for land management (GAEC, greening,..)

- Obtaining the subsidies from the single payments scheme (direct payments) is the main motivation for farmers (no interest in sustainable management because are not the owner of the land; they manage leased land)
- Weak mandate of institutions for sanctions demanding for legislation breach and restoring measures
- Czech national policy on renewable energy is too much based on biomass sources, because of low potential of water, wind, solar and geothermal energy; This cause serious problems in agricultural soil protection

Policy opportunities in CZ and cross-border

- Amendments in national legislation in water and soil management; new legislation – national landscape politics should be prepared (now only discussion within the amendments of Building Act)
- lack of intersectional or coherent policy approach (Nexus problems could reflect better "umbrella" strategy than national sectoral policy, for example "landscape integral planning" as new tool in our legislation policy (not existing, suggestion)
- Define water as public interest which would (maybe) enable easily enforce water retention measures in the landscape (today the public interest is considered e.g. flood protection, construction of roads; in the public interest, in exceptional cases, land may be expropriated; however public interest is not defined in any legal instrument)
- Conceptual and complex consideration/measures of water retention in the whole catchment – especially upper parts (need of inter-ministerial communication) have following impacts:

= tool for drought and flood mitigation (decrease outflow)
= water quality improvement
= increase groundwater level
= Decrease of erosion
= effect on local climate

Policy goals and instruments

- Water retention measures – ecosystem services assessment (farmers should realize better than compensations for drought is prevention = water retention)
- Changes in CAP – revise direct payments, greening system – financial support and subsidies for water retention
- Increase land state property in order to realize water retention technical measures
- Cancel quotas for renewable resources i.e. all production from renewable resources should be the responsibility of Member states (no obligation how much energy should be from renewables)
- Fines and penalties for poor landscape management – need to develop indicators of good landscape management
- Implementation of technical and biological measures for water retention resulting from the Management Plan of Labe River

B) German parallel session

- Removal of double taxation for electricity being transferred to a pumped-storage facility
- Laws prohibiting decentralisation: Additional VAT-Taxation of private households for generating photovoltaic electricity, Rain water users must install extra water clocks and pay money for usage
- Area consumption of renewables (wind, solar), conflicts with environmental protection, agriculture, and health. + There is a legal prohibition to combine photovoltaics and agriculture.
- How about water retention under energy plantations short rotation coppice, maize, rape,...)
- Photovoltaics have the highest untapped energy potential (20% efficiency, versus 1% photosynthesis)
- Laws fostering biomass usage lead to carbon removal from soils; in Berlin, dead wood is collected from the city forests. Also negative consequences for biodiversity.
- The system of subsidies in agriculture generates a lot of false incentives
- Forest devastation in countries from which wood (low carbon fuel) is imported

C) Slovak parallel session

What are the most critical challenges?

1. Landscape drainage – lack of water in the landscape
2. Economic interests prevail over the ecosystem services importance
3. Loss of the personal identification and responsibility of local people for landscape management
4. Un-effective motivation tools for landscape management

Policy opportunities in SK and cross-border

1. Implementation of the Concept for landscape revitalization at national level
2. Connection to social policy
3. Ecosystem-based approach for water retention in landscape
4. Promotion of best practices at international level

Policy goals and instruments

1. To change the motivation tools towards effective water retention measures in the landscape through the sectors (agriculture, forestry, industry, households, etc.)
2. To implement new water policy instruments for rain water
3. PR – general public education towards the importance of the ecosystem-based measures in landscape.

One of the most incentive discussion was provided by prof. Tomáš Kvítek (Povodí Vltavy s.p.) whose long term interest are complex land measures aimed at spatial water retention in landscape and water quality improvement. His (and his co-workers team) conclusions on water regime improvement:

- The fundamental structural differences between natural and artificial persons in agriculture are the result of the forced collectivization of Czech agriculture, the consequences of which are manifested to this day. The achieved degree of landholding concentration is quite different from most of the EU member states
- It is stated in the Strategy of the Ministry of Agriculture until 2030 that it will be necessary to bind the granting of direct payments to the condition of the maximum limitation of soil blocks; however, it is not a solution for decrease of erosion and increasing the retention ability of agricultural land. It cannot be expected that entrepreneurs will give up this benefit, as it is a fundamental prerequisite for plant production
- Only under the conditions of the farmer = the landowner, can be, in the long term, satisfied the condition of sustainable soil management and increased water retention
- From direct payments, including also other payments, increase the share of resources intended to improve soil quality and reduce the share of payments to direct production
- Increase farmers' responsibility for implementing measures aimed at mitigating the effects of climate change
- The need to adopt key policy decisions to stimulate complex structural measures in favor of water retention and accumulation in the landscape; financially demanding measures must have support in the state budget; the proposed measures need to be prepared well in advance and can only be tackled at a society-wide level without departmental barriers and unguarded competencies
- Increase state financial support of the complex land consolidation, which has been critically underestimated since 1991. If they are considered as a basic system of state measures in favor of reducing erosion, droughts, torrential rain. An average of 1.4 billion CZK / year is spent (25 mil. EUR), 60% of the measures are for the construction of roads, 8% for the realization of hydrological and ecological measures
- Number of non-production functions, aiming, among other things, to improve the water regime I s realized through complex land consolidation. It is possible to supplement the system, which under the competence of the State land Office provides management, repair, operation of main drainage, irrigation and anti-erosion measures, on the organizational structure, which will develop activities toward more effective complex land consolidation and with state support will implement measures for water retention, minimizing drought and erosion

- It is necessary to change the approach for the retention and accumulation of water on the agriculture land - erosion and associated water drainage and its quality is solved in the Czech Republic for over 50 years with the same results
- The solution cannot be just nature-friendly measures that are unable to solve larger volumes of water from the outflow, it cannot be either by increasing the organic matter in the soil or by changing/diversity the crops. Interconnection of natural and technical measures is necessary
- A promising proposal in the Strategy to reduce SAPSs by using part of the payments and measures in favor of improving the quality of agriculture land and water resources; support for measures aimed at reducing damage caused by climate change
- Payments to LFAs and SAPS, which are linked to GAEC and greening rules, should not be under pressure from different interest groups; other support – AECM and organic farming prefer in terms of sustainable soil and water resources management
- Offer investors ideas on how to participate in projects aimed at water retention in the landscape
- The current water management policy focuses on strategic objectives such as ensuring sufficient drinking water resources of the required quality, the necessary volume of water for irrigation in the areas most at risk of drought, raising minimum flows in rivers, increasing retention and accumulation of water on agriculture land, use of water for recreation, sport and for energy purposes. The fundamental strategic role of water in the above-mentioned contexts would deserve to set up better responsibilities in the over-ministerial setting from the social point of view. Consider and prioritize the importance of the proposed priorities by individual resorts and, on the basis of a political decision, to realize that water as a natural resource similar to land and air are irreplaceable and require a completely different degree of urgency and complexity treatment.

5 Conclusions

There is a common understanding that the current practice of farming in the cultural landscape leads to its drying out and soil degradation. The lack of water in the landscape has deepened noticeably over the past decades. Only thanks to the infrastructure from the past, i.e. the dams and water distribution system, and to distances over 100 km, most municipalities are provided with sufficient quality water. However, further drying out of the countries will lead to a lack of water and reservoirs as their source of water is a cultural landscape with forests. It is necessary to change the way of farming, respect the empirically proven role of permanent vegetation in the landscape and to dampen the overheating of the landscape. This overheating leads to its drying out by transport and loss of water vapors by overheated air (sensible heat). The direct role of water and vegetation in the local climate and the short water cycle is not the focus of contemporary science, which focuses on the indirect role, i.e. reduction of producing or sequestering greenhouse gases.
An exact description of the processes of solar energy and water distribution on the interface of the different landscape cover - the atmosphere, contemporary science does not hold. There are no reliable models that would be able to describe these phenomena and predict changes caused by changing the landscape coverage. Science cannot describe these processes; therefore, these critical processes of local climate formation are not paid attention. The importance of land cover and its direct effect on surface temperature is supported by thermal images, where forests, wetlands, growing vegetation have a surface temperature of up to 30 ° C, while the built-up area, like harvested fields and lawns, have a surface temperature above 50 ° C. The warm air coming from these hot surfaces drains the landscape by "atmospheric rivers". Thus, more water flows out of the air flow than by the rivers, where we carefully monitor the water balance of the landscape.
And all these facts we should try to respect and implement into policies that are targeting to solve the problem of climate change and water scarcity.

Horizon 2020 Societal challenge 5
Climate action, environment, resource
Efficiency and raw materials

D2.2: Upper Rhine Transboundary Case Study (France-Germany)

IDENTIFICATION AND ASSESSMENT OF NEXUS-RELEVANT POLICIES, ANALYSIS OF POLICY COHERENCE, IDENTIFICATION OF SUCCESS STORIES

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26 – July –2018

Horizon 2020 Societal challenge 5
Climate action, environment, resource
Efficiency and raw materials

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PROJECT NUMBER	689150
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DELIVERABLE	D.2.2 UPPER RHINE TRANSBOUNDARY CASE STUDY (FRANCE-GERMANY) IDENTIFICATION AND ASSESSMENT OF NEXUS-RELEVANT POLICIES, ANALYSIS OF POLICY COHERENCE, IDENTIFICATION OF SUCCESS STORIES
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1	DRAFT 1	26/07/2017	DRAFT BLOCK I
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3	FINAL	26/07/2018	BLOCK I + BLOCK II

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Climate action, environment, resource
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Executive summary

Dissemination and uptake

This report can be publicly consulted and quoted.

Short Summary of results

English
This report analyses how the water, land, climate, energy, food and climate Nexus sectors are governed by territorial stakeholders of the case study area that comprises the French region Grand Est and the German state Baden-Württemberg. Firstly, the region is described by a brief socio-economic analysis that focuses on two sectors of importance in the region: water and energy. Then, major stakeholders of the five Nexus sectors are identified and their relative power and interest positions are analysed. Sector-specific public policies, objectives and instruments in effect in the territory are identified. The report further analyses coherence of policy objectives and instruments and coherence in policy development and implementation. Finally, the report includes an analysis of regional formal and informal institutional arrangements in place that enhance policy coherence and transboundary cooperation.

French
Ce rapport analyse le traitement du Nexus et de ses enjeux par les acteurs territoriaux de la région du cas d'étude qui comprend la région française Grand Est et le Land allemand Baden-Württemberg. La région est décrite par une analyse socio-économique qui se focalise sur deux secteurs d'importance pour le cas d'étude: l'eau et l'énergie. Les acteurs majeurs des 5 secteurs du Nexus sont identifiés puis leurs positions relatives de pouvoir et d'intérêt sont analysées. Les politiques publiques, objectifs et certains des instruments en vigueur sur le territoire sont identifiés pour chaque secteur. L'analyse porte ensuite sur la cohérence du contenu des réglementations, des objectifs et sur la cohérence au niveau de l'implémentation, et en particulier via la description des dispositifs formels et informels mis en place.

German
Dieser Forschungsbericht analysiert das Verwalten der Akteure des sogenannten Nexus, die Verbindung zwischen Wasser- Land- Nahrungsmitteln-, Energie-, und Klima-Themen der Region Grand Est und Baden-Württemberg. Der erste Teil behandelt eine soziale und ökonomische Analyse der Region, zugespitzt auf die wichtigsten Sektoren: Wasser und Energie. Dann werden die wichtigsten Akteure der fünf Nexus Sektoren beschrieben und Ihr Einfluss und Interesse analysiert. Sektor spezifische Gesetzestexte, Zielen und Instrumente der Region werden im folgenden Kapitel identifiziert. Sowohl die Kohärenz zwischen Politischen Instrumenten und Zielen als auch die Kohärenz in der Durchführung und Entwicklung der Gesetzestexte werden analysiert. Dieser Bericht enthält eine Betrachtung regionaler formeller und informeller institutioneller Vereinbarungen die die Kohärenz und internationale Zusammenarbeit ergänzen.
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Glossary / Acronyms

TERM	EXPLANATION / MEANING
CAP	COMMON AGRICULTURAL POLICY
GHG	GREENHOUSE GAS
ICPR	INTERNATIONAL COMMISSION FOR THE PROTECTION OF THE RHINE
RBMP	RIVER BASIN MANAGEMENT PLAN
SRADDET	REGIONAL PLANS OF DEVELOPMENT, SUSTAINABLE DEVELOPMENT AND EQUALITY OF THE TERRITORY (FRANCE)
SRCAE	REGIONAL SCHEME FOR CLIMATE AIR ENERGY (FRANCE)
SRCE	REGIONAL SCHEME FOR ECOLOGICAL COHERENCE (FRANCE)

* Acronyms for stakeholders are provided in Figure 7.

Introduction

The **transboundary France-Germany case study** is situated in the Upper Rhine region and covers the federal state of **Baden-Württemberg** on the German side and the recently formed (2016) **Grand Est Region**[1] on the French side, with the (Upper) Rhine playing the role of physical and administrative borders in its middle[2]. The area along the Rhine is one of the most densely populated and highly industrialized areas of the European continent. The Upper Rhine region is also part of the so called *Blue Banana* in Western Europe, encompassing the highly and very densely populated region from Birmingham down along the Rhine axis through Alsace and Baden-Württemberg, to Torino and Florence[3]. This highlights the importance of the economy along the Rhine, its role in the provision of water for electricity generation and transportation in a European context.

Both sides of the river are historically intertwined and cooperation beyond borders, including between France and Germany or between all riparian countries of the Rhine River, is the norm in particular in the field of water management as illustrated by the activities of the International Commission for the Protection of the Rhine (ICPR). At a more local level, urban development around its main cities are transboundary, as illustrated by growth and planning of the Eurodistricts (around the cities of Basel and Freiburg) and the Eurométropole (around the city of Strasbourg).

The case study focuses on the links and synergies between **energy policies** and the **transition to a low-carbon economy** on one side, and the **management of natural resources (in particular water) and ecosystems** on the other side[4]. Because of its transboundary character, it also investigates the links between policy development and implementation on both sides of the Rhine, and whether there would be opportunities for enhancing cooperation and policy coherence between France and Germany for achieving jointly set policy objectives in an effective manner. More specifically, the questions that will be addressed in the case study include:

- What are **present policies** and instruments put in place in France and in Germany **for achieving energy transition**? What are the similarities and differences between France (Grand Est region) and Germany (Baden-Württenberg)? And what current mechanisms and initiatives exist (and at which decision-making level) for establishing synergies and coherence (if these already exist) between the two countries?
- What are (visible or foreseen) **positive and negative impacts** of these policies on the management of **natural resources, in particular water, ecosystems and biodiversity**? Which sectors are mainly responsible for these impacts? What are the mechanisms and instruments put in place (be it in the policies aiming at transition to a low-carbon economy, or in water/ecosystem policies) that limit, or enhance, these impacts? How do these impacts affect indirectly other economic activities and sectors of the Upper Rhine economy? Would the

[1] It integrates the former Alsace, Lorraine and Champagne administrative regions.

[2] The case study does not include the Swiss part of the territory which is usually defined as the Upper Rhine in a water management context.

[3] Diercke International Atlas, 'Geographic Models of the European Economy' <http://www.diercke.com/kartenansicht.xtp?stichwort=blue+banana&submit.x=0&submit.y=0> [accessed 11 July 2018].

[4] The other nexus (land, food and climate) will be explored in the context of WP5 models.

foreseen impacts on natural resources and ecosystems, and also on activities benefiting from these ecosystems, be aggravated, or reduced, under scenarios of **climate change**?

- Which **changes in policies** could enhance the **coherence between both policy domains** – in France (Grand Est region) and in Germany (Baden-Württemberg), considered as separate entities? What would be the social, economic and environmental impacts of such policy changes? What are the pre-conditions for ensuring that such policy changes take place and are effective?
- How could **cooperation** between France (Grand Est region) and Germany (Baden-Württemberg) be **strengthened** so as to **reach jointly the policy objectives** of transition to a low carbon economy in a more effective manner? Would such cooperation **modify significantly the impacts on natural resources and ecosystems** as compared to policies been implemented independently in both countries? More generally, what would be the social, economic and environmental impacts of such cooperation? And what are the pre-conditions for ensuring that such cooperation takes place and is effective?
- How should cooperation be designed, accounting for today's situation and for climate change, so as **negative impacts** on natural resources and ecosystems are **minimized**, and **positive impacts** on natural resources and ecosystems are **maximized**? What would be the pre-conditions for proposed mechanisms to take place and be effective?

1 Socio-economic context in the Upper Rhine region

1.1 General presentation

Socio-economic data corresponding to the Upper Rhine territory is generally available at the administrative levels of the Grand Est and Baden-Württemberg regions. Therefore the analysis will focus on these two perimeters in order to define an Upper Rhine identity.

The Grand Est region has a total surface area of 57 800 km² and a border with four countries (Germany, Luxembourg, Belgium and Switzerland) of about 760 km in total. Baden-Württemberg shares borders with France and Switzerland. It is Germany's third largest state in terms of size and population, with an area of 35 751 km^2. Both regions are represented in the map below.

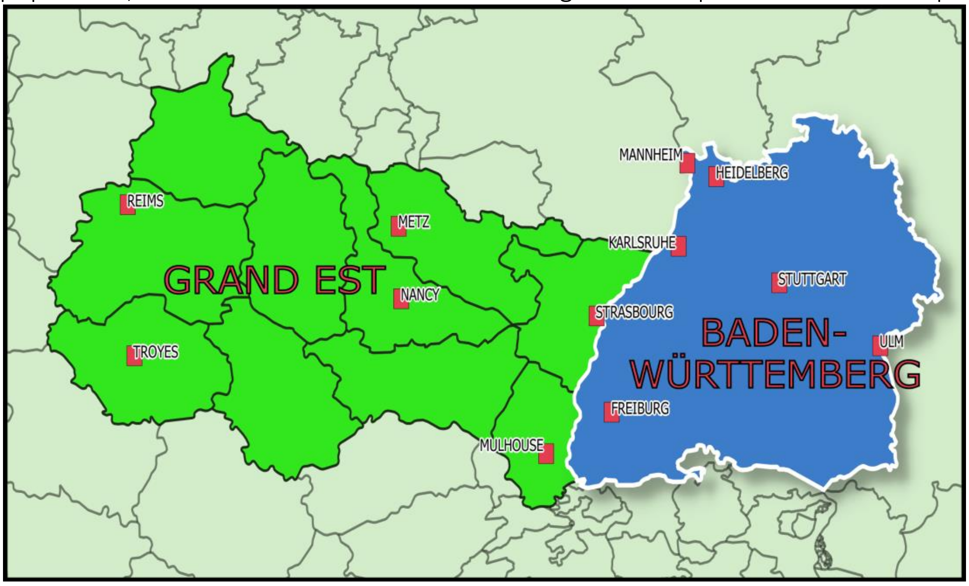


Figure 1: Grand Est and Baden-Württemberg regions

The Grand Est region had 5,5 million inhabitants in 2015 (representing app. 8,7% of the metropolitan French population)[5]. About 80% of the population lives in an urban area (see figure on the right). The average population density is 97 inhabitants per square kilometer, with significant disparities across the region: 52 inhab./km² in the former Champagne-Ardenne; 100 inhab./km² in the former Lorraine; and 225 inhab./km² in the former Alsace (2012 INSEE data)[6].

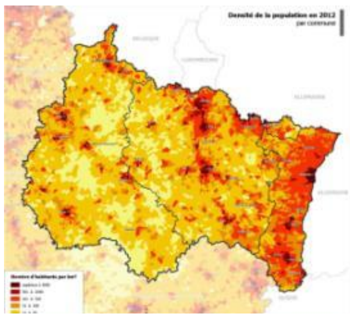


Figure 2: Population density in 2012 in Grand Est region (source: INSEE)

Baden-Württemberg was populated by 10,8 million inhabitants in

[5] SGAR Alsace, Champagne-Ardenne et Lorraine, 'Diagnostic de La Région Alsace, Champagne-Ardenne, Lorraine', 2015 <http://www.prefectures-regions.gouv.fr/grand-est/content/download/23953/165616/file/Diagnostic+SGAR+ACAL+Partie+1.pdf> [accessed 6 June 2018].

[6] La Région Gran Est, 'Atlas de la Région Grand Est', *GrandEst* <https://www.grandest.fr/atlas> [accessed 6 June 2018].

2016, for a population density of 302 inhab./km^2 in 2015 (Eurostat), concentrating higher proportions of population than on the French side of the case study perimeter (Figure 3).

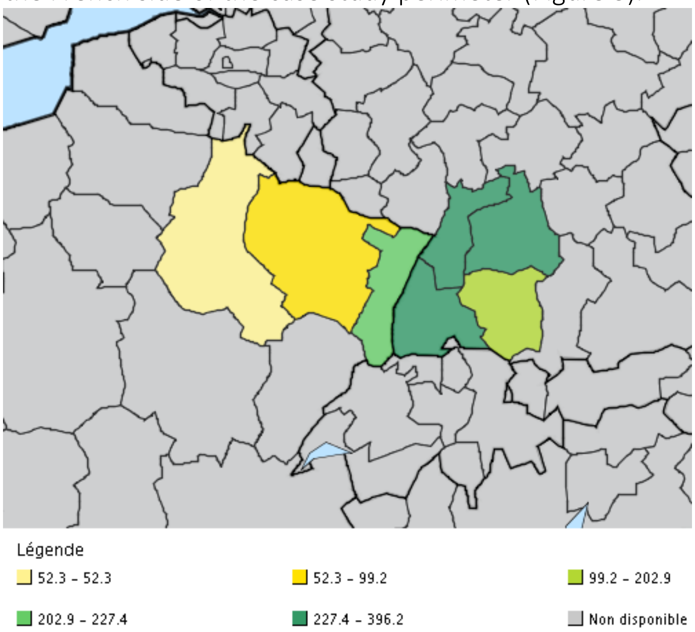


Figure 3: Population density per NUTS 2 region (Eurostat, 2015)

The trends indicate a rising population in Baden-Württemberg and former Alsace region, a declining population in former Lorraine region and a steady population in former Champagne-Ardenne region, as illustrated by the table below.

Table 1 : Evolution of population densities per NUTS 2 region in the Upper Rhine case study perimeter (Eurostat: 2011, 2013, 2015)

NUTS 3 region	2011	2013	2015
Baden-Württemberg	293,6	296,5	302
Alsace	224,2	226	227,4
Lorraine	99,8	99,5	99,2
Champagne-Ardenne	52,2	52,3	52,3

1.2 Economic specificities

Both the French and German parts of the Upper Rhine region are highly **industrialized**. Baden-Württemberg's economy is dominated by small and medium-sized enterprises: in 2003, there were almost 8 800 manufacturing enterprises with more than 20 employees, and 384 with more than 500[7]. Medium-sized enterprises account for 43% of the 1.2 million persons employed in the industry sector.

[7] Wikipedia, 'Baden-Württemberg' <https://en.wikipedia.org/wiki/Baden-W%C3%BCrttemberg#cite_ref-13.> [accessed 11 July 2018].

Baden-Württemberg is also home to large enterprises' headquarters[8]. The Grand Est region also has an important industrial past. Today, 25.3 % of the added value comes from the industry and construction sectors (19.6 % at national scale).
However **services** make up the highest share of GDP in Baden-Württemberg (61.7% in 2007), as shown in the table below. Energy supply and agriculture have a low share of total GDP.

Table 2: Economic activity in Baden-Württemberg per sector, 1991 and 2007[9]

Economic activity	1991 Mil €	1991 % of total GDP	2007 (1) Mil €	2007 % of total GDP
Total	1,534,600		2,428,200	
Manufacturing (2)	477,890	31.14%	607,720	25.03%
Energy Supply (3)	32,150	2.10%	48,940	2.02%
Agriculture and Forestry	2 ,629	0.17%	20,430	0.84%
Services (4)	863,480	56.27%	1,499,240	61.74%
Other activities (5)	156,451	10.33%	251,870	10.37%

Source: StaLaBW, 2010a
Notes: (1) latest available data for agriculture and forestry; (2) includes construction, mining, extraction of stones and earth, and manufacturing; (3) includes public water supply; (4) includes trade, catering and transport, financing, leasing and business services, and public and private service; (5) includes fisheries and taxes minus subsidies.

The **tertiary sector** makes up for 71.3% of total added value in Grand Est region. The **agriculture** sector in Grand Est region is more important than in Baden-Württemberg in terms of GDP since 3.3 % of the added value comes from the agriculture, forestry and fishery sectors (1.7 % in France). Moreover, close to 80% of the area is dedicated to agriculture and forestry, and it is the leading region in Europe for cereal production (especially the former Champagne-Ardenne region).
However, disparities exist among the economic structures of the former regions within the Grand Est region. As such, the former Champagne-Ardenne region is dominated by the agriculture sector, whereas in former Alsace it is less important than the national average, and almost three times less than the Grand Est region average. In contrast, the **industry and construction** sectors are more important in Alsace than at the national scale (27.7% vs. 19.6%) and Grand Est region (25.3%).

[8] Such as: Daimler AG, Porsche, Robert Bosch GmbH (automobile industry), Carl Zeiss AG (optics), SAP SE (largest software enterprise in Europe) and Heidelberger Druckmaschinen (precision mechanical engineering).
[9] Source: EPI-Water project, European Commission (FP7 Environment Programme).

Table 3: Value added by industry (%)

ADDED VALUE PER SECTOR (%)	GRAND EST REGION	FORMER ALSACE	FRANCE
AGRICULTURE, FORESTRY, FISHERY	3.3	1.3	1.7
INDUSTRY, CONSTRUCTION	25.3	27.7	19.6
TERTIARY SECTOR	71.3	71.0	78.6
TOTAL OF ADDED VALUES (EUR BILLION)	*134 609*	*49 252*	

Source : Région Grand Est, Le Grand Est en chiffres clés 2017 (data Grand Est and France) ; Rhin supérieur Faits et chiffres 2016 (data Alsace)

Tourism also represents significant revenues for the former Alsace and Baden-Württemberg regions, linked to the presence of the Rhine as well as mountains (Vosges and Black Forest) and cultural heritage. In the Grand Est region, the number of nights in tourist hotels amounted 13 661 in 2016 (6th rank out of the first ten French regions)[10]. The total number of visitors in 2015 in Baden-Württemberg was 20 380[11].

1.3 Presentation of the energy sector

1.3.1 Towards a transition to low carbon economies

1.3.1.1 In France

At the international level, France has committed under the Kyoto Protocol (1997) and the post-2012 regime to stabilize its greenhouse gas emissions compared to the 1990 level with the objective of limiting global warming to 2° C. This commitment has first translated into the adoption of the Grenelle laws of 2009 and 2010 then progressively built up to the adoption of the Law on the energy transition for green growth in 2015 (see Figure 4 below).

[10] Insee, 'Statistiques Locales' <https://statistiques-locales.insee.fr/#c=indicator&i=tcrd020_hotels.freq_hotel&s=2016&view=map3> [accessed 11 July 2018].
[11] Statistisches Landesamt Baden-Württemberg, 'Baden-Württemberg – Facts and Figures 2016', 2016.

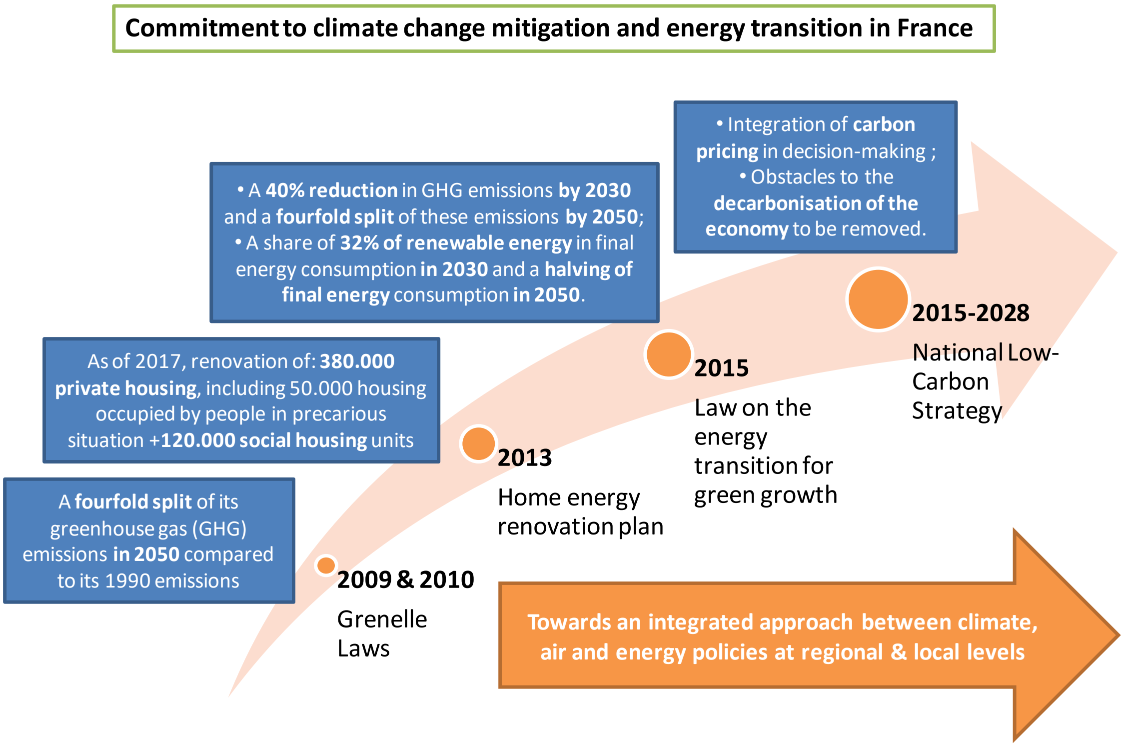
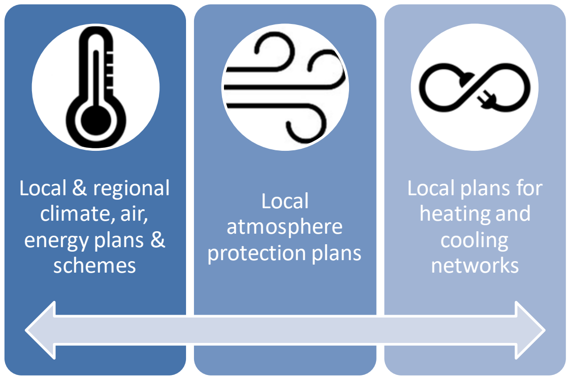


Figure 4: Climate change and energy transition policy framework in France



The Law on the energy transition for green growth reinforces the integration of three public policies regarding climate change mitigation and adaptation, energy transition and air quality (represented on the right): the objectives sought by these policies must be coherent and articulated, and are considered to be at a comparable level of priority.
At the regional level, national objectives were integrated within 26 Energy, Air and Climate Regional Schemes before the institutional reform of 2015. The Law on the New Territorial Organization of the Republic of 2015 brings modifications to the regional plans of development, sustainable development and equality of the territory (SRADDET). In particular, they will have to replace several existing schemes, in terms of climate and energy, intermodality, waste and biodiversity. As such, the current old Energy, Air and Climate Regional Schemes will be integrated into the SRADDET (the deadline for their elaboration is set by the end of 2018). The SRADDET has to take the national low-carbon strategy goals into account. It is currently being elaborated in the Grand Est region, of the Upper Rhine region case study.
Therefore public authorities at different levels (Regions, departments and intercommunalities for the implementation of Local energy, air and climate plans) are responsible for the implementation of integrated climate-air-energy strategies at their level, respecting national goals and in coherence with urban planning documents. The Environment Agency and Energy Management (ADEME) provides funds and technical support for the elaboration and implementation of such strategies.

1.3.1.2 In Germany

In energy policy, the federal government (the Federal Ministry of Economics and Technology, *Bundesministerium für Wirtschaft und Technologie* - BMWi) is primarily responsible for introducing legislation and the Länder or states are responsible for administrative implementation of national law (although the government has significant administrative powers). The individual Länder are involved in shaping energy management and state committees. The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (*Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit*, BMU) administers the Renewable Energy Sources Act and is responsible for environmental regulation that affects the energy sector (e.g. regulations relating to pollution abatement, climate change mitigation, nuclear safety and radiation protection). The German Energy Agency (*Deutsche Energie-Agentur*, DENA) is the federal government's centre for energy efficiency and renewable energy sources. It is jointly owned by the German government and the KfW Bank Group.

The cornerstone of German energy policy is the *Energiewende* based on the twin pillars of the federal government's Energy Concept of 2010 and the Energy Package of 2011. This strategy built on the success of previous policies and took into account a decision to phase-out nuclear power by 2022[12]. Three legislations were passed in 2016 bridging renewable energy, the electricity market, energy efficiency, the grids and digitization[13]. What has been done is to turn these all into a consistent overall framework on a national level[14].

The Renewable Energy Sources Act made the targets set out in the Energy Concept legally binding: 35% of energy consumption should be covered by renewable energy in 2020, 40 to 45% in 2025 and 80% by 2050. A further objective is to consume 20% less primary energy by 2020 (including 10% less in the transport sector alone), and to lower GHG emissions by 40% (compared to a 1990 baseline) by 2020. The table below synthesizes the policy's goals.

Table 4: Targets contained in the Energy Concept/Energy Package (source: BMWi)

	2012	2020	2030	2040	2050
Reduction in GHGs (base year: 1990)	-27%	-40%	-55%	-70%	-80%
Share of renewable energies in total final energy consumption	10%	18%	30%	45%	60%
Share of renewable energies in electricity consumption	20%	35%	50%	65%	80%
Reduction of primary energy consumption (base year: 2008)	-5%	-20%			-50%
Reduction of electricity consumption (base year: 2008)	-1%	-10%			-25%
Reduction of final energy consumption in the transport sector (base year: 2008)		-10%			-40%

So far nearly one-third of the electricity supply comes from renewable sources such as wind, solar and biomass.

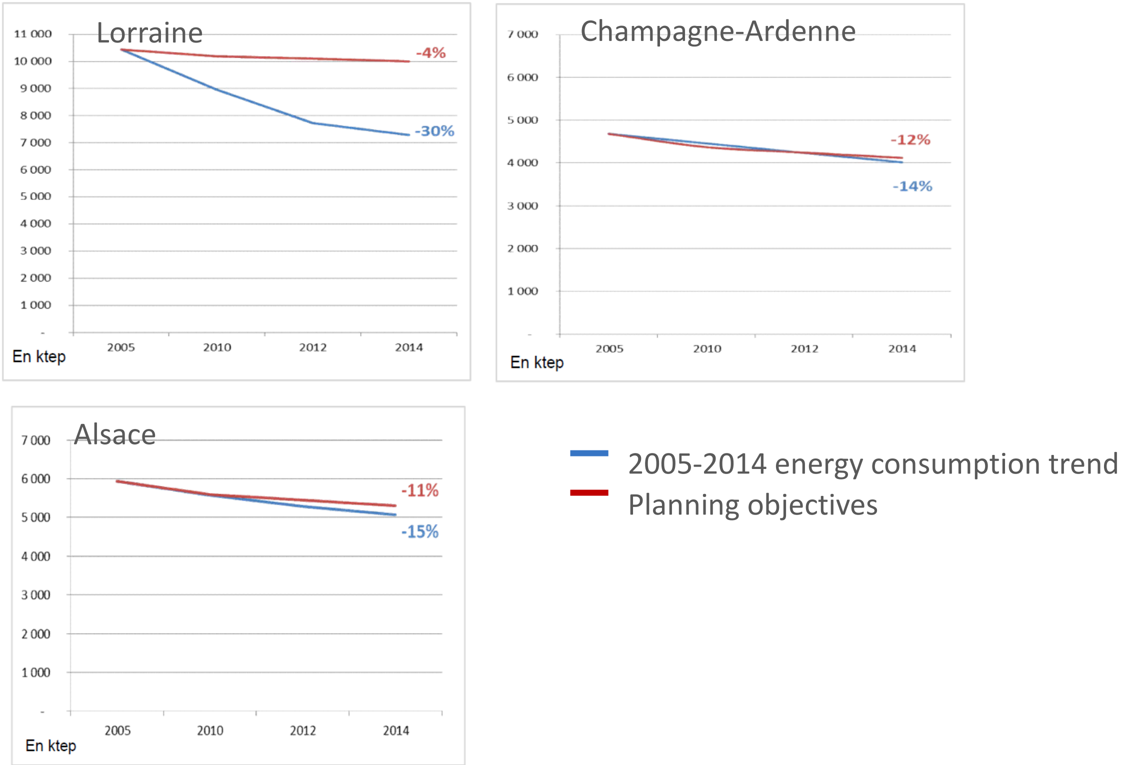
[12] Even though in 2010, nuclear power provided Germany with 22.6 % of its electricity needs and accounted for 13 % of its generating capacity.
[13] Federal Ministry for Economics Affairs and Energy, 'Ready for the next Phase of the Energy Transition' <https://www.bmwi.de/Redaktion/EN/Dossier/energy-transition.html> [accessed 11 July 2018].
[14] Federal Ministry Education and research, 'German Energy Transition' <https://www.bmbf.de/en/german-energy-transition-2319.html> [accessed 11 July 2018].

1.3.2 Final energy consumption per sector

1.3.2.1 Grand Est region in France

In 2010, the total final energy consumption in Grand Est region was 18 550 ktoe. In 2014, it had decreased between -4 and -12% since 2005, in all former regions (Champagne-Ardenne, Lorraine and Alsace), as illustrated in Figure 5. The actual decrease was even more important than the planned objectives of the Energy, Air and Climate Regional Schemes (to achieve carbon neutrality by 2050). In particular in former Lorraine, the reduction target was 4% and the real reduction reached 30%.

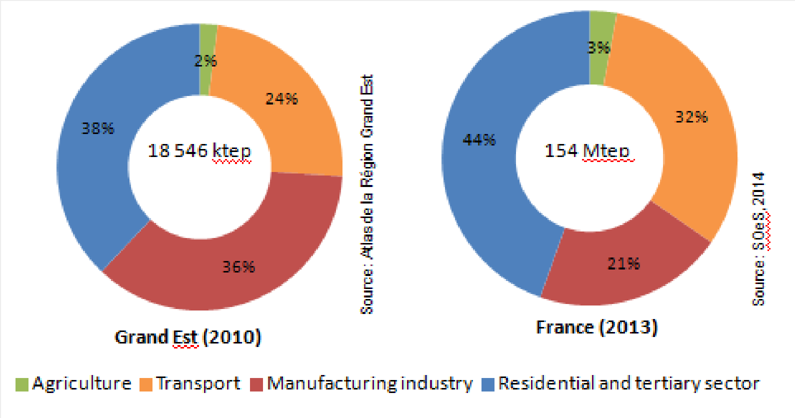
Figure 5: Final energy consumption 2005-2014 by former regions



Source : Région Grand Est, SRADDET, Séminaire de co-construction Air-Energie-Climat, 5 juillet 2017

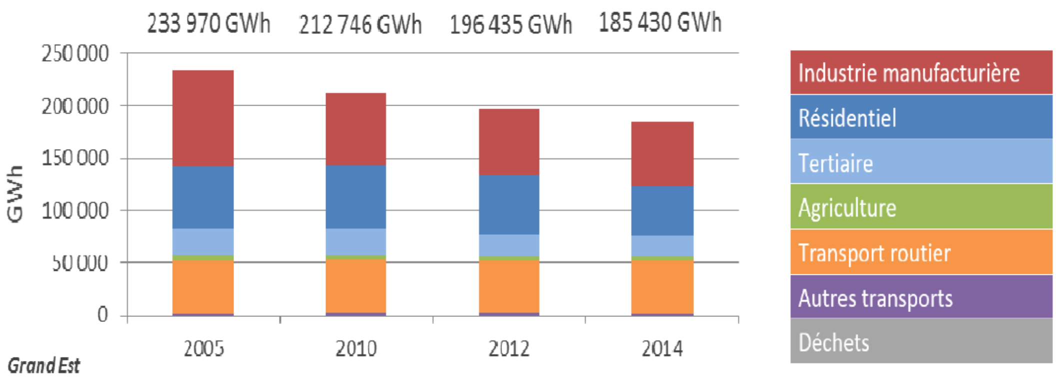
Energy was mainly consumed by four sectors as illustrated in Figure 6. In 2010, the sector with the largest share of final energy consumption is the residential and service sector, which consumed 38% of the total amount of final energy consumption. The industry sector is second, consuming 36%. Transport is third with the consumption reaching 24% and last, the share of agriculture sector is 2%.
Consumption of industry sector is particularly important compared to the national level (38% vs. 21%). Industry and residential-tertiary sectors account for 75% of the total energy consumption.

Figure 6: Final energy consumption by sector in the Grand Est region and in France



Final energy consumption distribution by sector concerning four different years (i.e. 2005, 2010, 2012 and 2014) is shown in Figure 7. A similar decrease as the one shown in Figure 5 can be observed (-21% during the period). Also, the rankings of the sectors regarding final energy consumption have been maintained.

Figure 7: Final energy consumption shares by sector in the Grand Est region (2005, 2010, 2012, 2014)



Source : Région Grand Est, SRADDET, Séminaire de co-construction Air-Energie-Climat, 5 juillet 2017 – ATMO Grand Est Invent'Air V2016

1.3.2.2 In Germany

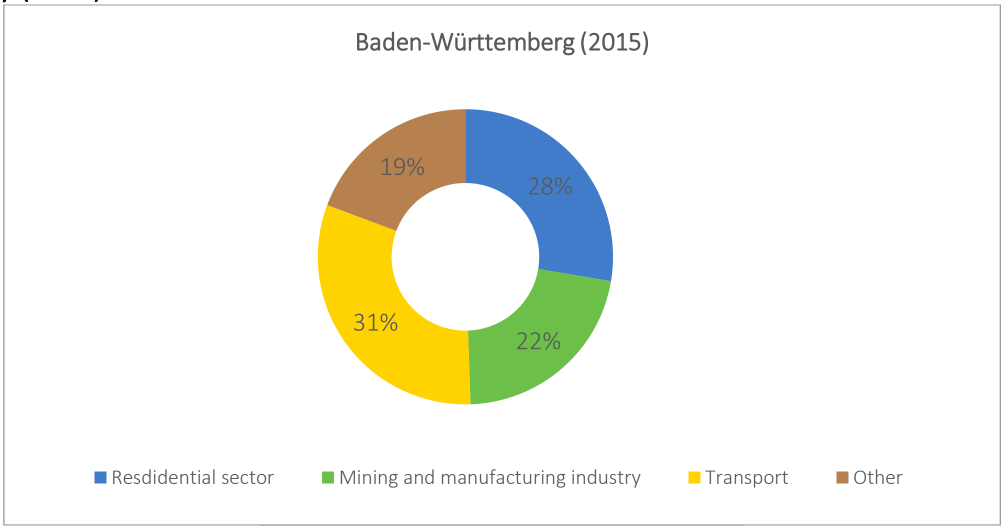
The total final energy consumption in Germany decreased from 221 Mtoe in 2011 to 212 Mtoe in 2015. In 2015, the industry sector consumed 28,6% of the total final consumption, residential sector and transport accounted for 25,9% and 29,5 %, respectively, while commercial and other services amounted to 16%[15].

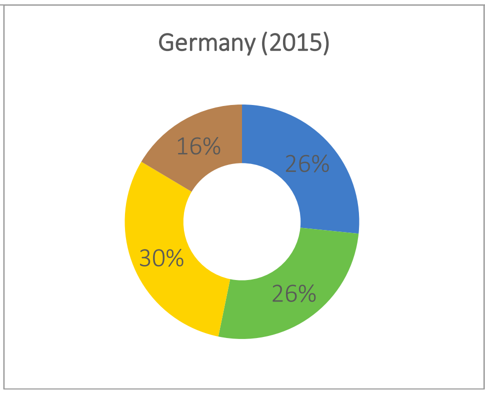
In the Baden-Württemberg region, primary energy consumption reached 33 Mtoe in 2014 for all energy sources.[16]. All energy using sectors in Baden-Württemberg amounted to 24 Mtoe (1023 PJ) in

[15] International Energy Agency, 'Energy Policies of IEA Countries - Germany 2013 Review', *Energy Policies of IEA Countries*, 2013, 212.
[16] Baden-Württemberg.

2015. Transport is the most heavy sector that consumes 31,6%. After that, households follow with 27,5%, see figure 8. Mining, manufacturing and business account for 21,7%[17].

Figure 8 Final energy consumption shares by sector in the Baden-Württemberg region and Germany (2015)





Source : Energiebericht kompakt 2017 :Statistisches landesambt Baden-Württemberg

1.3.3 Final energy consumption per type of energy

1.3.3.1 In Grand Est region (France)

The main types of energy are petroleum products, gas and electricity, which provided respectively 34%, 27% and 21% of the final energy consumption in 2010. Fuel wood, other renewables and derived heat have a total share of around 9%. Solid fuels and other non renewables have a total share of around 6% (Table 5)[18].

[17] Statistisches Landesambt Baden-Württemberg, 'Energiebericht kompakt 2017', 2017.
[18] La Région Gran Est.

Table 5: Final energy consumption per type of energy in Grand Est region in 2010

unit: ktoe	Total	%
Electricity	3 909	21%
Natural Gas	5 008	27%
Total Petroleum Products	6 367	34%
Solid Fuels	1 002	5%
Fuel wood	1 054	6%
Other renewable energies	326	2%
Other Non renewable	683	4%
Derived heat	196	1%
Total	**18 545**	**100%**

Source : Atlas de la Région Grand Est

In the industry sector, the main energy types consumed are gas (38%), electricity (25%) and coal (25%). In buildings, the main energy types consumed are gas (43%), electricity (31%), fuel (20%) and fuelwood (12%). In the road transport sector, petroleum product (gasoline and diesel) represent almost the totality of consumptions.

In the period 2005-2014, gas consumption decreased by 32%, petroleum products consumption decreased by 20%, and electricity consumption decreased by 10%[19].

1.3.3.2 In Germany

Over 85 % of energy consumption is from oil, natural gas and electricity. Oil products represent 41.6% of the total final consumption, with more than half is consumed by transport. Natural gas and electricity account for 23.2% and 20.3% of energy consumption, respectively, and are primarily used in industry and in the residential and commercial sectors. Biofuels and waste consumption have grown strongly over the past decade, increasing from 2% in 2000 to 6.2 % of energy consumption in 2011. Higher use of biofuels in industry and transport has partially offset the use of oil in those sectors[20].

[19] La Région Gran Est.
[20] International Energy Agency.

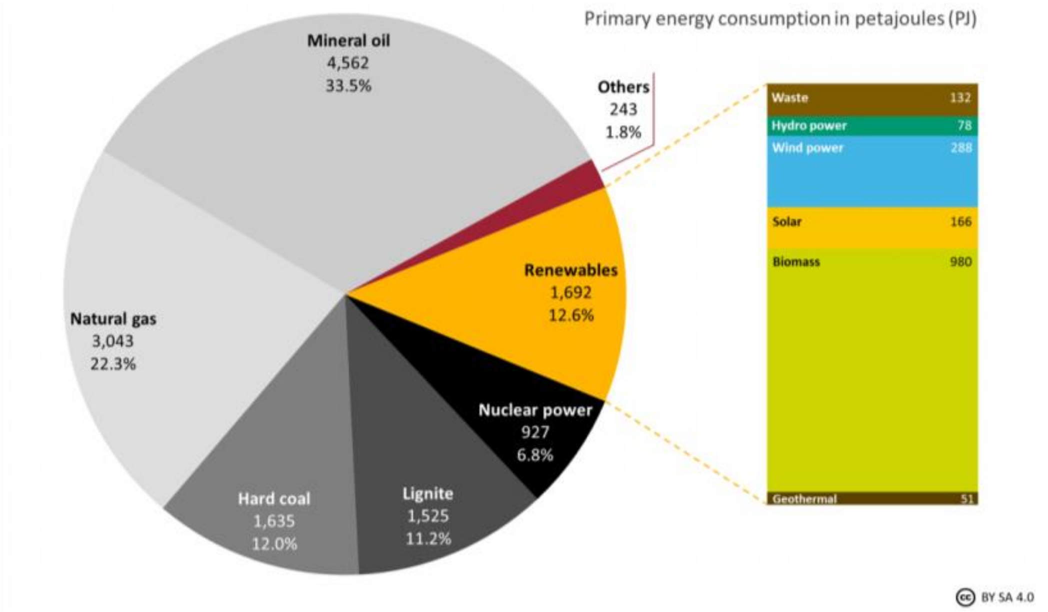


Figure 9 German energy mix 2016: Energy sources' share in primary energy consumption (data: AG Energiebilanzen 2016, cleanenergywire.org)

The share of energy from renewable sources in gross final consumption of energy in 2010 was 11%, for a 2020 target of 18%. The share of renewables in primary energy consumption was 12.6% in 2016. In the Baden-Württemberg region, the share of renewable energy sources in the primary energy consumption reached 12.3% in 2014[21].

1.3.4 Final energy generation by renewable sources

1.3.4.1 In Grand Est region (France)

Energy is provided by different 'renewable' sources, mainly hydraulic power, fuelwood, agrofuel and wind power. The distribution of energy generation varies from a former region to another (Table). In former Alsace, hydroelectricity represents 2/3[rds] of the renewable energy generated, as it is provided by hydroelectric dams along the Rhine River. Fuelwood represents the second renewable energy source (18%). In Champagne-Ardenne, agrofuels represent close to half of renewable energy generation (44%), followed by fuelwood (30%) and windpower (17%). In Lorraine, fuelwood is the main source of renewable energy (43%), followed by windpower (20%) and agrofuels (20%).

[21] Baden-Württemberg.

Table 6: Renewable energy generation by sources in Grand Est region in 2012

Unit: kton/year in 2012	Alsace	Lorraine	Champagne-Ardenne	Total
Hydroelectricity	700	20	90	**810**
Fuelwood	191	228	341	**760**
Waste	28	18	6,5	**52,5**
Agricultural biomass	0,4	nd	nd	**0,4**
Agrofuel	67	107	507	**681**
Deep geothermy	0,1	0	0	**0,1**
Surface geothermy	16	3,6	6,7	**26,3**
Air heater	21	nd	nd	**21**
Thermal solar	3,3	2,2	0,7	**6,2**
Photovoltaic solar	9,6	8,1	6,8	**24,5**
Biogas	5,7	4,4	7,7	**17,8**
Wind	0	106	192	**298**
Total	1 042	497	1 158	**2 698**

Source : Atlas de la Région Grand Est – Alsace : ASPA – Lorraine : Air Lorraine – Champagne-Ardenne : SOeS/ADEME/SRCAE/RTE

1.3.4.2 In Germany

The share of renewable in the electricity that is generated within the region is relatively high: 23% or 15 TWh in 2015[22]. Compared to the national share, hydropower is an important energy source in the region. In 2015 however, electricity from solar PV surpassed that from hydropower in the region. The share of electricity from wind turbines is relatively small: 1,3% or 0,8 TWh of generated electricity while nationally this amounted to 12,3% in 2015, see table 7. The amount of electricity generated with biomass increased quickly from 786 GWh in 2001 to 4760 GWh in 2015.

Table 7: Renewable energy generation by sources in Baden-Wurttemberg region in 2015

Unit: TWh/year in 2015	
Hydroelectricity	4,3
Photovoltaic solar	4,9
Biomass	4,8
Wind	0,8
Total	14,8

Source : Energiebericht kompakt 2017 :Statistisches landesambt Baden-Wurttemberg

1.4 Presentation of the water sector

[22] Statistisches Landesambt Baden-Württemberg, 'Energiebericht kompakt 2017'.

The frame of the case study is set by the Rhine River and its adjacent regions. The Rhine River underwent heavy straightening of the watercourses in the 19th and 20th centuries, cutting off old meanders. In the late 1950's, the Rhine canal was built between Basel and Breisach. The canal runs parallel to the Rhine, is 50km long and is used for the generation of electricity through hydropower. Over the years the straightening led to a lower groundwater table declining by two to seven meters in the lowlands on both sides of the Upper Rhine since the establishment of the canal[23]. At the moment there are ten hydroelectric stations[24] and one nuclear power plant, which receives cooling water from the canal,[25] all are run by the French energy company EDF (see Figure 1) the canal,[26] all are run by the French energy company EDF (see **Figure** 10: **Hydroelectric facilities of the Upper Rhine**).

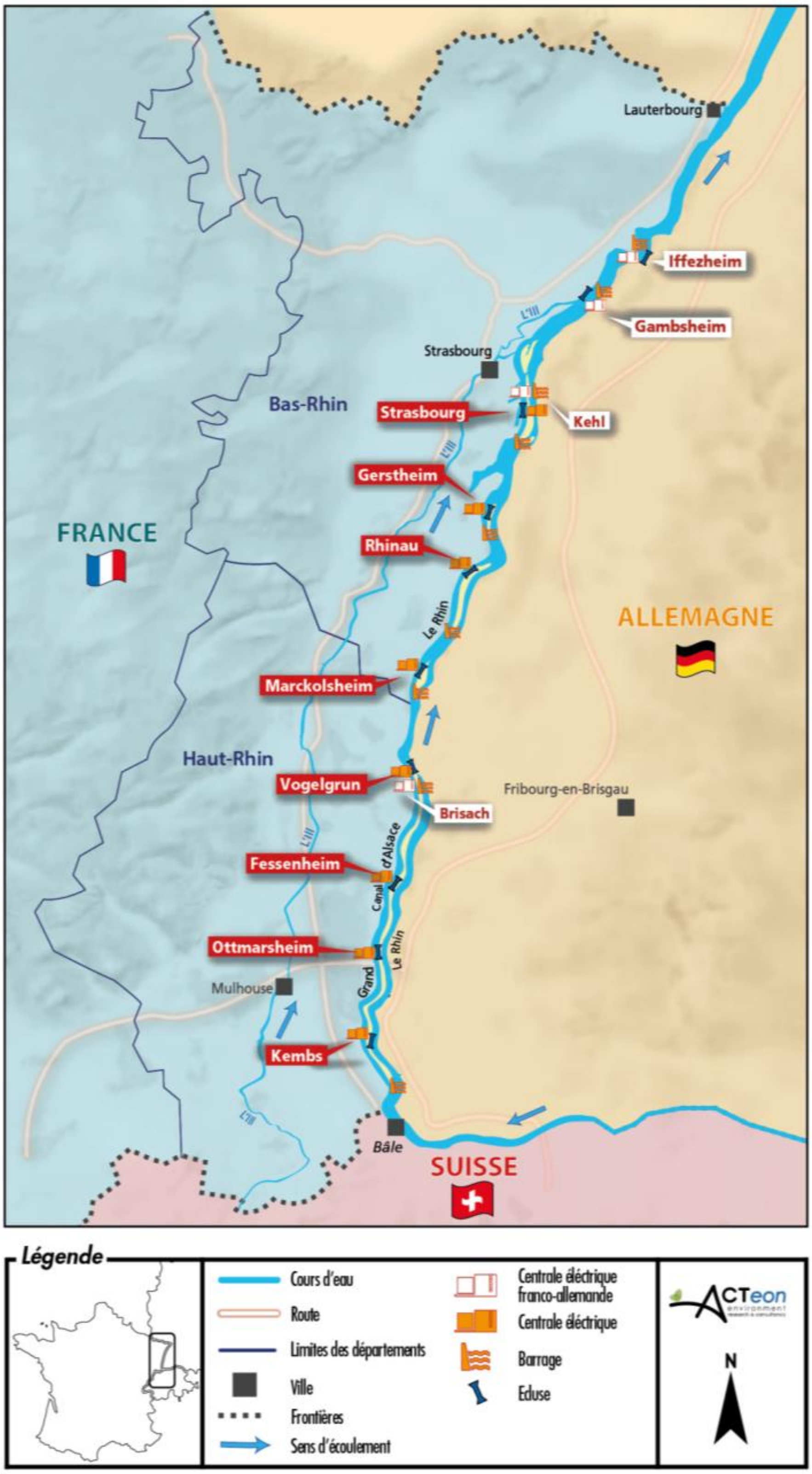
The Rhine aquifer is one of the biggest in Central Europe and an important source of drinking water, the area between Basel and Strasbourg receiving three-quarters of its drinking water from this aquifer. Half of the industrial demand is also met in this highly industrialized region by the 45 billion m³ aquifer. In the Upper Rhine Graben or rift valley, the groundwater table is relatively close to the surface. The physical boundaries of the rift are the Vosges in the West, the Black Forest in the East and the Swiss Jura in the South.

[23] LUBW Landesanstalt für Umwelt Baden-Württemberg, online: http://www4.lubw.baden-wuerttemberg.de/servlet/is/21695/

[24] EDF, 'Les Aménagements Hydroélectriques Du Rhin Franco-Allemand', 2013 <https://www.edf.fr/sites/default/files/Hydraulique/Alsace-Vosges/documents/les_amenagements_hydroelectriques_du_rhin_franco-allemand.pdf> [accessed 11 July 2018].

[25] EDF, 'Das Kernkraftwerk Fessenheim', 2017 <https://www.edf.fr/sites/default/files/contrib/groupe-edf/producteur-industriel/carte-des-implantations/centrale-fessenheim/actualites/Juin%202017/presseunterlagen_2017_de.pdf> [accessed 11 July 2018].

[26] EDF, 'Das Kernkraftwerk Fessenheim', 2017 <https://www.edf.fr/sites/default/files/contrib/groupe-edf/producteur-industriel/carte-des-implantations/centrale-fessenheim/actualites/Juin%202017/presseunterlagen_2017_de.pdf> [accessed 11 July 2018].


Lauterbourg
Iffezheim
Gambsheim
L'Ill
Strasbourg
Bas-Rhin
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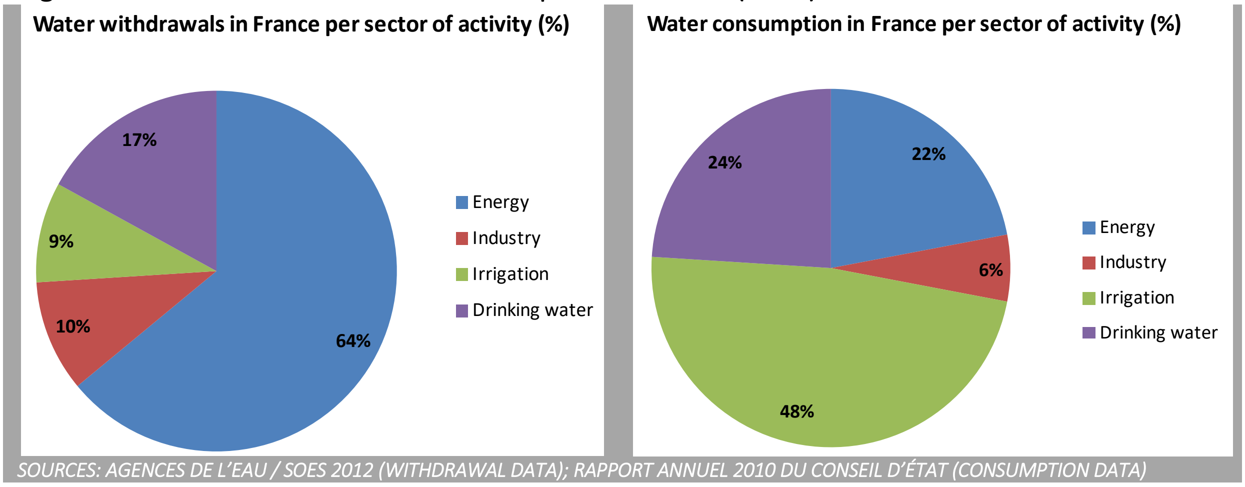
Kehl
Gerstheim
L'Ill
FRANCE
Rhinau
Le Rhin
ALLEMAGNE
Marckolsheim
Haut-Rhin
Vogelgrun
Fribourg-en-Brisgau
Brisach
L'Ill
Canal d'Alsace
Fessenheim
Ottmarsheim
Grand
Le Rhin
Mulhouse
Kembs
L'Ill
Bâle
SUISSE
Légende
Cours d'eau
Route
Limites des départements
Ville
Frontières
Sens d'écoulement
Centrale électrique franco-allemande
Centrale électrique
Barrage
Ecluse
ACTeon
N

Figure 10: Hydroelectric facilities of the Upper Rhine

1.4.1 Water abstraction and consumption per sector

Energy production in France accounts for 64% of the water withdrawn which is mainly used for the cooling of thermal and nuclear power plants. These volumes are then quickly returned to nature, at the very place where they were taken. The resource is therefore available locally and the quantity of water actually consumed is low (see **Błąd! Nie można odnaleźć źródła odwołania.**).
Agricultural activity is equivalent to 9% of withdrawals. This water is partly used to irrigate plants, infiltrated into the soil or evaporated. The amount of water actually consumed is, however, important (48%). Rainwater used directly by crops is not accounted for.

Figure 11: Water withdrawal and consumption in France (2012)[27]

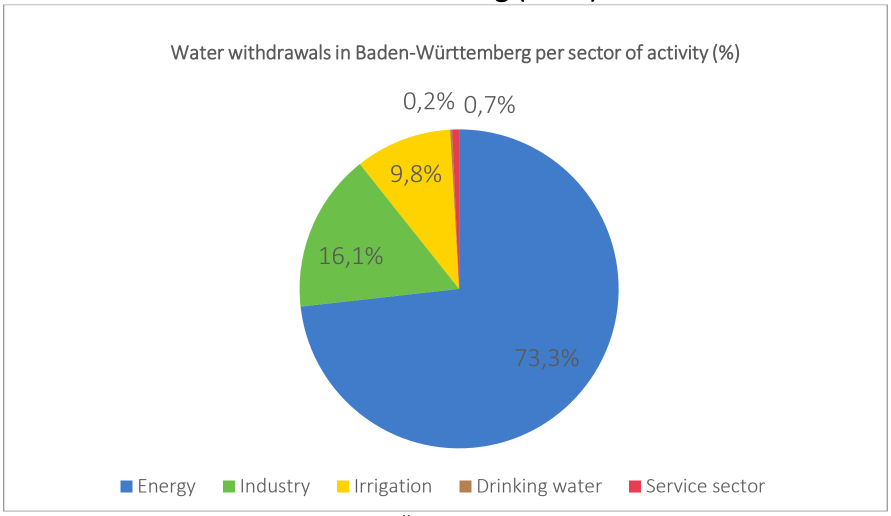


In the Rhine-Meuse basin, industrial withdrawals, excluding energy, account for the vast majority of surface water withdrawals. More than ¾ of these withdrawals are made by the ten largest consumers. Most of the water withdrawals for drinking water are provided by groundwater. Surface water withdrawals are lower than those of industry and concern only about twenty communities. Agricultural withdrawals are very scattered and unimportant, but these volumes are almost completely consumed. Withdrawals from surface waters concern small streams in the plain of Alsace. In the Rhine-Meuse basin, 360 million m^3 of water are collected each year by local authorities. The drinking water distribution networks (38,000 kilometers) show losses of 25% on average[28].

[27] Le Centre d'Information sur l'Eau, 'Qui prélève et consomme l'eau en France ?', *Centre d'Information sur l'eau* <https://www.cieau.com/le-metier-de-leau/ressource-en-eau-eau-potable-eaux-usees/qui-preleve-et-consomme-leau-en-france/> [accessed 11 July 2018].
[28] Agence de l'Eau Rhin-Meuse, 'Connaissance Du Bassin Rhin-Meuse', 2014 <http://www.eau-rhin-meuse.fr/connaissance_du_bassin_rhin_meuse> [accessed 11 July 2018].

In 2010, 5 841 million m³ from groundwater resources and 27 195 million m³ from surface water were abstracted in Germany. In terms of total water abstraction (surface and groundwater), close to 80% was withdrawn by the industry sector, 15% for agriculture, and 5% for domestic use[29].
In 2013 about 4 million m³ of water were withdrawn in total for electricity production, agricultural and industrial production and drinking water for Baden-Württemberg[30]. This includes abstraction of ground, source and surface water: 466, 143 and 3452 million m³ respectively. As in France, energy was the most important source for water abstraction from the Rhine and the Neckar amounting to 2977 million m³. Over the past 20 years this water-using sector has halved its demand. Public drinking water services and manufacturing industries follow with 653 and 398 million respectively, see figure 12[31]. Paper and pulp industries are the most important water using branches. Also the amount of water used per person has reduced since 1991[32].

Figure 12 : Water withdrawal in Baden-Württemberg (2013)[33]



Source: Statischtisches Landesambt Baden-Württemberg, Öffentliche Wasserversorgung und Abwasserentsorgung, Wasser in der Wirtschaft,

1.4.2 Transnational cooperation in the field of water resources management

The Rhine in general and the Upper Rhine, in particular, are known as **good practice examples** in integrated (water) resource management and transnational cooperation in decision-making. This is shown by a variety of legal transnational entities and their policies, as well as initiatives and projects across borders.

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[29] EEA, 2016, "The Problems of water stress", online: https://www.eea.europa.eu/publications/92-9167-025-1/page003.html.
[30] Statistisches Landesamt Baden-Württemberg, 'Wasserwirtschaft in Baden-Württemberg – unentbehrlich für Bevölkerung und Industrie', 2016.
[31] Statistisches Landesamt Baden-Württemberg.
[32] Statistisches Landesambt Baden-Württemberg, 'Öffentliche Wasserversorgung Und Abwasserentsorgung, Wasser in Der Wirtschaft' <https://www.statistik-bw.de/Umwelt/Wasser/Wasserwirtschaft.jsp> [accessed 11 July 2018].
[33] Statistisches Landesamt Baden-Württemberg.

For instance, the Commission for the Protection of the Rhine is an organization under international law. It was founded in 1950 and evolved over time in size, scope and thematic foci. Its members are the riparian states of the Rhine like Switzerland, Germany, France, Luxemburg, Netherlands and the European Commission. Austria, Liechtenstein, Italy, as well as various associations and institutions (governmental and non-governmental), each holds an observer status. The objective of the commission is to intensify multilateral cooperation in order to decrease and prevent pollution of the Rhine River and its tributaries and restore the North Sea. Therefore, the sustainable development of the Rhine ecosystem is the main task to ensure secure drinking water supply and to improve sediment quality. Cooperative work between the members will help integrated flood prevention taking ecological compatibility into consideration.

Integrated Rhine Program for flood prevention[34] was established by the federal state parliament in 2010 after more than 20 years of transboundary cooperation between France and Germany on the topic. It entails 13 polders that used to be former alluvial floodplains alongside the German border of the Rhine in Baden-Württemberg between Basel and Mannheim. The program integrates ecological concerns into extensive flood prevention and fosters cooperation in between two federal states on the German side and the Alsace region on the French side[35].

The "Oberrhein/Rhin supérieur" Ramsar site is one of only nine transboundary conservation sites under the Ramsar convention. It stretches along 190 km of the Upper Rhine between Weil am Rhein in

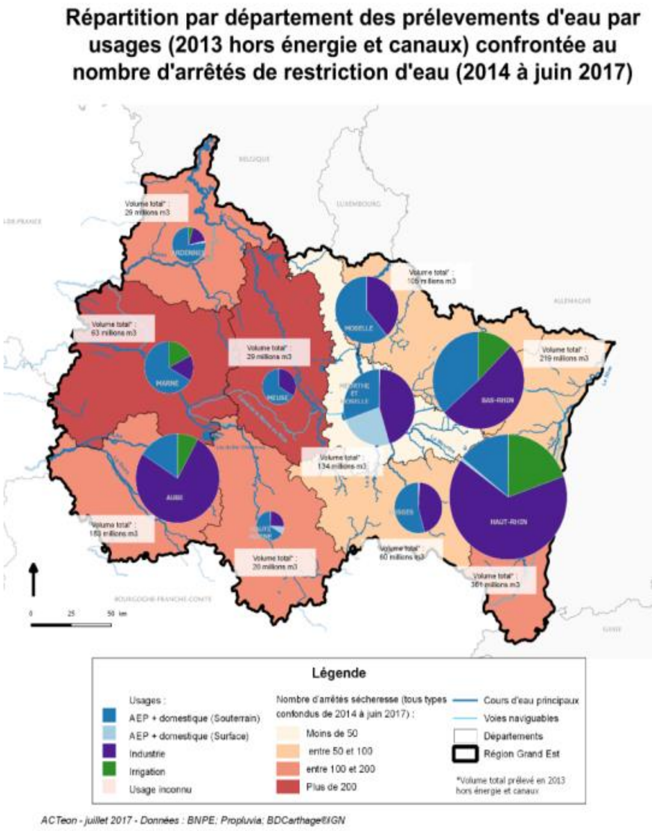


Figure 13 : Water abstraction volumes for each user and number of water restriction orders from 2013 to 2017 in the Grand Est region

[34] Ministerium Umwelt, Klima und Energiewirtschaft Baden-Württemberg, *Das Integrierte Rheinprogramm*, 2011 <https://rp.baden-wuerttemberg.de/rpf/PR/Documents/rpf-ref53.3-kurz_irp.pdf> [accessed 25 June 2018].

[35] Minitserium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg, *Das Integrierte Rheinprogramm*, 2016 <https://rp.baden-wuerttemberg.de/Themen/WasserBoden/IRP/Rueckhalteraum/irp_de.pdf> [accessed 6 June 2018].

the triangle border of Switzerland, France and Germany and the German city of Karlsruhe. The Ramsar conservation site consists of 475 km² including the Rhine itself, its aquatic ecosystems and adjacent alluvial plains[36].

In spite of years of actions to protect these water resources, there is still concern on:

Water quality

Pesticides and most importantly nutrients are still present in spite of stronger regulations (the good status thresholds have also been lowered and the detection levels have improved). Half of water bodies do not reach the good chemical status required by the WFD. Micro-pollutants are a new threat. A warning and alert plan has been established among countries in case of accidental pollution from the industries along the Rhine and tributaries. In Germany the percentage of nitrates in ground water sources has decreased between 1994 and 2016 from 42,6% to 35% at measurements of 25 mg/l [37].

Water quantity

Groundwater levels are decreasing in strategic areas due to the combined effects of increasing abstractions and decreasing infiltration.

Drought situations are occurring more frequently, putting a threat on aquatic life.

Błąd! Nie można odnaleźć źródła odwołania.3 shows, on the Grand Est region, the water needs for the different users (drinking water in blue, industries in violet, irrigation in green) as well as the number of water restriction orders (more than 200 orders in dark red) issued between 2013 and 2017.

In Baden-Württemberg the amount of water abstraction has decreased between 1994 and 2016. The amount of cooling water and industrial uses has decreased to 3215,5 million m³ and 207,3 million m³ respectively[38].

Aquatic ecosystems and river morphology

Continuity of the river is still not reached due to large dams and sluices on the Rhine and its tributaries (10 000 obstacles reported on Grand Est region). The migration of fish species is limited and efforts to reintroduce the Salmon fish are jeopardized.

Flood hazard

[36] Ramsar convention, online: https://um.baden-wuerttemberg.de/fileadmin/redaktion/m-um/intern/Dateien/Dokumente/3_Umwelt/Naturschutz/Schutzgebiete/Ramsar_Oberrhein_Faltblatt.pdf.

[37] Statistisches Landesamt, 'Daten zur Umwelt – Umweltindikatoren Baden-Württemberg 2017', 12.

[38] Statistisches Landesambt Baden-Württemberg, 'Öffentliche Wasserversorgung Und Abwasserentsorgung, Wasser in Der Wirtschaft'.

Expensive projects are implemented to recreate floodplains in order to mitigate the impacts from major floods and protect human settlements. 85% of the former alluvial area of the Rhine was lost to urbanization and digging. In Région Grand Est, ¼ of cities and 10% of the population are located in flood prone areas. The floods in 1993 and 1995 caused severe damage (in Germany alone about 900 million USD[39]).The threat of climate change and its consequences on rainfall and snowmelt puts a high uncertainty on the frequency and magnitude of future flood events.

Navigability

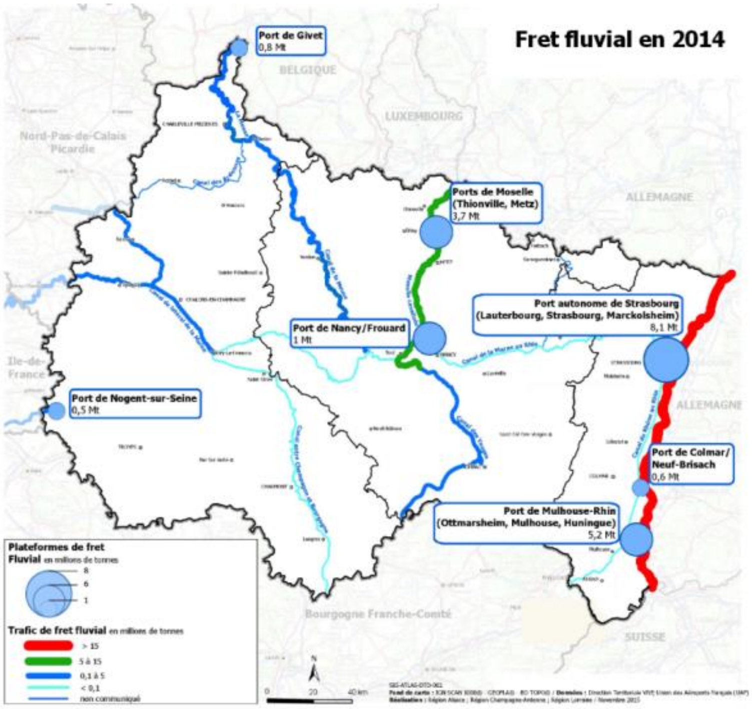


Figure 14 River transport in 2014 in the Grand Est region

Navigation is a particular sector to be considered in this case study, due to its importance in the economy of both French and German regions as well as for the associated infrastructures (ports, canals, sluices, etc). **Błąd! Nie można odnaleźć źródła odwołania.**4 presents the main ports (blue spots) and rivers as well as the quantities transported annually (more than 15 million tons in red, form 5 to 15 million tons in green, less than 5 million tons in blue). In Baden-Württemberg 32,1 million tons of goods were transshipped in 2017 in the ports of amongst others Mannheim, Kehl, Karlsruhe, Stuttgart and Heilbronn. The growth of the shipping industry is large compared to the national average of inland shipping[40].

[39] Kleinn, J., C. Frei, J. Gurtz, D. Lthi, P. L. Vidale, *and* C. Schär *(*2005*),* Hydrologic simulations in the Rhine basin driven by a regional climate model, J. Geophys. Res.*,* 110*, D04102, doi:*10.1029/2004JD005143*.*

[40] Statistisches Landesambt (201), Binnenschifffahrt 2017: Güterumschlag um 6 Prozent gestiegen, https://www.statistik-bw.de/Presse/Pressemitteilungen/2018107

2 Mapping of stakeholders in the Upper Rhine transboundary case study

1.5 Water and energy stakeholders in the Upper Rhine region

Stakeholders from various sectors relevant to the Upper Rhine case study were first identified and listed in the table below. Since the case is transboundary (France/Germany), some organizations work in both or more countries. Some stakeholders function as networking platforms or clusters within their field of expertise and have other stakeholders as contributing members. For example the members of the working groups of the Upper Rhine Commission are members of the French, German and Swiss local governments and ministries.

Table 8: List of relevant stakeholders in the Upper Rhine Nexus

Country	Nexus Sector	Type of Organization	Abbreviation of organisation	Name of Organization
France				
FR	Multiple sectors	Regional governmental organisation	Région GE	Région Grand Est
FR	Multiple sectors	Regional governmental organization	SGARE	Secrétaire Général pour les Affaires Régionales et Européennes (SGARE)
FR	Multiple sectors	Governmental organizations	Departments	Départements Grand Est (10: Ardennes, Aube, Marne, Haute-Marne, Meurthe-et-Moselle, Meuse, Moselle, Bas-Rhin, Haut-Rhin, Vosges)
FR	Multiple sectors	Governmental organizations	DDT	Directions Départementales des Territoires (10)
FR	Multiple sectors	National governmental organisation	ADEME	Agence de l'environnement et de la maîtrise de l'énergie
FR	Multiple sectors	Regional governmental organization	ADEMEGE	Agence de l'environnement et de la maîtrise de l'énergie régionale Grand Est
FR	Multiple sectors	Trade union	CCI Alsace	Chambre de commerce et de l'Industrie d'Alsace
FR	Multiple sectors	Network	IDA	Idée Alsace
FR	Agriculture	Trade union	CRA	Chambre d'agriculture d'Alsace
FR	Agriculture	Research	INRA Colmar	Institut National de Recherche Agronomique de Colmar
FR	Agriculture	Business	CAC	Coopérative Agricole de Céréales
FR	Agriculture	Business	Le Comptoir Agricole	Le Comptoir Agricole
FR	Agriculture, Land use	Business	SAFER	Sociétés d'aménagement foncier et d'établissement rural
FR	Agriculture, Land use	Regional governmental organisation	DRAAF GE	Direction Régionale de l'Alimentation, de l'Agriculture et de la Forêt Grand Est
FR	Land use	National governmental organisation	ONF	Office National des Forêts
FR	Land use	Regional governmental organisation	DREAL	Direction régionale de l'environnement, de

				l'aménagement et du logement
FR	Land use	National governmental organisation	ONCFS	**Office National de la Chasse et de la Faune Sauvage**
FR	Land use, water, energy	NGO	Alsace Nature	**Alsace nature**
FR	Land use, water, energy	NGO	FNEGE	France Nature Environnement Grand Est
FR	Water, Land use, Climate	Research	ENGEES	**École national du génie de l'eau et de l'environnement de Strasbourg**
FR	Water	Network	APRONA	**Association pour la Protection de la Nappe Phréatique de la Plaine d'Alsace**
FR	Water	Regional governmental organisation	AERM	Agence de l'eau Rhine-Meuse
FR	Energy, Water	Business	EDF	Électricité de France
Germany				
GER	Multiple sectors	Regional governmental organisation	RPräsF	Regierungspräsidium Freiburg
GER	Multiple sectors	Regional governmental organisation	RPräsK	Regierungspräsidium Karlsruhe
GER	Multiple sectors	Regional governmental organisation	RPräsS	Regierungspräsidium Stuttgart
GER	Multiple sectors	Regional governmental organisation	RPräsT	Regierungspräsidium Tübingen
GER	Multiple sectors	Business	IHK	IHK Südlicher Oberrhein
GER	Multiple sectors	Research	KIT	**Karlsruhe Institute of Technology**
GER	Agriculture	Trade Union	BLHV	Badischer Landwirtschaftlicher Hauptverband e.V .
GER	Agriculture	Research	WBI	**Weinbauinstituts and Staatsweingut Freiburg**
GER	Agriculture, Land use	Regional governmental organisation	MLV	Ministerium für Ländlichen Raum und Verbraucherschutz Baden-Württemberg
GER	Land use, Water, Energy	NGO	BUND	Bund für Umwelt und Naturschutz Deutschland Regionalverband Mittlerer Oberrhein
GER	Land use	Regional governmental organisation	FLBW	Forst Landesbetrieb Baden Württemberg
GER	Climate, energy	Network	KPO	Klimapartner Oberrhein
GER	Energy, Climate, Land use	Regional governmental organisation	MUKE	**Ministerium für Umwelt, Klima und Energiewirtschaft Baden-Württemberg**
GER	Energy	Business	EnBW	Energie Baden-Württemberg
GER	Energy	Network	SPKO	Strategische Partner Klimaschutz am Oberrhein e.V.
International				
FR, GER, CH	Multiple sectors	International governmental	UPC	**Upper Rhine Conference**

		organization		
FR, GER	Multiple sectors	Network	EU SKO	Eurodistrict Strasbourg-Kehl-Offenburg
FR, GER	Multiple sectors	Network	EU FR	Eurodistrict Freiburg-Alsace
FR, GER	Multiple sectors	NGO	ICLEI	International Council for Local Environmental Initiatives
Inter-national [41]	Water	International governmental organization	ICPR	International Commission for the Protection of the Rhine
Inter-national [42]	Water	Research	CHR	Commission Internationale pour l'Hydrologie du bassin du Rhin
FR,GER	Water	Network	LOGAR	Länderübergreifende Organisation für Grundwasserschutz am Rhein
FR, GER	Energy, Land use	Network	URC	Upper Rhine Cluster for Sustainability Research
FR, GER	Energy	Research	EIFER	European institute for Energy Research
FR,GER	Energy	Network	TRION	TRION Climate e.V. Netzwerk für Energie und Klima der Trinationalen Metropolregion Oberrhein
International	Energy, climate	Network	ICLEI	International Council for Local Environmental Initiatives (ICLEI)

1.6 Mapping of organizations according to their power and interest in different issues

Stakeholders involved in the relevant policy sectors of the case study were then mapped according to their **power**[43] and **interest**[44] over the policy issues investigated in the case study.

Power may be formal when attributed by law to the different governmental levels and other stakeholders in the relevant policy sectors. Formal power may also be attributed to private stakeholders, in the form of regulated interaction between governments and influential organized lobby groups (e.g. consultation roundtables). Other possible forms of formal power include delegated power to manage shared resources such as for example joint public-private partnerships for resource management and community-based resource management.

[41] Switzerland, France, Germany, Luxemburg, the Netherlands, the European Commission, Austria, Liechtenstein, the Belgian region of Wallonia, Italy.
[42] Switzerland, Austria, Germany, France, Luxembourg and the Netherlands.
[43] For e.g., farmers associations in regions where agriculture is an important economic sector may have the power, based on the economic relevance of their sector, to influence decisions on the allocation of water in times of drought.
[44] For e.g., farmers have the interest to see as much water as possible allocated to them during drought times for irrigating their crops.

Informal power refers to the capacity of stakeholders to influence the actions, policies, or decisions of governments (unregulated, informal lobbying power).
Therefore the sources of power emanate from legal authority (the stakeholder is empowered by law), economic relevance of the stakeholders (e.g. corporation with big turnover and high number of employees), knowledge and expertise, access/linkage to key stakeholders such as high level officials or politicians, high level businessmen, highly reputed opinion leaders, etc., relationship with the media, money for investment or implementation, etc.
Interest is understood from a political science perspective, as the agenda of the organization in relation to decisions in the specific policy sector.
The following policy sectors (corresponding to the Nexus approach as well as the environment) were investigated:

- Water
- Energy
- Agriculture and Food
- Land use
- Climate
- Environment

Please note that the analysis has not come across cases of stakeholders with low interest and high power (which would be incoherent). However, stakeholders with high interest may in some cases have low power.

Please also note that some stakeholders were identified at a later stage of the study. As a consequence, some of them may not appear in the power/interest mappings. However, they are listed above and have usually a relatively low power.
Some of the relevant stakeholders were identified throughout the process as purposive sampling and snowball methods were used. These stakeholders have been included, see table 8, but they do not appear in the power and interest grid. Especially on the German side, the various departments within administrative districts of Baden-Württemberg proved important for implementing policies and transboundary coordination. The state is subdivided into the four sub regions or 'Regierungsbezirke' that are governed by four 'Regierungspräsidien'. These district governments function as an authority between the Federal Ministries and the subordinate administrations that bundle multiple municipalities. Their mandate is to coordinate multiple policy domains and different interests and to monitor implementation of policies. Legislate power lies at the superordinate federal level [45]. A governance reform diminished the power of the Regierungspräsidien in most federal states, however in Baden-Württemberg more responsibilities were transferred to this administrative level[46].

[45] Jörg Bogumil, 'Verwaltungsstrukturreformen in Den Bundesländern. Abschaffung Oder Reorganisation Der Bezirksregierungen', *Zeitschrift Für Gesetzgebung*, 22.2 (2007), 246–259.
[46] Jörg Bogumil and Falk Ebinger, 'Verwaltungspolitik in Den Bundesländern: Vom Stiefkind Zum Darling Der Politik', in *Die Politik Der Bundesländer* (Springer, 2008), pp. 275–288.

1.6.1 Energy issues

The graphic below illustrates the power/interest mapping of relevant stakeholders.
The stakeholder with the highest power and interest in energy issues is the **French *Direction régionale de l'environnement, de l'aménagement et du logement* (DREAL)**, which corresponds to decentralised State services in regions, focusing on environment, planning and housing policies. Placed under the authority of the regional and departmental prefects, the DREALs are thus entrusted with the task of developing and coordinating the State's policies in terms of sustainable development and management, ecological transition, climate change, preservation of the quality of the environment (water, air, soil), biodiversity and landscapes, prevention of pollution, risks and nuisances, as well as housing, accommodation, urban renewal and transport. DREALs also develop or co-develop framework documents, have various special policing powers, issue opinions in regulatory proceedings, and produce or publish data or information. Their main source of power is thus legal, and their policing activities also confer power over others.
It is followed, on the same level of interest but slightly behind in terms of power, by the **French Environment and Energy Management Agency (ADEME)**, **Electricité de France (EDF)** and **Energie Baden-Württemberg (EnBW)**.
The ADEME is a public industrial and commercial undertaking placed under the authority of the French environment ministry. It produces scientific and technical expertise and knowledge, accompanies and advises stakeholders and promotes the dissemination of good practices in the following: waste management, soil preservation, energetic efficiency, renewable energies, air and noise pollution. Its main source of power may be its reliability and acknowledgement by other stakeholders as a producer of information. It also participates in co-financing of initiatives which gives it power.
EDF and EnBW are electricity and energy producers and suppliers. As such, they have a high interest in energy issues. They also have a direct control over production and supply of energy which is a source of power.
A category of stakeholders with high interest but low power may be NGOs and associations, such as Alsace Nature, which is present at meetings and involved in energy networks but its power is limited to awareness rising and campaigning.
More transversal and generic stakeholders are situated toward the middle of the graphic. Stakeholders with lowest interest are typically in charge of other policies (agriculture, water, environment...) and are described more in detail thereafter.

Figure 15: Power/interest mapping of organizations on energy issues

1.6.2 Water issues

A stakeholder with high power and interest in water issues is, as for energy issues, the **French DREAL**. The DREAL Grand Est has power and interest in water issues as it is responsible for water and nature policing activities. It is also in charge of monitoring and supporting the implementation of European directives on water (floods directive, water framework directive, nitrates directive...).

Another stakeholder with high power and interest concerning water issues is the **Rhin-Meuse water agency**. It is one of six French agencies responsible for combating pollution and protecting aquatic environments[47]. It carries out its missions on the French territory of the Rhine and Meuse river basin. It has power through its economic instruments (fees and subsidies) to carry out its action. Fees or "redevances" in French are environmental tax revenues collected from users (consumers, economic actors) in application of the polluter pays principle. These fees are shared under basin solidarity. The law sets the overall spending cap. Through the collected fees, the Rhin-Meuse water agency provides financial aid (grants, loans) to public or private individuals (local authorities, economic actors, associations, etc.), which carry out actions or projects of common interest contributing to a balanced management of water resources. The intervention priorities of the water agency are defined by a multi-year program of actions.

Other specific water management organizations including transboundary ones such as the **Integrated Rhine Program** (RFIR) concerning flood control in the Upper Rhine (e.g. creation of retention areas), and the **International Commission for Hydrology of the Rhine Basin** (CHR) also have high interest but lower power. In France, the *Association pour la Protection de la Nappe Phréatique de la Plaine d'Alsace* (**APRONA**) concerning water quality, and the National School of Water and Environment Engineering of Strasbourg (**ENGEES**) have high interest and medium power. **EDF** and **EnBW** also have high interest in water issues with regards to energy production.

An institution with considerable power and interest is the French **Grand Est region**, especially since it has chosen to include a voluntary chapter on water in its SRADDET.

Stakeholders traditionally qualified as from the agriculture world were rated with high interest and power in the agriculture and food issues. However as their interest in water is indirect (the production of food depends in the availability and quality of the resource), their rating here is relatively low.

[47] According to French law, water agencies promote "balanced and economic management of water resources and aquatic environments, drinking water supply, flood control and sustainable development of economic activities".

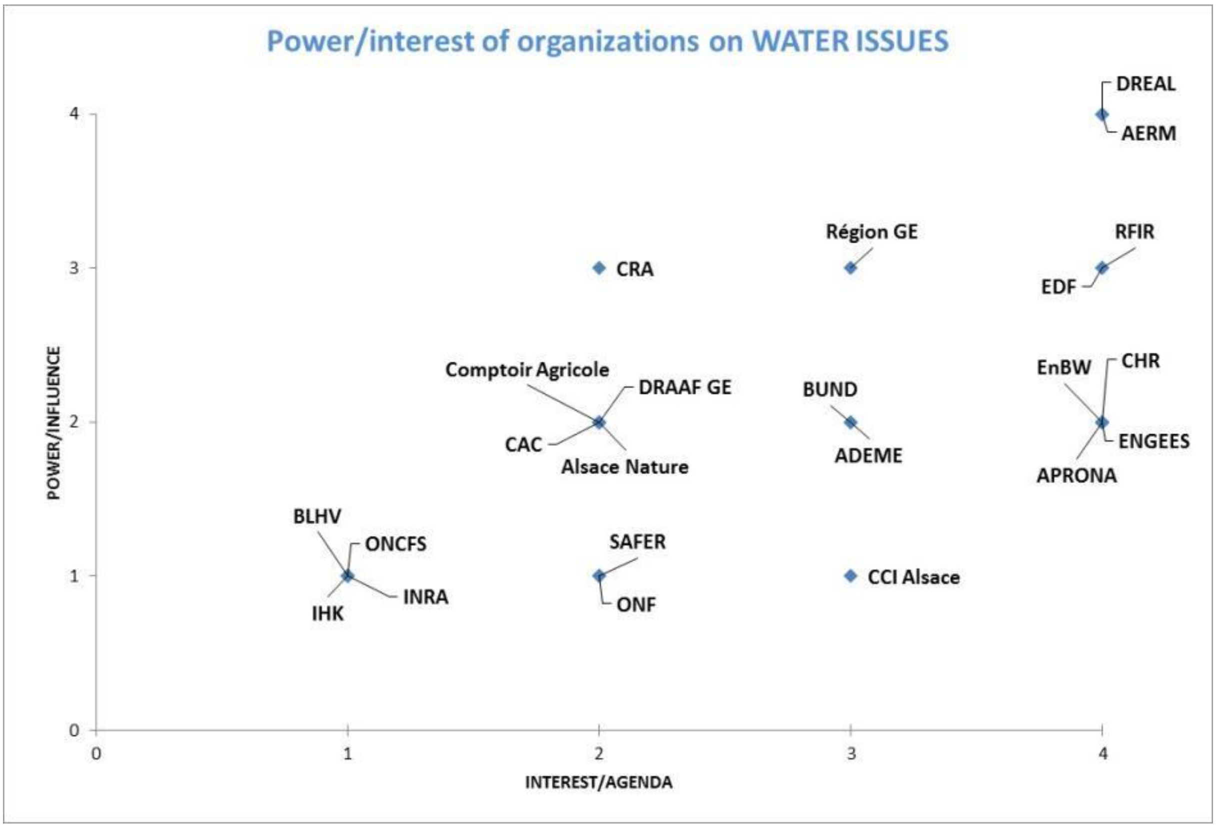


Figure 16: Power/interest mapping of organizations on water issues

1.6.3 Agriculture and food issues

Stakeholders rated with highest interest and power in agriculture and food issues are the following French stakeholders:

- The land development and rural settlement societies (**SAFER**)[48]
- The Alsace Chamber of Agriculture (**CRA**)[49]
- The Agricultural Cooperative of Cereals (**CAC**)[50]
- The **Comptoir Agricole**[51]

The SAFER gets its power from its control over certain land transactions. The other three stakeholders either count on elected officials or represent the agriculture sector through their members (farmers, employees, retailers, etc.).

On the same level of interest however with less power comes the German Badischer Landwirtschaftlicher Hauptverband e.V . (**BLHV**) and the National Institute of Agronomic Research (**INRA**) based in Colmar.

Stakeholders with relative high interest but little power are the IHK Südlicher Oberrhein and the Alsace Nature environmental protection association.

[48] Their role is to enable any viable project leader - be it agricultural, artisanal, service, residential or environmental - to settle in rural areas. For instance, they can do land transactions. They are placed under the supervision of the Ministries of Agriculture and Finance.

[49] The Chambers of Agriculture, created in 1924, are public institutions run by elected officials. They represent all the stakeholders of the agricultural, rural and forest worlds: farmers, owners, employees, professional groups...

[50] In Alsace, the CAC is a cooperative enterprise aiming to ensure the economic development and income of its members (most of them being farmers).

[51] The Comptoir Agricole is also a cooperative enterprise fostering the development and preservation of agriculture in Alsace.

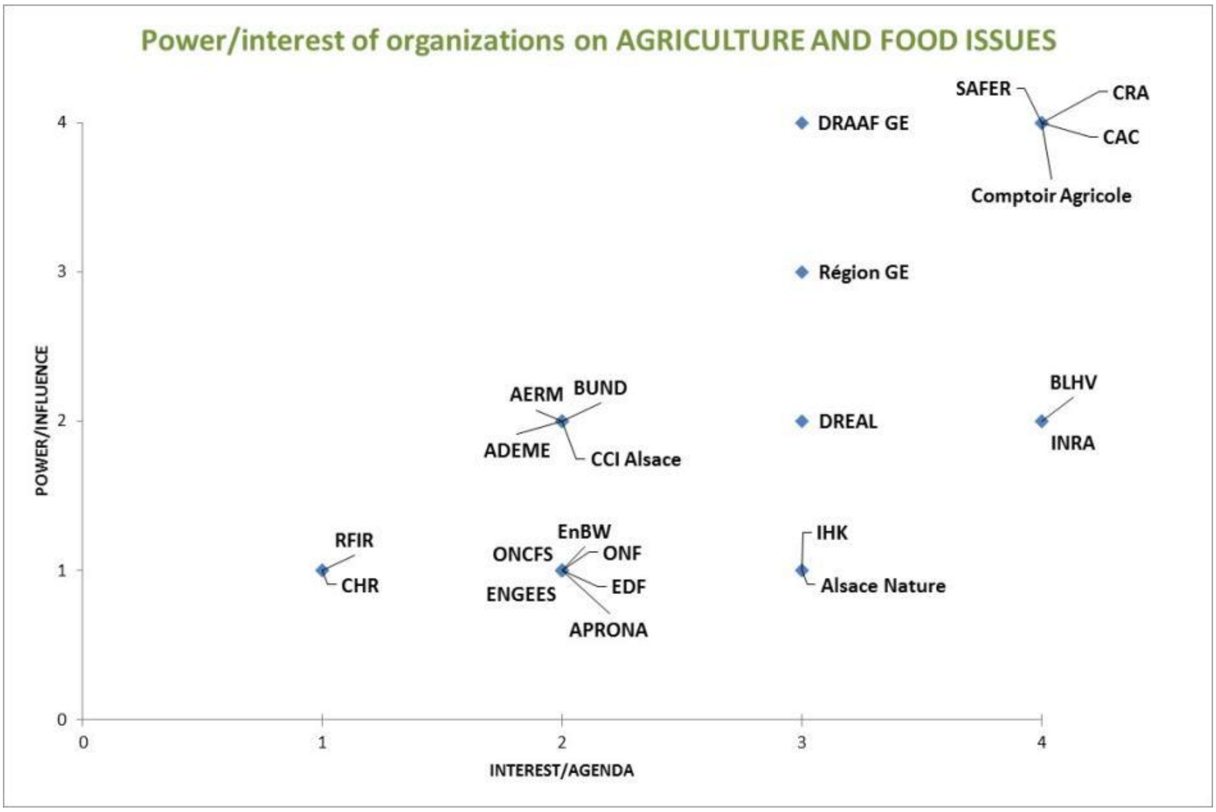


Figure 17: Power/interest mapping of organizations on agriculture and food issues

1.6.4 Land issues

As seen before, the **SAFER** has high interest and power over land issues. So does the **French national forest office (ONF)**[52], which manages 394,000 ha of state forests, 719,000 ha of communal forests and 5,000 ha of private forests in the Grand Est region.

Because stakes are high concerning land issues in the agriculture sector - especially in Alsace where land pressure is important due to highly urbanized and densely populated areas-, some agriculture stakeholders have high interest in land issues (CRA, DRAAF Grand Est).

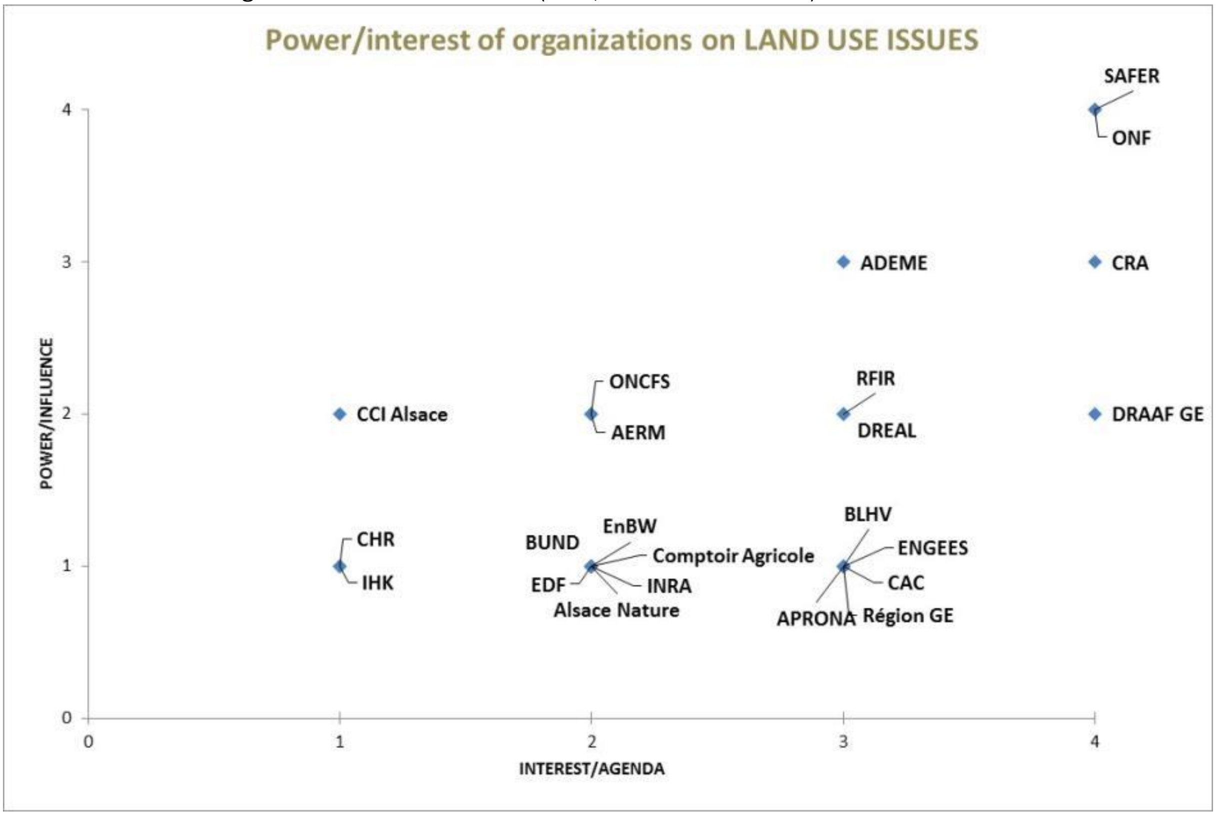


Figure 18: Power/interest mapping of organizations on land use issues

[52] The ONF is an establishment of industrial and commercial nature created in 1964.

1.6.5 Environment issues

The environment is probably the issue, which accounts for the highest number of highly interested stakeholders (11 of them, compared to 5 for energy, 8 for water, 6 for agriculture, 4 for land, and 4 for climate issues). However, only 3 of them have high power (as opposed to 4 for the agriculture issues for example): the **ONF**, the **National Office of Hunting and Wildlife (ONCFS)**[53], and the **DREAL**. The ONCFS has a high formal power, which comes from its influence on the governments through its presence in lobby groups and its representation at the Parliament and the Senate. It also exercises influence through unregulated, informal lobbying power.

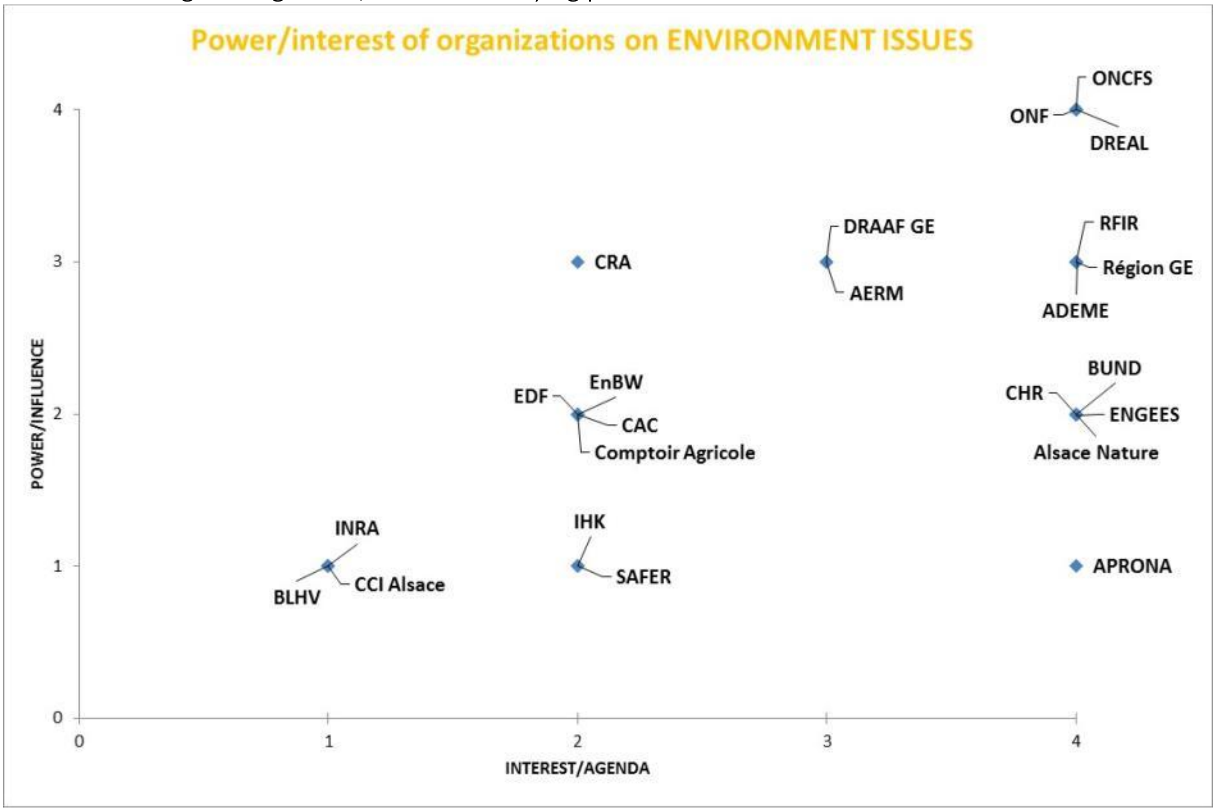


Figure 19: Power/interest mapping of organizations on environmental issues

[53] The ONCFS is a public establishment placed under the double supervision of the Ministries in charge of Ecology and Agriculture. Its missions include: territorial surveillance and the environment and hunting police, studies and research on wildlife and its habitats, technical support and advice to administrations, local authorities, managers and developers of territories, the evolution of hunting practices according to principles of sustainable development and the development of rural territories management practices respectful of the environment, the organization of the examination and the issuing of hunting licenses.

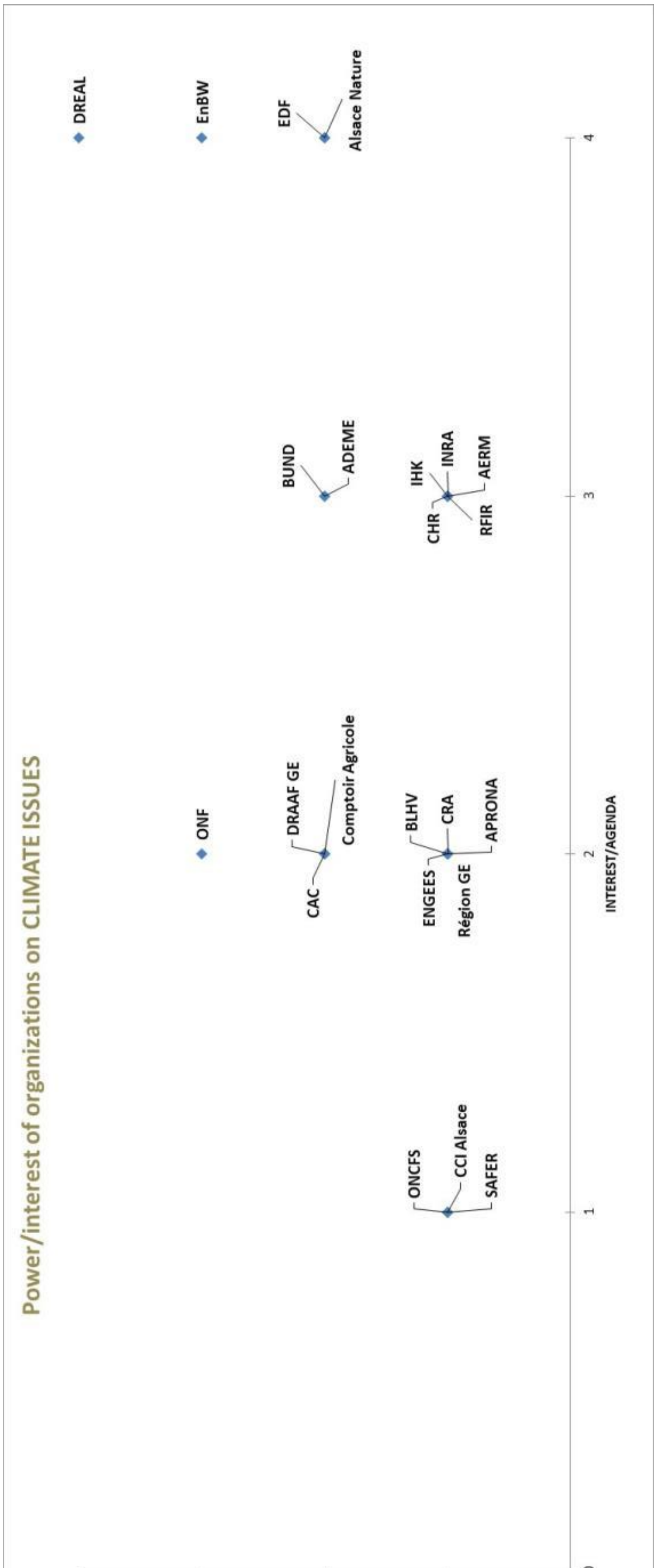
1.6.6 Climate issues

Climate issues may be tackled by two approaches: climate mitigation aiming at the reduction of greenhouse gas (GHG) emissions through an energy transition (i.e. encompassing the evolution towards less-emitting energy sources, thus decarbonizing the economy), and climate adaptation to the effects of climate change induced by the rise in GHG emissions.

As energy producers and suppliers, **EDF** and **EnBW** have a lever on climate mitigation, which is why their interest on climate issues is high. The **DREAL** also has high interest and power because of its missions and formal power attributed by law. Since climate mitigation is linked to environmental issues, and climate adaptation may depend on nature-based solutions, **Alsace nature** also has a high interest in climate issues.

These stakeholders are followed by the **French Environment and Energy Management Agency (ADEME)**, as climate issues are at the core of its missions, and the environment and nature conservation association **BUND**.

Figure 20: Power/interest mapping of organizations on climate issues



3 Mapping of policy goals and instruments

1.7 Sector-specific policy documents in the Upper Rhine

The Upper Rhine case lies in a unique policy sphere with transnational cooperation that has been ongoing for decades (e.g. the international integrated management of the Rhine basin). Therefore the case study may provide insights in how policies and cooperation can be improved. To answer the first research question about what policies are in place, the following section maps out relevant policies, objectives and instruments. Sections that follow aim to answer research questions about the impact of these policies on one another by assessing the degree of coherence between certain selected objectives and instruments and in implementation. Due to the transboundary of the case study, the analysis focus on listing so-called “horizontal” policies (policies of the same administrative level) rather than “vertical” ones (for example, comparing the European, national and regional levels). Moreover, the policy inventory concentrates on policies from the former Alsace region, which was integrated in the Grand Est region, as it is riparian to the Rhine.

The policy documents that appear relevant based on the interviews and workshop with stakeholders from the regions, various organizations and sectors, are **highlighted in bold**. This judgment has been made after the policy mapping and is further substantiated in the following sections.

Table 9: Inventory of policy documents

Type of document, Scope	Nexus sector	Title of document	Short description of the content	Time horizon
France				
National Framework, FR	Food, agriculture	National Framework for the European Agricultural Fund for Rural Development	The framework gives guidance for intelligent sustainable agriculture and rural development.	2014-2020
National Programmes, FR	Food, agriculture	Agro-ecologic Project for France	This programme launches ecological initiatives to mobilize projects for sustainable agriculture in face of climate change including economic, social and environmental performance.	2012-NA
Regional Programme, FR	Food, agriculture	Rural Development Programme Alsace	The programme seeks practical guidance and funds for agricultural practices preserving ecosystems, biodiversity and soils as well as promoting climate smart and organic agriculture. The Programmes are the regional implementation of the National Framework for the European Agricultural Fund for Rural Development.	2014-2020
Regional Plan, FR	Food, agriculture	Regional Plan for sustainable agriculture Alsace	The plan sets out the main orientations of the agricultural, agri-food and agro-industrial policy of the region taking into account the	2012-NA

Type of document, Scope	Nexus sector	Title of document	Short description of the content	Time horizon
			specificities of the territories as well as all economic, social and environmental interests.	
Germany				
Federal state Law, GER	Food, agriculture	Improvement of Agricultural Structure and Coastal Protection joint task and law	Plan to improve the agricultural structure and coastal protection including coastal protection measures in a context of climate change and a framework plan with measures of preventive flood protection.	2017-2020
Regional Law, GER	Food, agriculture, land use	Agriculture and Landscapes Law Baden-Württemberg (LLG)	The law puts agriculture and forestry into the overall political agenda through funding schemes (EU agricultural fund) and ensures the preservation of the cultural and recreational landscape for the general public.	1972-NA
Regional Law, GER	Food, agriculture	Rural development programme (MEPL III)	The programme focuses on competitiveness of the agri-sector and sustainable forestry and on preserving and enhancing ecosystems related to agriculture and forestry. It is validated by the European Commission.	2014-2020
Transboundary				
European Law, applied in both FR and GER	Food; agriculture	Common Agricultural Policy (CAP)	The common agricultural policy consists of two pillars, direct payments for production and indirect payments that enhance rural development. Income security, meeting market demand and greening agricultural production are central to the renewed policy. National agencies are appointed to administer direct payments. The indirect payments are further determined by member states.	2014-2020
France				
National law, FR	Land use	Biodiversity Law	The law aims at protecting, restoring and promoting biodiversity, notably through the "avoid, reduce,	2016-NA

Type of document, Scope	Nexus sector	Title of document	Short description of the content	Time horizon
			compensate" trilogy. It introduces the notions of ecological damage, of environmental regulation ratchet effect and of zero biodiversity net loss.	
Regional Scheme, FR	Land use, energy, climate	Regional scheme of development, sustainable development and equality of the territory (SRADDET)	The scheme aims at integrating numerous regional schemes: land use, energy, climate, biodiversity, transportation, waste management etc.	2019-2023
National law, FR	Land use, urban development and spatial planning	Urbanization law	The law aims to balance objectives of sustainable development and urban planning.	2018-NA
Regional Schemes, FR	Land use	Regional schemes for ecological coherence (Alsace, Champagne-Ardennes, Lorraine)	The aim of this policy is to reconcile the preservation of nature with the development of human activities by improving the ecological function and preserving biodiversity and its services.	2014-2020
Sub-regional planning, FR	Land use	Urbanism local plans (PLU)	The planning may contain one or several cities. It contains a territory and environmental assessment, a non-binding zoning and an environmental impacts assessment.	NA
National law, FR	Land use	Environmental law	This is a group of laws that regulate the environmental protection in France on a national level. It regulates the management of coastal zones, nature conservation parks and reserves, landscapes and ecological corridors. It is applicable to urban development and rural zones.	2018-NA
Germany				
Federal state Law, GER	Land use	Law of Nature Conservation and Landscape Development	The Law regulates all aspects of nature conservation and land planning on a state level.	2009-NA
Regional Law, GER	Land use	Spatial planning law Baden-Württemberg	The law contains the goals and principles for spatial planning for the	2003-NA

Type of document, Scope	Nexus sector	Title of document	Short description of the content	Time horizon
			region. It also contains goals for specific areas that are subject to significant projects.	
Regional Law, GER	Land use	Regional forest development type guidelines	The guidelines offer a wide range of approved forest management programs that are compliant with legal and certification requirements. It gives all forest owners the opportunity to choose the appropriate method according to their individual objectives.	2014-NA
Regional Law, GER	Land use	Law of Nature Conservation and Landscape Development Baden-Württemberg	The Law regulates all aspects of nature conservation and land planning on a state level based on the national version.	2015-NA
National la, GER	Land use	Environmental compensation law, GER	The law builds on the Nature Conservation law to the size and type of determine compensation measures.	1977-NA
Sub-regional planning, GER	Land use	Regional Plan Southern Upper Rhine 3.0	The plan is written by the Regionalverband, which is a cluster of municipalities. It applies the federal state law on spatial planning. Specific plans and maps are developed on the basis of this strategic document.	2017-NA
Transboundary				
European Law, International	Land use	EC No 1107/2009	The law protects plants and products on the European market and repeals former directives concerning plant protection products.	2009-NA
France				
National Plan, FR	Climate	National Plan for Climate Change Adaptation	The plan guides adaptation efforts in all sectors following the objectives to protect persons and property, avoid inequalities in risk, limit costs and preserve the natural heritage.	2011-2015
National Strategy, FR	Climate	National Low-Carbon Strategy (SNBC)	The low-carbon strategy comes from the 2015 energy law. It aims at reducing GHG emission by 40% in 2030 and by 75% in 2050 in comparison with 1990. It gives indicatives emissions quotas by	2015-2018

Type of document, Scope	Nexus sector	Title of document	Short description of the content	Time horizon
			sectors.	
Germany				
Federal state Plan, GER	Climate, energy	Climate Action Plan 2050	The plan adopts the goals of the Paris Climate Agreement 2016 to transform the country greenhouse gas neutral by 2050.	2016-NA
Regional Law, GER	Climate	Climate Change Adaptation Strategy Baden-Württemberg	This document is provides guidelines for an integrated adaptation strategy. Thus, the document is not binding but rather a work in progress that aims to probe various actors to partake. A follow-up strategy will be developed.	2015-NA
Regional Law, GER	Climate, energy	Act governing the Mitigation of Climate Change in the state of Baden-Württemberg	The law is the basis of the later detailed version including the IEKK 2014. The aim is to take the share in international, European and national reduction of GHG emissions and ensure the sustainable provision of energy within the federal state of Baden-Württemberg and discuss instruments and ways of implementation.	2013-NA
Transboundary				
Climate and energy strategy, international	Climate, energy	Tri-national climate and energy strategy for the Upper Rhine region, transnational	The strategy deals with issues regarding climate protection and energy in an interdisciplinary, mutual, transboundary way.	2013-NA
France				
National law, FR	Water	Water Law	European water directive transposition. Objectives on water quality, access, management and fresh water fishing.	2006-NA
Hydrological Plan, FR	Water	Management Plan for Flood Risk Management Rhine-Meuse	The plan is the flood management reference document for the region Grand Est and is the implementation of the Flood Directive aiming at reducing the human and economic consequences of floods.	2016-2021
Hydrological Plan, FR	Water	Rhine-Meuse River basin Management Plan	The Plan seeks to achieve the protection, improvement and	2016-2021

Type of document, Scope	Nexus sector	Title of document	Short description of the content	Time horizon
			sustainable use of the water environment for the river basins of Rhine and Meuse under the EU Water Framework Directive	
Hydrological Plan, FR	Water	Ill-Nappe-Rhine River basin Management Plan	The plan seeks to preserve and restore the groundwater quality and the water ecosystems related to the river and the wetlands.	2016-2021
Germany				
Federal state law, GER	Water	Water resources law	The law is the main water law for Germany. It contains provisions on the protection and the use of surface and groundwater, as well as regulations on the development of water bodies, water management planning and flood protection.	2009-NA
Regional Law, GER	Water	Water law for Baden-Württemberg	The law is the state level implementation of the water law.	2013-NA
Regional Law, GER	Water	Integrated Rhine Programme (IRP)	The programme is led by the Baden-Württemberg region with a contractual agreement with France to create flood retention basins and preserve or restore flood plains.	1996-2016 2016-NA
Hydrological Plan, GER	Water	Management Plan Upper Rhine	Management plan for the German Upper Rhine Basin under the EU Water Framework Directive together with other national water management laws.	2015-2021
Transboundary				
Hydrological Directive, international[54]	Water	Internationally coordinated flood risk management plan for the Rhine basin	The Directive combines the national and regional flood risk management plans to an overarching international plan in order to lower flood levels on a bigger scale.	2015-NA
Hydrological basin, international	Water, climate	Strategy for the IRBD Rhine for adapting to climate change	It is a transnational adaptation strategy for the Rhine basin based on joint climate change scenarios and	2015-NA

[54] Switzerland, France, Germany, Luxemburg, the Netherlands, the European Commission, Austria, Liechtenstein, the Belgian region of Wallonia, Italy.

Type of document, Scope	Nexus sector	Title of document	Short description of the content	Time horizon
			impact assessments. It sets the basic strategic principles and describes possible fields of actions and adaptation measures.	
France				
National Law, FR	Energy	Energy transition law for green growth	The law aims at enabling France to contribute more effectively to the fight against climate change and the preservation of the environment, as well as to strengthen the nation's energy independence while offering its companies and citizens access to energy at a competitive cost.	2015-NA
National planning, FR	Energy	5-years Energy Planning (PPE)	5-years energy implementation planning. Goals are set by energy production means and for energy efficiency.	2014-2018, 2019-2023
National strategy, FR	Energy	National biomass management strategy (SNBC)	The strategy has three operational objectives in terms of 1) volumes and quality 2) preventing and managing difficulties to access the resources while preventing use conflicts and 3) optimizing the co-benefits	2018-NA
Regional Schemes, FR	Energy	Regional Schemes for Climate Air Energy (Alsace, Champagne-Ardennes, Lorraine)	The strategic documents sets guidelines on controlling energy consumption, reduction of GHGs, improvement of air quality and the development of renewable energies.	2012-NA
Sub-regional planning, FR	Energy, climate	Climate, air and energy territorial planning (PCAET)	This planning is edited by all local authorities with at least 20 thousands inhabitants. It plans territorial GHG emissions, energy dependency reduction, air pollutions reduction and climate adaptation.	NA
Germany				
Federal state law, GER	Energy	Renewable Energy Sources Act (EEG)	The law, last altered in 2017, provides a financial incentives to support the generation of renewable electricity.	2014-NA
Federal state law, GER	Energy	Regulation of electricity generation by biomass	The regulation is part of the Renewable Energy act and states which material falls under biomass,	2017-NA

Type of document, Scope	Nexus sector	Title of document	Short description of the content	Time horizon
			which technical procedures are allowed and what environmental requirements have to be met by electricity generation from biomass.	
Federal state law, GER	Energy	Law on energy services and other energy efficiency measures	This law contributes to national goals of energy efficiency.	2015-NA
Federal state law, GER	Energy	Law on the revision of the co-generation Act	The law aims at promoting co-generation and its efficiency.	2016-NA
Regional Law, GER	Energy, climate	Integrated Energy and Climate Change Law (IEKK) Baden-Württemberg	The state law applies the 2013 national energy laws. It comprises a broad spectrum of energy topics, such as energy efficiency, renewable, nuclear energy and GHG emissions.	2014-NA
Regional Law, GER	Energy, land use	Free surfaces opening regulation Baden Württemberg	The law aims at promoting the use of free surface for photovoltaic solar parks in the region.	2017-NA
International				
International stategy	Energy, climate	Climate and energy strategy for the tri-national Upper Rhine metropolitan region	This strategy is presented by the Upper Rhine Commission who made the TRION network responsible for implementing the climate and energy strategy that aims at pooling cross-border synergy effects relating to climate and energy in the tri-national Upper Rhine metropolitan region.	2013-NA

Some documents are not purely sector-specific but already adopt a partially integrated view:

- The French SRADDET was designed to be an inter-sector, integrated scheme. As such, it comprises almost all aspects of the Nexus. It was classified under « Land use » even though it does not comprise any binding spatial planning.
- Most energy and climate policy documents usually comprise both energy and climate mitigation aspects. They can be therefore classified in both categories. The “energy” classification has been selected by default in order to leave the “climate” classification for “climate adaptation” and “climate mitigation”, non sector specific documents.
- Both French and German rural planning documents have been classified in “agriculture/food” to leave the “land use” classification for non sector-specific documents (“Plan de Développement Rural” and “Maßnahmen- und Entwicklungsplan Ländlicher Raum”).

- The same logic applies to the German regulation aiming at defining new free surfaces for photovoltaic solar parks ("Freiflächenöffnungsverordnung"). It has been classified in "energy".
- In some cases, national and regional laws overlap. In that case both documents are highlighted. Although vertical coherence is not a focus of this study it prevents losing this information.

International bodies such as the Upper Rhine Conference and Council were created as governance bodies in the region. These bodies have objectives, means and strategies that are distinct from France and Germany. As a consequence, relevant documents that were edited by them are listed here at the same level than national and regional regulations.

1.8 Policy goals in relevant sectors

The following table presents an inventory of the overarching and specific objectives of each relevant policy sector (water, energy, agricultural, climate and environmental policy sectors), linking these objectives to specific policy documents included in Table 10. In France, climate and energy are often tackled within a common policy or document. Following the methodology of the previous section, objectives referring to the development of renewable energies were classified in the "energy" sector, and non sector-specific objectives regarding climate mitigation (reduction of GHG emissions) and adaptation were classified under the "climate" sector, although they are included within the same policy.
As in the previous table 9, those objectives that are selected for the analysis of policy interactions as further explained below, are indicated in bold. The last column indicates the policy document and country from which objectives are retrieved.

Table 10: Inventory of policy goals

Water policies		
Overarching goals	Specific goals	Reference documents
Reach the good water status objectives as defined by the EU Water Framework Directive in the Rhin-Meuse basin	<u>Status of water bodies</u>, to reach by 2021: **- 44% of the rivers in the basin in good ecological status** - 80% of groundwater in good chemical status <u>Polluting substances</u>: Reduction or suppression objectives have been set for the Rhine-Meuse basin for more than 50 substances or families of substances according to their dangerousness. <u>Protected areas</u>: On protected areas (catchments used for drinking water, remarkable areas for fauna and flora ...), it was reaffirmed to respect the effective standards.	Rhine-Meuse River basin Management Plan, FR Strategy for the IRBD Rhine for adapting to climate change, TB
Preserve and restore the groundwater quality of the Rhine, more precisely the Alsace ground water, the river Ill and the water flows between Ill and Rhine	- Reestablish the ground water quality - Preserve the ground water body from new pollution - Stay alert to avoid overexploitation of the water table	Ill-Nappe-Rhine River basin Management Plan, FR

Integrate and ensure consistency between different approaches to flood risk management in the Rhin-Meuse basin	→ Not aggravate flood risks in the various states / regions of the International Commission for the Meuse river through relevant coordination of cross-border impact measures ; foster cooperation between actors → Improve forecasting and warning systems through multilateral exchange of hydrological data ; improve knowledge and develop risk culture ; prepare for a crises and facilitate a return to a normal situation → Improve flood prevention through knowledge exchange on past floods and their occurrence in the future → Promote sustainable development of the territories (e.g. preserve areas of flood expansion in non-urban areas) → Prevent risk through balanced and sustainable management of water resources (in coherence with the River basin management plan, e.g.: limit the discharge of rainwater into watercourses, encourage infiltration ; limit the acceleration and increase of runoff in rural and peri-urban river basins by preserving wetlands and developing agro-ecological infrastructure)	Management Plan for Flood Risk Management, FR Internationally coordinated flood risk management plan for the Rhine basin, TB Strategy for the IRBD Rhine for adapting to climate change; TB
Reduce flood risks to a socially acceptable level and prevent unacceptable risks so as to secure living areas and economic areas for the future	(1) Avoid new, unacceptable risks (2) Reduction of existing risks to an acceptable level (3) Reduction of adverse consequences during a flood event (4) Reduction of adverse consequences after a flood event	Internationally coordinated flood risk management plan for the Rhine basin, international
Germany		
Improve ecological status of the Rhine	- Good status (or the good potential) of water bodies. It is expected that 10 lake water bodies and 21 groundwater bodies are in good status in 2015. For all the other water bodies (127 surface water bodies, 13 lake water bodies, 12 groundwater bodies) it is planned that good status is reached either in 2021 or in 2027.	Management Plan Upper Rhine, GER
Food protection on the Rhine	Flood protection and ecological restoration: - Strengthen flood protection between Iffenstein and Worms in an ecological manner - Restoration of wetlands	Integrated Rhine Programme (IRP), GER

Energy policies		
Overarching goals	Specific goals	Reference documents
Support the development of renewable energies and limit energy use	Ensure energy supply (share of renewable energy in 2020 at 38 % [12% solar/ 10% wind/ 8% hydro/ 8% biomass of which half of this comes from waste incinerators] and 2050 at 86 %) for the transition period construction of gas powered combined heat & power plants until 2020 and decrease the energy consumption by 16 % in 2020 and 49 % by 2050 (baseline 2010)	Climate Action Plan 2050 in Baden Württemberg; GER
	The share of gross electricity consumption generated by	Renewable Energy Sources Act

	renewable energies should increase incremental to 18% until 2020 /40-45% until 2025 / 55-60% until 2035 / minimum 80% in 2050.	(EEG), GER
	Multiple capacity objectives for renewable energy technologies and energy efficiency, amongst which objective VIII for anaerobic digestion, in terms of total installed capacity: objective capacity installed December 31, 2018 137 MW, December 31, 2023 Low option: 237 MW, High option: 300 MW nationally	5-years Energy Planning (PPE)
	Increase the production of renewable energies by 20% by 2020 by diversifying the production sectors.	Regional Scheme for Climate Air Energy Alsace, FR
	- Increase the share of renewable energies to 23 % of gross final energy consumption in 2020 and 32 % of gross final energy consumption in 2030; - Reduce the share of nuclear power in electricity production to 50 % by 2025	Law on the energy transition for green growth, FR
Fight against energy poverty	Enforce a right to access for all to energy without excessive cost in relation to household resources	Law on the energy transition for green growth, FR

Agricultural policies		
Overarching goals	Specific goals	Reference documents
Provide practical guidance and funds for agricultural practices preserving ecosystems, biodiversity and soils as well as promoting climate smart and organic agriculture in Alsace	- 52 % of the Alsace RDP resources are dedicated to the development of agricultural practices preserving ecosystems and biodiversity through agri-environmental and climate operations as well as support in the development of surfaces in organic farming (13% of the agricultural surface will be concerned). - 26 % of the Alsace RDP resources are dedicated to support farms in order to strengthen their competitiveness and sustain their activity, through modernization and development projects for about 1000 farms and 700 young farmers' installation projects in order to guarantee generational renewal. To this will be added the support of farmers through training actions.	Rural Development Program (RDP) in Alsace, FR Regional Plan for sustainable agriculture in Alsace, FR
Define specific elements of common measures to the 21 regional French rural development programs (RDP)	Common objectives include : 1) Develop new production methods that improve the competitiveness of farms by reducing the cost of factors of production while preserving the natural resources from which farms derive their production. 2) Promote the generational renewal of farms by promoting the creation, transfer and adaptation of farms 3) Protect the natural environment by implementing measures to preserve, restore and manage natural resources	National Framework for the European Agricultural Fund for Rural Development (France), FR
Promote agroecology principles (linking environment, social and economical performance) at	Train and advise farmers; Develop and facilitate collective projects; Reduce the use of phytosanitary products; Support the transition; Promote organic farming; Engage and mobilize sectors and territories; Decrease the use of	Agro-ecologic Project for France, FR

the national level (France)	veterinary antibiotics; Select suitable seeds; Enrich the soil with the 4 per 1000 initiative[55]; Encourage beekeeping; Promote the use of trees to improve production.	
- Recover good water quality - Preserve and improve balance between agriculture and biodiversity - Take into account air quality and climate change issues - Support agricultural sectors	→ The River Basin Management Plan for the Rhin-Meuse district identified 56 priority catchments in Alsace, where the good status must be achieved by 2015 → Beyond the strict preservation measures of the most sensitive areas, solutions must be sought to restore or maintain a balance between biodiversity and agriculture at the territorial level. The rate of contractualization of areas with biodiversity issues such as Natura 2000 areas is a good example. → Support energy recovery of agricultural biomass and co-products (methanisation, boilers), geothermal energy, photovoltaic projects Viticulture: strengthen the competitiveness of the sector to strengthen its economic contribution (trade balance, employment, ...); support the adaptation of the sector to the structural changes linked to greater liberalization; pursue the development of organic viticulture; contribute to territorial development by reinforcing the role of viticulture in tourism, enhancing landscapes, etc. Corn and field crops: preserve the regional corn sector by strengthening its sustainability (impacts on water, biodiversity, societal image); promote the development of organic production of field crops especially in areas with environmental issues Milk production: increase the productivity of regional production systems; strengthen farms' resistance to economic and natural hazards (support to improve competitiveness); strengthen the economic power of producers (support approaches to better valorise milk as part of the mountain milk scheme); increase regional markets: support the modernization or development of new transformation tools	Regional Plan for sustainable agriculture in Alsace, FR
Improvement of the agricultural sector and the protection of coastal zones:	**Ensure competitiveness agriculture and forestry** - Strengthen rural structure - Improve infrastructure of rural areas - Strengthen agricultural enterprises - Diversification of agricultural practices to maintain agricultural sector - Improve marketing, distribution and processing processes of agriculture - Improve marketing, distribution and processing	**Rural development programme (MEPL III), GER** **Improvement of Agricultural Structure and Coastal Protection joint task and law, GER**

[55] The "4 per 1000" initiative aims at the annual growth rate of 0.4% of the stock of carbon in soils that would stop the current increase in CO2 in the air.

	processes of fishing industry **Ensure sustainable performance** - Environmentally sound landscape management - Environmentally sound agricultural and arboriculture production and management of permanent grassland - Animal well being - Preserve genetic diversity	
Support income of agricultural enterprises	- Ensure income security for farmers - Align production with market demand - Enhance sustainable agricultural production	Common Agricultural Policy (CAP); international

Climate policies		
Overarching goals	Specific goals	Reference documents
Reduce GHG emissions and control energy demand	→ climate protection through reducing GHG emission by 25% in 2020 and by 90% by 2050 (baseline: emissions in 1990) in the federal state of Baden-Württemberg → general electricity saving: reduction of 5,5% in 2020 (baseline 2010) and 14% in 2050 whereby 20% of electricity will be imported → make heating 100% climate-neutral until 2050	Climate Action Plan 2050 in Baden Württemberg, GER
	→ 75% reduction in greenhouse gas emissions between 2003 and 2050 → Reduce final energy consumption by 20% between 2003 and 2020 and decrease by 50% by 2050	Regional Scheme for Climate Air Energy Alsace, FR
	- Reduce greenhouse gas emissions by 40% between 1990 and 2030 and divide by four greenhouse gas emissions between 1990 and 2050 (factor 4); - Reduce the final energy consumption by 50% in 2050 compared to the 2012 reference by aiming at an intermediate target of 20% in 2030; - Reduce the primary energy consumption of fossil fuels by 30% in 2030 compared to the 2012 reference - Reduce by 50% the amount of waste sent to landfill by 2025 and gradually decouple economic growth and consumption of raw materials.	French law on the energy transition for green growth, FR
Reduce and prevent atmospheric pollution	→ Reduce emissions of particulates and nitrogen oxides as a priority. → Prevent exposure to air pollution due to ozone, heavy metals, pesticides...	Regional Scheme for Climate Air Energy Alsace, FR
Adapt to climate change	- improve knowledge on the effects of climate change, in order to inform public decisions on adaptation - integrate adaptation into existing public policies, in order to ensure overall coherence and to reflect the cross-cutting nature of adaptation - inform society about climate change and adaptation so that everyone can learn about the issues and act - consider interactions between activities	French National Plan for Climate Change Adaptation, FR Regional Scheme for Climate Air Energy Alsace, FR

	- pinpoint responsibilities in terms of implementation and financing → Key specific objectives include, for the water sector: Develop water savings and ensure better water use efficiency - Save 20% of the water withdrawn, excluding winter water storage, by 2020 ; → for agriculture: improve water resource efficiency in agriculture; → for energy / industry: Promote the use of more efficient cooling (air conditioning) equipment or using renewable or renewable energy sources.	
	Measures relating to water quantity (flood risk management, low flow management), water quality (improvement of water quality, optimizing the use of fertilizers and plant protection agents and enhancing organic farming, use of Warning and Alarm Plan Rhine (WAP) if considerable amounts of pollutants flow into the Rhine...), the ecosystem (protect and renature habitats, work on habitat network connectivity, develop ecological flood protection, improve water quality, keep additional anthropogenic increase of water temperature due to thermal discharges to a minimum, monitor biocoenosis)... Additional measures may concern: Agriculture - Adapt existing practice (recovering of precipitation water, choice of suitable plant species requiring less water, use of irrigation techniques using less water, e.g. drip irrigation, etc.); Hydro power generation: Determine a biological minimum water flow for hydropower plants in bypass rivers, in order to secure life, migration and reproduction of the species living in the water bodies.	Strategy for the IRBD Rhine for adapting to climate change, international
Adapt to climate change	Adaptation strategies to the changes and their impacts caused by climate change in the sectors forestry, agriculture, soil, nature conservation and biodiversity, hydrological balance, tourism, public health, urban and land planning and economy and energy economy. Examples: - Forestry: Adapt forestry in order to ensure sustainable production of timber and NTFP / ensure the forest's protective function for climate, water, air, soil, and species preservation, landscape / preserve recreational assets - Agriculture: minimize the effects of droughts, pests and extreme weather events / maintain and enhance economic competitiveness for agricultural products - Nature conservation, biodiversity: identify endangered and key species / enhance survival of vulnerable species / monitor and act on neobiota / intensify renaturation efforts in peat land / preserve wetlands for water retention / preservation and restoration of riparian areas	Climate Adaptation Strategy Baden Wurttemberg, GER

	Focus points are: Implementation of the measures • Expanding knowledge on climate change and adaptation through promotion of research • Funding of model and best practice projects on regional, community and enterprise level • Develop monitoring system for efficiency of adaptation measures and for climate change impacts • Sensitization of relevant stakeholders through accessible data and communications and public relation strategy	
Mitigate climate change	Strategically work on issues regarding climate protection and energy in an interdisciplinary, mutual, transboundary way => cooperation between stakeholders from politics, administrations, economy, communes, environment, research and civil society GHG emissions should be reduced steadily and sustainably by a minimum of 80% until 2050 in the Upper Rhine region (baseline=year 2000)	Tri-national climate and energy strategy for the Upper Rhine region, transnational

Environmental policies		
Overarching goals	Specific goals	Reference documents
Reconcile the preservation of nature and the development of human activities, through the development or restoration of ecological continuities, to promote the movement of species and reduce habitat fragmentation and preserve the services rendered by biodiversity and prepare adaptation to climate change.	→ Maintaining the existing functionality of the green and blue belts: preservation and good management of the 145,100 ha of biodiversity reservoirs in the plain (25% of the surface area), the 69,000 ha of biodiversity reservoirs in the Vosges mountains (26% of the area) and rivers of the region in good ecological condition → Consolidation of the current network of ecological corridors: rehabilitation of a linear of 560 km of corridors, corresponding to 34% of identified corridors → Restoration of ecological continuity on rivers: preservation and restoration of ecological continuity over the 1,415 km of rivers classified in list 2 of the environmental code → Removal of the most important discontinuities related to transport infrastructure (classes 4 and 5, and those that significantly disrupt amphibian migrations) → In mountain areas, maintaining of non-urbanized spaces between towns and neighboring villages in order to guarantee the continuity of wildlife exchanges between slopes of the same valley and control of the development of leisure facilities	Regional scheme for ecological coherence Alsace, FR
Mitigate the impacts of modified discharge and temperature patterns on the flora and fauna caused by climate change.	Protect and renature habitats Restore habitat network connectivity Promote ecological flood protection Improve water quality Additional anthropogenic increase of water temperature	Strategy for the IRBD Rhine for adapting to climate change, international

	due to thermal discharges should be limited to a minimum and should not prevent achieving the good ecological status or the good ecological potential Monitoring of biocoenosis	
Regional planning taking into account diverse needs	Strategic document for planning This guideline for spatial planning also integrates various policy domains such as forestry, soil management and climate and transboundary interests are addressed General goals are (additional sub-goals specify these) -Further development of the polycentric settlement structure -Demographic change and safeguarding services of general interest -Demographic change and safeguarding services of general interest -Sustainable development of transport infrastructure -The region as a livable landscape, nature and culture area -The region of energy efficiency and renewable energies -Other domains such as soil, water and transboundary interests and the cooperation across the border are mentioned	Regional Plan Southern Upper Rhine 3.0

Balance objectives of sustainable development and urban planning.	1 ° The balance between: (a) Populations residing in urban and rural areas; (b) Urban renewal, (c) Economical use of natural areas d) The safeguarding of urban buildings e) Mobility needs; 2 ° Urban, architectural and landscape quality 3 ° The diversity of urban and rural functions and the social mix in housing, 4 ° Public safety and health; 5 ° The prevention of foreseeable natural and other risk; 6 ° The protection of natural environments and landscapes 7 ° The fight against climate change and adaptation	Urban law, FR
Integrated planning for the city of Strasbourg	Specific objectives for the following interests: -Housing: 45 000 additional housings -Traffic objectives: better circulation, more bicycles etc. -Strengthen tram vertes et blues; continue environmental services, respond to needs of inhabitant -Commercial interests and location -Sanitation -Thresholds for urbanization	Urbanism local plans (PLU)
Safeguard biodiversity	- Safeguard biological diversity: protection of populations of wild plants and animals, counter threats to ecosystems, preserve communities and biotopes - Safeguard the performance and resilience of natural resources for humans use: use resources in a sustainable manner, soil conservation, protect water bodies, climate and air as well as wild animals and plants - Maintain the diversity and characteristics of nature and landscape: develop natural and cultural landscapes, protect recreational areas against destruction - Protect un-fragmented landscape areas: design routes and projects in such a way that adverse effects are mineralized, re-cultivate used areas - Restore and protect open spaces within and near settlements: such as parks, large green spaces and green belts, forests and edges of woods, trees and woody shrubbery	Law of Nature Conservation and Landscape Development, GER
Preserve biological diversity	Preserve species, genetic and ecosystems biodiversity Amongst others: - Restore and protect biodiversity - Introduce the notions of ecological damage	Biodiversity law, FR
Ensure high level protection of both human and animal health and the environment and safeguard competitiveness of agriculture	Harmonized rules across member states to safeguard protection of humans and environment. Harmonized rules should also remove obstacles for trade of plant protection substances. Spatial attention should be paid to the protection of vulnerable groups of humans.	EC No 1107/2009

1.9 Policy means in relevant sectors

For policies to achieve announced goals, they must give stakeholders the responsibility for the implementation of measures to fulfill their ambitions. In order to simplify the analysis and facilitate comparison between sectors and policies, a typology or set of categories[56] were predefined and filled, corresponding to:

- **Economic penalties** - taxation according to the 'polluter pays' principle (e.g. the internal tax on the consumption of energy products in France)
- **Economic incentives** - including tax expenditures to encourage certain behavior (such as investing in solar panels for individual housing) and subsidies to encourage production (such as to farmers to produce certain crops)
- Formal **regulations or legislation** to control behavior or punish non-compliance (such as criminal laws) and legal penalties (e.g. economic sanctions approved by courts)
- **Voluntary regulations**, including professional codes of practice and agreements between governments and other actors such as unions and business and international agreements
- Providing **services and resources** to help change behavior such as funding programs and technical support
- **Strategic support**, developing a common and coherent vision for a given territory based on local knowledge and information
- **Public education & awareness** and advertising, e.g. awareness-raising campaigns on certain issues
- **Organizational change**, such as the establishment of a new unit within a government department or a reform of local government structures
- **Dialogue and consultation** between stakeholders to coordinate plans and actions.

Table 11: Inventory of policy means

Water policies		
General instrument or instrument category	Specific policy instruments	Reference documents
Strategic document Dialogue and consultation	The Management Plan for Flood Risk Management is the planning document for flood control measures at the river basin level. As such, it aims to provide a strategic vision of the actions to be undertaken and must orchestrate the various components of flood risk management.	Rhin-Meuse Management Plan for Flood Risk Management, FR
Regulatory	The Management Plan for Flood Risk Management is mandatory for local administrative structures and planning and programming documents. In turn, it must be compatible with the River Basin Management Plan and the national strategy for flood risk management. It must take into account, and be taken into account by, the Regional scheme for ecological coherence (SRCE).	Rhin-Meuse Management Plan for Flood Risk Management, FR

[56] Inspired from: Paul Cairney, *Policy and Policymaking in the UK*, 2015, Basingstoke: Palgrave.

	The fundamental orientations and provisions of the RBMP are opposable to all the programs and administrative decisions in the field of water, as well as to other documents such as certain urban planning documents (in particular the territorial coherence schemes) or career plans. They are the administrative rules for a balanced and sustainable management of water resources and to preserve or improve the state of water and aquatic environments at the scale of the basin. The plan also provides deadlines for achieving the status of rivers, lakes and groundwater and for reducing emissions of hazardous substances.	Rhin-Meuse River Basin Management Plan, FR
Strategic documents & Dialogue and consultation	The RBMP, which is elaborated by the Basin Committee (Basin-wide Water Parliament) and the program of measures by the Basin Coordinator Prefect, are built in a coordinated way. The actors of water management (local authorities, economic actors, associative world, State services) contributed to the updating of the RBMP and programs of measures. The RBMP and the program of measures for each district are submitted to the public and institutional stakeholders for consultation.	Rhin-Meuse River Basin Management Plan, FR
	The International Commission for the Protection of the Rhine (ICPR) is carrying out the coordination and exchange of information indicated in the Floods Directive for the Rhine river basin	Internationally coordinated flood risk management plan for the Rhine basin, international
	The ICPR working groups have analysed the possible specific impacts on the assets of protection as well as their sensitivity and the risks in the fields of water quantity, ecology and water quality.	Strategy for the IRBD Rhine for adapting to climate change
Strategic document	Polders, relocation of dams (dammrückverlegung) and special operation measures of hydroelectric dams. On the Upper Rhine between Basel and Worms alone, a retention volume of approx. 273 million m3 will be created. Baden-Württemberg contributes to this ambitious, internationally agreed target 13 flood retention areas with a total volume of 167.3 million m3.	Integrated Rhine Program, GER

Energy policies		
General instrument or instrument category	Specific policy instruments	Reference documents
Strategic document	The Regional Scheme for Climate Air Energy (SRCAE) has a strategic scope. It is therefore not a regulatory tool, directly opposable to a request for an administrative authorization (urban planning, for example), but a framework that defines the regional objectives in terms of energy management, and guidance to achieve air quality standards and to prevent, reduce or mitigate air pollution.	Regional Scheme for Climate Air Energy Alsace, FR
Economic incentive - tax expenditure	The energy transition tax credit (*Crédit d'impôt transition énergétique* – CITE) provides for a refund of 30% of the total	Law on the energy transition for

	cost of energy renovation work, up to a limit of €8,000 for a single person and €16,000 per couple.	**green growth, FR**
Economic incentive - interest-free loan	The interest-free eco-loan is a loan of up to €30,000 available to property owners carrying out energy renovation work. It can be combined with the CITE, with no restrictions applying.	
Economic incentive - rebate on the purchase of an electric vehicle	The rebate for the purchase of an electric vehicle, provided it is accompanied by scrapping a polluting vehicle (diesel vehicle over 10 years old), has been extended and increased since 1 April 2015. The rebate is worth up to 10,000 euros. 7,000 electric vehicles have been purchased using the conversion rebate, worth 70 million euros for the electric vehicle market in the first year. This aid has helped double the French electric vehicle market, making it the largest in Europe, with over 12,000 electric vehicles registered since the beginning of 2016.	
Economic incentive - guarantee on a purchase tariff for electricity	In 2016, the purchase tariff for electricity cogenerated by existing methanisation plants was revised to improve the return on investment in biogas plants (mostly operated by farmers), and to lay sound foundations for the development of this technology. A 20-year guaranteed purchase tariff exists to support development of biogas plants with output under 500 kW.	
Funding program	The regions have been mobilised by the call for projects "Breathable cities in 5 years" (*Ville respirables en 5 ans*): 25 winners have been selected and will receive aid packages of up to a million euros.	
	The Environment Ministry and the Ademe provide technical and financial support to the regions, mainly through the Waste Fund. This fund provided 55 million euros for the regions in 2015, funding promotion of the Zero waste, zero wastage regions initiative.	
	Heat fund: this fund is used to support the production of heat from renewable sources (biomass, geothermal, solar thermal, etc.). In two years, 733 projects have received funding worth a total of 400 million euros.	
	The "positive energy territories for green growth" call for projects, launched in September 2014, has generated a lot of community interest. The laureates (nearly 400 territories labeled in November 2016) receive financial support of 500,000 euros which can be increased up to 2 million euros depending on the quality of the projects and their contribution to the objectives enshrined in the law.	
	To boost energy renovation work in the housing sector, the *Habiter Mieux* (Better housing) programme managed by France's National Housing Agency (ANAH) set a target of renovating 70,000 homes in 2016; this implies a 40% increase in the programme's targets	
Regulation	The regulation is part of the Renewable Energy act and states which material falls under biomass, which technical procedures	Regulation of electricity generation of biomass, FR

	are allowed and what environmental requirements have to be met by electricity generation from biomass.	
Legislation	The law was published in the Official Journal of 18 August 2015. It includes mid and long-term objectives to prepare for the post-oil era and to establish a robust and sustainable energy model in the face of energy supply issues, price developments, resource depletion and the imperatives of environmental protection.	Law on the energy transition for green growth, FR)
	The law, last altered in 2017, provides a feed-in tariff to encourage more generation of renewable electricity. The main instrument of the law is to pay feed-in tariffs directly for electricity generated from renewable energies and mine gas that is transferred to the grid. The tariff consist of three parts: market premiums (Height determined based on competitive auctions**/ tenders which guarantees premium for 20 years: applicable to biomass, biogas, wind and solar)/** feed-in tariff (All renewable technologies are legible including previously stored electricity. Tariffs will decrease over years)/ landlord- to - tenant supply premium surcharge (also direct selling: to foster installations on rental apartment, payment lower than FIT but tax benefits) is based on article guidelines	**Renewable Energy Sources Act, GER**

Agricultural policies		
General instrument or instrument category	**Specific policy instruments**	**Reference documents**
Economic incentives - subsidies and market measures	**EU's common agricultural policy (CAP), providing income support to farmers through direct payments (depending on compliance with certain requirements in the areas of public, animal and plant health, environment and animal welfare), financing agri-environmental and climate measures and intervening on agricultural markets and providing sector-specific support**	Agro-ecologic Project for France **Common agricultural policy, international**
Funding program	European Agricultural Fund for Rural Development, partly contributing to the 180,5 million € allocated to the Alsace Rural Development Program.	Alsace Rural Development Program National Framework for the European Agricultural Fund for Rural Development, FR
Public education and advertising	Training: “teach to produce differently” program Providing farmers (and their advisers) with an agro-ecological diagnostic tool Methodological guide for mobilizing rural development aid at regional level Launching of calls for projects to disseminate, in more than 30,000 farms, the lessons learned by the 3,000 Dephy farms, which innovate to reduce the use of pesticides (Ecophyto 2 plan).	Agro-ecologic Project for France, FR
Strategic document	Setting the main orientations of the agricultural, agri-food and agro-industrial policy of the State in the economic, social and	Regional Plan for sustainable agriculture Alsace, FR

	environmental regional context	
Legislation	Federal law which puts agriculture and forestry into the overall political agenda through funding schemes (EU agricultural fund) and ensures the preservation of the cultural and recreational landscape for the general public.	Law of Agriculture and National Culture Baden-Württemberg, GER
Funding programme	Budget for 2014-2020 of Rural Development Program (MEPL III) : ELER/EAFRD: 710 million euro's + State budget (national and state): 622 million euro's + GAK (national and state): 533 million euro's = Total 1864 million euro's - For multiple schemes such as: **-Agricultural investment program Agrarinvestitionsprogram** For investments in to agricultural production processes and working conditions, reduction of production cost, increase of added value. This funding is available to middle sizes agricultural businesses. Passed on in form of a grant or guarantee (Bürgschaft). Investment in diversification: Investments expansion or establishment of non-agricultural activities **- Subsidies for organic farming and other particularly sustainable overall practices (Förderung - Agrarumwelt, Klimaschutz und Tierwohl (FAKT)**) - Organic agricultural production methods/ Nitrogen fertilizer use that is environmentally sound and causes low GHG emissions/ Fertilizer use that is conserves the quality of water bodies/ Subsidies for particularly sustainable practices in agriculture or annual one-off crops/ Varied crops in agriculture/ Conservation of catch crops and subsets the winter/ Cultivation method on erosion-prone locations/ Integration of natural structural elements of the field corridor/ Careful use of climate, water and soil/ Conversion of farmland/ Subsidies for sustainable practices in permanent grassland/ For sustainable practices in permanent crops/ For sustainable and animal-friendly husbandry practices/ For preservation of the diversity of genetic resources in agriculture/ For non-productive investment conservation/ For soil preservation measures	**Rural Development Program (MEPL III), GER**

Climate policies		
General instrument or instrument category	**Specific policy instruments**	**Reference documents**
Public education & awareness	Communication on climate scenarios for France and their consequences on resources and activities.	French National Plan for Climate Change Adaptation, FR
Legislative and regulatory	The code of urbanism states that local authorities' "urban planning contributes to the fight against climate change and adaptation to this change"	Grenelle Laws of 2009 and 2010, FR
Strategic document	Definition of measures to implement as well as designed organizations to lead the measures (estimated cost of 171 million € for the implementation of the new measures).	French National Plan for Climate Change Adaptation, FR

	Adaptation strategies per sector: forestry, agriculture, soil, nature conservation, water, tourism, health, urban planning and economy and energy measures are proposed. Examples of specific proposals: - Forestry: develop supplementary strategies for the existing near-nature silviculture through diversification of tree species (forestry research institute should do this) / consultancy and training for forest owners / monitoring of pests / minimize mechanical disturbances and enhance soil fertility and root penetration / develop a decision support tool for timber producing companies / promote game migration routes / vulnerable ecosystem like peat forest shall be maintained / - Nature conservation: preserve wetlands for water retention - Agriculture: conserve soils / diversify crop rotation / control pests and establish early-warning system / expand frost protection / build roofs for vulnerable crop and fruit stands / develop and enhance irrigation systems / adapt species portfolio / enhance intensive grasslands / minimize heat effects in pig fattening farms	Climate Change Adaptation Strategy Baden-Württemberg, GER
	Sets quantified objectives in terms of GHG emissions reduction	Climate Action Plan 2050 in Baden-Württemberg, GER
Strategic document	The TRION network and the commission climate and Energy from the Upper Rhine Commission are responsible for the implementation through: • Transboundary cooperation between regional climate agencies and clusters • Networking of stakeholders from environmental sector, economy, research and others • Transboundary exchange of knowledge, best practice and education • Collect data on evaluation of actions and projects for best practices and strategic planning • Transboundary coherence on standards, labels and indicators • Identifying and implementing best practice initiatives and (EU) projects in a transboundary cooperation • Support and marketing for innovative projects and technologies	Tri-national climate and energy strategy for the Upper Rhine region, transnational

Environmental policies		
General instrument or instrument category	Specific policy instruments	Reference documents
Regulatory	Planning documents and projects of the State, local authorities and their groupings take into account the SRCE. The French code of urbanism states that urban planning documents take into account the SRCE.	Regional scheme for ecological coherence (SRCE), FR
Strategic document	The SRCE identifies the main ecological continuities in Alsace and is meant to support decision-making.	

Regulatory	It introduces the notions of ecological damage, of environmental regulation ratchet effect and of zero biodiversity net loss. The regulation states that the hierarchy of action should be "avoid, reduce, compensate"; meaning that any damage should first be avoided or prevented, if this is not possible the damage should be reduced and lastly compensated.	Biodiversity Law, FR
Regulatory	Amendment to the Code of the Environment: Art 543-292 Methanization facilities for non-hazardous waste or raw vegetable material may be supplied by food or energy crops, grown in a main crop, in a proportion not exceeding 15% of the gross tonnage total inputs by calendar year. This proportion may be exceeded for a given year if the proportion of food or energy crops, cultivated as the main title of the crop, in the supply of the lower plant, on average, for the last three years, to 15 % of total gross tonnage of inputs. the volumes of inputs of permanent grassland and intermediate energy crops are not taken into account.	Environmental law, FR
Legislation	Federal law which regulates all aspects of nature conservation and land planning on a federal level based on the national version. Some specific regulations in this document states that Interventions in nature conservations areas need to be compensated. Interventions are changes in form or use of areas or changes in the soil layer, groundwater level, the performance and functionality of the natural environment or landscape. Compensation is carried out in terms of land, and can be doubled is it concerns "serious" interventions. Municipalities can build up an "land account" of areas to which they have a right for compensation. The use of agricultural land for compensation should be avoided.	Law of Nature Conservation and Landscape Development Baden-Württemberg, GER Environmental compensation law, GER
Legislation	Regulation of the regional Government on the opening of the tender for photovoltaic open-field plants for bids on arable land and grassland in less-favored areas. Builds on the Renewable Energy Sources Act	Access to open land regulation, GER (Freiflachenoffnungsverordnung) Renewable Energy Sources Act (EEG)
Legislation	This law implements European law on plant protection products, and limits amongst others the use of pesticides in cities.	Plant protection Product Law (Loi Labbe), FR
Strategic plan	Spatial planning documents are developed on the basis of this document. The 'regionalverband' represents clusters of municipalities who further implement the strategy.	Regional Plan Southern Upper Rhine 3.0
Strategic plan	The planning may contain one or several cities. It contains a territory and environmental assessment, a non-binding zoning and an environmental impacts assessment.	Urbanism local plans (PLU), FR

	The plan for Strasbourg and surroundings is divided into five zones for which specific goals are determined that cover the objectives for housing, traffic, sanitation, commercial interests and environmental services. One specific instrument is the planning of the urban area with tram vertes et blue and areas, blue and green ecological corridors, for the Great Hamster included as well as infrastructure plans which go through some natural areas	

4 Assessment of policy coherence

One of objectives of this report is to investigate opportunities that enhance cooperation and policy coherence both at the level of policy development and implementation. Because the scope of the policy documents that are mapped in the previous stages is too broad, specific instruments and objectives were selected to assess policy coherence on the output level. Selection criteria were based on the definition of Critical Nexus Objectives proposed in the guidelines for this report. Such an objective can be defined as a: “policy objective that according to the stakeholders and the policy analysis is highly relevant for the issue under investigation in the case study and has a potentially high number of interactions with other objectives in the nexus”[57]. The same logic applies to the instruments that have been selected for the assessment of policy coherence using the scoring range by Nilsson et al. that can also be found in the guidelines[58].
The next section introduces the selected policy instruments and objectives. Thereafter, the interactions between objectives and between objectives and instruments are rated in terms of coherence using the scoring range. Finally, this analysis is complemented with a discussion of coherence in earlier policy development stages and implementation.
In total 25 semi-structured interviews were conducted face-to-face with 43 French and German stakeholders from the five different sectors, representing different types of organization. At some interviews, more than one person was present, which explains the difference between the number of interviews and interviewees. Two researchers, one of which is fluent in the German language and the other in French, conducted the interviews. Five interviews were conducted over the phone. The interviews were by default conducted in the native language of the stakeholder: 17 German and 26 French people were spoken to. 21 interviewees represented public governance organizations; five were from NGOs and another four from research and three represented sector networks (see Annex for the exhaustive list). Both researchers were present during most interviews to enhance data collection and analysis. The interviewers took notes and recorded the conversation.
Interviews were summarized and analyzed to determine interactions, relevant instruments and objectives and institutional arrangements. Due to time limitations, not all interviews were transcribed literarily. The audio recordings were used only when needed to confirm a piece of information or a particular hypothesis. Moreover, the researchers compared their notes before one of them wrote a summary. Right after each interview, both interviewees discussed and noted the most important findings and subsequent actions. Both interviewees contributed to deriving results from the raw interview data. The interview notes were then read and semi-coded by putting information into a table with different categories such as “nexus sectors interactions” and “policy documents mentioned”. This helped identify reoccurring themes.

1.10 Nexus Critical Objectives and Instruments

[57] Stefania Munaretto and Witmer, ‘D2.1 Water-Land-Energy-Food-Climate Nexus: Policies and Policy Coherence at European and International Scale’, 2017, 75.
[58] M\a ans Nilsson and others, ‘A Draft Framework for Understanding SDG Interactions’, *ICSU–International Council for Science. PDF for Download*, 2016.

Based on the policy documents, objectives, instruments and nexus interactions that were mentioned during interviews, certain objectives and instruments were selected for the coherence analysis. The following tables will briefly introduce the selected objective and instruments (see table 12, 13).
Overall, interviewees spoke of nexus interactions more in physical than governance terms and did not necessarily consider themselves knowledgeable about policy coherence. However, the physical nexus interactions that were mentioned did point towards regional or national objectives. Moreover, stakeholders sometimes referred to European directives and funds but this level of vertical coherence is out of the scope of this report.
Objectives and instruments are categorized per nexus sector based on the policy domain from which these are retrieved and the way in which interviewees framed them. For example, climate adaptation objectives that concern forestry are part of the climate sector, as these objectives stem from a climate policy document. In the case of an integrated policy documents this criteria remains arbitrary and therefore the interviewee's perspective was used as a guideline. Like in the policy mapping, energy policies that contribute to climate objectives are considered energy related.

Table 12: Nexus Critical Objectives

Objectives		
Land use		
Code	Heading	Detailed description
GL1	Safeguard biodiversity of plants and animals	The objective aims for the protection of populations of wild plants and animals. Their biodiversity policy is complex: it includes offsetting mechanisms. Source of objective: Law of Nature Conservation and Landscape Development, Law of Nature Conservation and Landscape Development Baden-Württemberg.
GL2	Further development of polycentric settlement structures	Development of settlements should be located in the central places along development axes and near concentrated traffic, according to this objective. Settlement and traffic development should be interlinked. Source of objective: Regional Plan Southern Upper Rhine 3.0.
FL3	Ensure the conservation of species biodiversity	This objective comes from the national law and speaks for itself. Regions further define the strategy to reach these common goals. Source of objective: Biodiversity law France.
FL4	Ensure sufficient housings with 45 000 additional housings	With this specific goal the aim is to meet the current and future needs of the population of Strasbourg by 2030. The city is an attractive place within Bas-Rhin department as it provides half of all jobs in the department. Source of objective: Urbanism local plans (PLU) Strasbourg.
GL5	Ecological management of cultural landscape by farmers	Farmers play a role in the maintenance of the cultural landscape in Baden-Württemberg. Without maintenance, forests would cover many of the current open areas. Source of objective: Rural development program (MEPL III) and Improvement of Agricultural Structure and Coastal Protection joint task and law.
Water		
Code	Heading	Detailed description
TBW1	Improvement ecological potential of the Rhine river	Good ecological status refers to biological, hydrological and chemical characteristics. All surface water bodies of the upper Rhine stream are designated as heavily modified, 41% of its bodies are targeted. Source of objective: Rhine-Meuse River basin Management Plan and Strategy for the IRBD Rhine for adapting to climate change.
TBW2	Prevent floods in	The highly modified Rhine river carries flood risks. Floods on the Upper Rhine

	the Rhine-Meuse Basin	area are a threat to 96 towns and municipalities, according to the Integrated Rhine Program. The Basin on the French side consists of the Moselle, Nied, Sarre and tributaries of and the Rhine river. Source of objective: Management Plan for Flood Risk Management and Internationally coordinated flood risk management plan for the Rhine basin and Strategy for the IRBD Rhine for adapting to climate change.
TBW3	Good quantitative status of Rhine ground water body	Currently there is abundant water in the large ground water body of the Alsace region. Also the ground water body of Sundau, Hagenau and the Vosges are available. Quantity may become a more pressing issue in the future, according to interviewees. Source of objective: Ill-Nappe-Rhine River basin Management Plan.
Food		
Code	Heading	Detailed description
TBF1	Income security for farmers	Farming enterprises receive income that enables them to continue their practices despite competition from other producing regions and countries. Since the reform of the CAP payments are linked to environmental or 'greening' criteria. Source: CAP.
TBF2	Alignment of agricultural production to meet market needs	Produce agricultural products within Europe despite competition from other producing regions. The two regions produce various products, amongst others wine and other specialized products such as biological and regional product. Source of objective: CAP.
Energy		
Code	Heading	Detailed description
GE1	Increase renewable energy supply from solar PV	The renewed German electricity law from 2017 target for solar on land and other renewable energy sources. In the case of solar this is annual gross increase 2500MW. They are capped per year to adjust grid capacities. Source of objective: Renewable Energy Sources Act (EEG).
FRE2	Promote renewable energy from biogas	The aim is to increase production with 790 GWh or 68 toe by 2020 in Grand Est. Biogas is one of the renewable energy sources promoted nationally and regionally. Source of objective: 5-years Energy Planning (PPE).
Climate		
Code	Heading	Detailed description
GC1	Adapt forestry to climate change to ensure sustainable timber production	Water stress, changes of climate and pests are climate change effects that harm forests. Municipalities own about 40% of the forests and the rest is private and state owned. Source of objective: Regional forest development type guidelines.
TBC2	Reduce GHG emissions by 80%	GHG emissions should be reduced steadily and sustainably by a minimum of 80% until 2050 in the Upper Rhine region (baseline=year 2000). Source of the objective: Tri-national climate and energy strategy for the Upper Rhine region.

The following instruments are considered critical for the coherence analysis, based on the information obtained during interviews.

Table 13: Nexus Critical Instruments

Instruments
Land use

Code	Heading	Detailed description
GLa	Compensation for environmental loss near the same area and of the same function	Compensation of an intervention in the natural environment requires restoration of the same environmental function in area connected to it. Especially the possibility to bank and trade environmental credits is rather unique. Source of instrument: Biodiversity law.
GLb	Replacement of environmental loss in different forms but of the same value as loss	Replacement means that a different environmental function of the same value is implemented elsewhere. The environmental impact law further specifies ‘interventions’ as damage to species, natural habitats, water bodies and soil. Source of instrument: Biodiversity law.
GLc	Land use allowance for PV installation on "less favorable" grasslands and arable areas	To enables the expansion of maximum 2500MW annual gross increase in Germany, less favorable arable and grassland areas are open for PV tenders. Source of instrument: Access to open land regulation, addition to Renewable Energy law.
FLd	Planning of Strasbourg metropolitan area with integrated ecological corridors	The city of Strasbourg aims to balance conflicting objectives through ‘green and blue’ or ecological land and water corridors that enable biodiversity preservation. Environmental and climate objectives are present in national urban planning laws since the revised Grenelle laws for the protection of the environment. Source of instrument: Urbanism Local Plan of Strasbourg.
FLe	Principle of hierarchical measures to prevent - reduce - compensate environmental loss	Regions develop their strategy to implement the national law and local authorities further define this strategy at the level of their territory. Implementation is based on this principle. Source of instrument: Biodiversity law.
FLf	Maximum of 15% from crops in biogas facilities	A 15% cap on the annual amount of crops that can be used in biogas installations. Interviewees are concerned about the increase of bio-digesters in the region, despite the cap. Source of instrument: Environmental law.
GLg	Investments in expansion or establishment of non-agricultural activities	During interviews, diversification was framed as a means to sustain farming enterprises. Many farmers in the region have already diversified. Source of instrument: Rural Development Program (MEPL III).
GLh	Subsidies for sustainable production methods	Sustainable farming practices include irrigation, fertilization, soil preservation and organic farming practices. For example, fertilizer use that is conserves the quality of water bodies. Source of instrument: Rural Development Program (MEPL III).
FLi	Prohibition of the use of pesticides by cities	The prohibition for cities to use pesticides was mentioned during interviews as a way to improve water quality, a prominent issue in the region. Source of instrument: Plant protection Product Law (Loi Labbe).
Water		
Code	**Heading**	**Detailed description**
TBWa	Ecological flooding of flood retention polders every two years	These flooding measures restore alluvial forests that are natural to the flood plains of the Rhine. Transboundary plans to develop these have been on the table since the 80’s and are further negotiated within and between the countries. Source of instrument: Internationally coordinated flood risk management plan for the Rhine basin and Integrated Rhine Program.
TBWc	Establishment of	Stakeholders both mentioned flood retention polders and ecological floods to

	flood retention polders	restore natural ecosystems on the German and French side. Source of instrument: Internationally coordinated flood risk management plan for the Rhine basin and Integrated Rhine Program.
Food		
Code	**Heading**	**Detailed description**
GFa	Direct payments of 175 euro's per hectare by 2019	Since the reform of this European policy, payments are provided per hectare and not per production unit. Enterprises that receive payment have to comply with a set of environmental and animal welfare criteria. Source of instrument: BMEL, CAP[59].
FFb	Redistributive payment 25 euro's per hectare in 2016	Redistributive payments are an optional scheme under the first pillar of the CAP. This allows for the strengthening of small and middle-sized farmers. Source of instrument: Redistributive payments, EC, 2016; EC Europe, CAP explained[60].
Energy		
Code	**Heading**	**Detailed description**
GEa	Renewable energy tenders	Height of the feed-in tariff is determined based on competitive tenders, which guarantees premium for 20 year. Applies to biomass, biogas, wind and solar Interviewees expect an increase of solar PV installations in Baden-Württemberg. The tenders are technology specific. Source of instrument: Renewable Energy Sources Act.
FEb	Funds for biogas projects	Funds available for developing mechanization and production plants. The amount of bio-digesters in the region has increased rapidly over the past years. These projects are funded through the Fonds de chaleurs and call for tenders. Source of instrument: Law on the energy transition for green growth.
Climate		
Code	**Heading**	**Detailed description**
GCa	Diversification of tree species	Develop climate adaptation strategies for existing forests: diversification of tree species. The forestry research institute is responsible for this. According to Forestry officials, more research is needed to develop this strategy and define what trees are planted. Especially with regards to private ownership.

1.11 Coherence analysis between policy objectives and instruments

Two matrixes below present the scores that were attributed to interactions between objectives and between instruments and objectives across different policy domains and countries. In the following chapter the findings on policy coherence are summarized and justifications are provided for each attributed score.

[59] BMEL, 'Grundzüge Der Gemeinsamen Agrarpolitik (GAP) Und Ihrer Umsetzung in Deutschland' <https://www.bmel.de/DE/Landwirtschaft/Agrarpolitik/_Texte/GAP-NationaleUmsetzung.html> [accessed 11 July 2018].

[60] European Commission, 'Redistributive Payment', 2016 <https://ec.europa.eu/agriculture/sites/agriculture/files/ds-dp-redistributive-payment_en.pdf> [accessed 11 July 2018]; European Commission, 'Direct Payment for Farmers 2015-2020', 2017 <https://agriculture.public.lu/content/dam/agriculture/publications/ma/agrarpolitik/direktzahlungen-en.pdf> [accessed 11 July 2018].

The analysis of policy coherence on the outcome level was based on a scoring scale ranging from -3 for negative to +3 for positive interactions [61]. The scores are assigned to the relationship between objectives and objectives and between instruments and objectives of different policy domains. By asking what happened to one policy objective when advancing on another, the level of coherence is determined[62]. Similarly, the coherence levels of instruments compared to objectives are determined. As illustrated in the figure below, -3 indicates a cancelling relationship where progress on one objective or instruments disables that of another, -2 means that one counteracts another, -1 is a constraint and 0 indicated consistency. Similarly, +1 is enabling, +2 reinforcing, +3 indivisible. Direct interactions were scored and feedback loops were not assessed. Double scores such as -2/+2 were given when external factors intervene with the specific interaction. The following figure illustrates this scoring range.

Scoring system for the assessment of policy coherence

-3	-2	-1	0	+1	+2	+3
Cancelling	Counter-acting	Constrain-ing	Consistent	Enabling	Reinforc-ing	Indivisible
Progress in one objective makes it impossible to reach another objective and possibly leads to a deteriorating state of the second. A choice has to be made between the two (trade-off)	The pursuit of one objective counteracts another objective	The pursuit of one objective sets a condition or a constraint on the achievement of another objective	There is no significant interaction between two objectives	The pursuit of one objective enables the achievement of another objective	One objective directly creates conditions that lead to the achievement of another objective	One objective is inextricably linked to the achievement of another objective

Figure 21: Scoring scale for policy coherence[63]

1.12 Assessment of horizontal and transboundary interactions between nexus critical objectives

Overall, there is horizontal and transboundary coherence between selected objectives of various policy domains. Advancement on one objective more often enhances than constrains the achievement of another objective from the same or another sector: there are 34 positive and 17 negative ~~interactions, most objectives do~~ not interact (

[61] Nilsson and others.
[62] Stefania Munaretto and Witmer.
[63] Stefania Munaretto and Witmer.

Table 14). Thus, on paper objectives are coherent with one another. Some scores are difficult to determine because the objective can be interpreted in different manners or because the interaction between objectives is determined by external factors.

Most constraining interactions occur as a consequence of spatial development (GL2; FL4), aligning agricultural production with market demands (TBF2) and due to increasing renewable energy capacity (GE1; GE2). The constraining conditions that these objectives create are mostly a consequence of a claim on land that can no longer be used for the advancement on another objective that requires land. Most positive interactions are related to improvement of ground and surface water quality and quantity (TBW2, TBW3), biodiversity conservation (GL1, FL3), forest and landscape maintenance (GL6) and climate objectives (GC1; TBC2). Water is used by many other sectors and therefore guaranteeing its availability in both quality and quantity impacts many sectors positively. Similarly, biodiversity contribute to the maintenance of ecological functions of water and soil. Mitigating and adapting to climate change is crucial for all policy domains (TBC1). The table below provides justifications for the scores that have been attributed.

Table 14: Policy coherence between objectives using Nilsson's et al. (2012) scoring range

	GL1	GL2	FL3	FL4	GL5	GC1	TBC 1	TBF 1	TBF 2	GE1	FE2	TBW 1	TBW 2	TBW 3	Positiv e	Negativ e
GL1		0	+1/+3	0	0	+2	+2	0	0	0	0	+2	+2	0/+1	5	0
GL2	-2		**-1/2**	0	**-1**	0	-2	0	**-1**	0	0	0	0	0	0	5
FL3	+1/+3	0		0	0	+1/+2	+2	0	0	0	0	+2	+1	+1	5	0
FL4	**-1**	0	-2		0	0	-2	0	**-1**	0	0	0	0	0	0	4
GL5	+2	0	+1	0		0	0	0	0	0	0	+2	0	0	3	0
GC1	+2	0	+1/+2	0	0		0	0	0	0	0	0	+1	+1	4	0
TBC1	+2	0	+2	0	0	0		0	0	0	0	0	0	0	2	0
TBF1	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0
TBF2	**-1/-2**	0	**-1/-2**	0	0	0	0	0		0	0	**-1/-2**	0	**-1/-2**	0	3
GE1	-1/+1	0	0	0	0	0	+2	+1	**-1**		0	0	0	0	2	1
FE2	0	0	**-1/0**	0	0	0	+2	+1	**-1**	0		**-1/0**	0	0	2	3
TBW1	+2	0	+2	0	0	0	0	0	0	0	0		0	0	2	0
TBW2	+2	+1	+2	+1	0	0	0	0	0	0	0	0		0	4	0
TBW3	+2	0	+2	0	+1	+1	0	0	+1	0	0	0	0		6	0
															34	17

Table 15: Justifications for attributed scores between objectives

Interaction	Score	Justification objectives - objectives
GL1> FL3	+1/+2	Maintenance of biological diversity in one place may enhance that of another, however this is dependent on the existence of corridors between two areas in France and Germany. Connectedness is one of the main measurements for assessing the potential of an area to maintain biodiversity. Because the effect depends on the existence of corridors, two positive scenarios are indicated in the matrix with different scores.
GL1>GC1	+2	Resilience of forests, their ability to maintain and restore their ecological function, depends amongst others on species diversity[64]. This ability is of importance for adaptation to climate change, even those that have a commercial purpose. The effect of species diversity within the country has a direct impact.
GC1> TBC2	+2	Mitigating climate change by reducing GHG emissions enables the preservation of biodiversity, as climate change is one of the threats for preservation of species if these are not resilient to changing climate conditions.
GL1> TBW1	+2	Biodiversity as defined by the Biodiversity law includes that in water bodies. Also the surrounding areas of rivers that maintain biodiversity have an impact on the status of the river through so-called riparian zones and amongst others their vegetation river [65]. The objective of the 'good ecological potential' contains biological, physic-chemical and hydro morphological elements.
GL1> TBW3	0/+1	Ground water quantity is dependent on land cover, and if biodiversity is protected this may mean that less areas are used for farming purposes which require irrigation and more areas are covered with shrubs which allow for better water infiltration. If forests are preserved under this objective, it may both use and replenish aquifers.
GL1> TBW2	+2	Depending on where biodiversity is enhances; near the river it could mean a restoration of ecosystems such as alluvial forests, which have a natural flood protection function.
GL2> GL1	-2	The expansion of housing (GL2; FL4) is one of the main causes of biodiversity loss because it causes a long lasting form of habitat loss. Expansion of housing decreases the distance to protected areas and can cut through corridors that connect different areas and sustain non-native species. Although there may be measures to sustain urban biodiversity, this is not taken into account in the coherence scores, because this would be a separate urban development objective.
GL2> GL3	-1/2	See GL2>GL1

[64] Ian Thompson and others, *Forest Resilience, Biodiversity, and Climate Change: A Synthesis of the Biodiversity, Resilience, Stabiblity Relationship in Forest Ecosystems*, 2014 <http://www.deslibris.ca/ID/242852> [accessed 20 June 2018].
[65] Stanley V. Gregory and others, 'An Ecosystem Perspective of Riparian Zones', *BioScience*, 41.8 (1991), 540–551.

GL2> GL5	-1	Polycentric urban expansion may take up land for maintenance of 'cultural landscape' as it requires new buildings and infrastructure development.
GL2> TBC2	-2	City development contributes to emission of GHGs through the embodied emissions in construction materials, even if the use of buildings and infrastructure leads to little emissions. The process itself demands energy inputs.
FL3>GL1	+1/+3	See GL1> FL3
FL3>GC1	+1/+2	Resilience of forests, their ability to maintain and restore their ecological function, depends amongst others on species diversity. This function is of importance for the adaptation of forests, even those that have a commercial purpose. The effect is dependent on the external factor of aligned policies. Therefore two scenarios are given.
FL3> TBC2	+2	See GC1> TBC2
FL3>TBW1	+2	Biodiversity as defined by the Biodiversity law includes that in water bodies. Also the surrounding areas of rivers that maintain biodiversity, have an impact on the status of the river through so-called riparian zones and amongst others their vegetation[66].
FL3>TBW2	+1	See GL1>TBW2
FL3>TBW3	+1	See GL1>TBW2
FL4>GL1	-1	See GL2> GL1: but very limited since the only effect would be potentially taking away some of the habitat of one species who also lives in other places across the Rhine.
FL4>TBF2	-1	Expansion may limit food production because it claims land.
FL4>FL3	-2	See GL2> GL1
GL4> TBC2	-2	See GL2> TBC2
GL5>GL1	+2	If farming land is used to sustain biodiversity and the cultural landscape, this directly contributes to the achievement of safeguarding biodiversity of those areas as it provides habitats for natural species and contributes to maintaining a good status of water and soil form which species also profit.
GL5>FL3	+1/+2	See GL5>GL1 but to a lesser extend since its more likely that there are no geographical connection between areas that are maintained more sustainably by farmers and areas where nature conservation is very high.
GL5>TBW1	+2	Less fertilizers, pesticides and herbicides used and therefore less will run-off to rivers and streams, which discharges in the Rhine.

[66] Gregory and others.

GC1>GL1	+1	There is a very strong relationship between the ecological functioning of forests and biodiversity as forests provide habitats for plants and animals: they hold a very large share of all species on a global scale. But there is a trade-off between forestry for timber production, as stated in the objective, and biodiversity maintenance. Therefore the relationship is not very strong.
GC1>FL3	+1/+2	See GL6>GL1 but limited because less likely that there are connections between areas with high biodiversity on other side to give way to the relationship.
TBC2>GL1	+2	Safeguarding biodiversity entails the preservation of wetlands, soil and forests and other flora, which contribute, amongst others to the capturing and storage of greenhouse gasses. Therefore the climate objective sets conditions to achieve biodiversity objectives.
TBC2>FL3	+2	See TBC2>GL1
TBC2>TBW2	+1	Reducing GHG emissions should reduce the effects of climate change, amongst which the risk of floods due to irregular precipitation pattern.
GL6>TBW1	+2	If forests adapt to climate change this may enable the maintenance or improvement of water quality over time through prevention of erosion of soils (especially in the context of increased rainfall due to climate change) through its filtering function it can prevent polluting substances entering[67].
GC1>TBW2	+1	Forests may improve of flood protection, especially in the case of European forest due to their water retention function which reduced the impacts of flooding.
GC1>TBW3	+1	The type of forest management is crucial for the impact on water sources. Aquifers can be recharged if broadleaf and mixed forests managed well in Baden-Württemberg [68].
TBF2>GL1	-1/-2	Alignment of agricultural production to meet market demands may constrain the achievement of the objective to preserve biodiversity because food production depletes the soil, pollutes and uses water and not provide a habitat for many species. The size of the impact depends however, on what market demand entails: large demand would require more land or more intensive production with increasingly negative impacts. Also the type of demand matters, ecological production may preserve some species and ecosystems biodiversity. Due to the ambiguity of this objective the strength of interactions may be more or less strong.
TBF2>FL3	-1/-2	See TBF2>GL1

[67] EEA, 'Water-Retention Potential of Europe's Forests', *European Environment Agency* <https://www.eea.europa.eu/publications/water-retention-potential-of-forests> [accessed 16 June 2018].
[68] European Forest Institute, 'Ground Water Forests Baden Württemberg - Google Zoeken' <https://www.google.nl/search?q=ground+water+forests+baden+w%C3%BCrttemberg&spell=1&sa=X&ved=0ahUKEwiRuurxv-TbAhVBWhQKHc7vBJ4QBQglKAA&biw=1112&bih=673> [accessed 21 June 2018].

TBF>TBW1	-1/-2	See GF1>GL1
TBF>TBW3	-1/-2	See GF1>GL1
GE1>GL1	-1/+1	PV on land installations, may impact biodiversity through direct and indirect effects such as fragmentation, soil and habitat disturbance, depending on the chosen site while in other cases biodiversity seems to increase . Since its "less suitable" land that will be used, this should limit destruction of biodiversity. However, a group of NGOs have expressed their concern about this because they do not consider the law strict enough. Due to the ambiguity about the impact and implementation, a double score has been assigned that represent a positive and negative scenario.
GE1>TBF1	+1	Farmers will receive extra income if their land is used for production of electricity from solar PV. In combination with the legislation that `frees` agricultural land for this purpose, there is a possibility that renewable electricity targets and subsidies will benefit farmers.
GE1>TBC2	+2	Renewable electricity production, from solar PV installations, is one of the main strategies to achieve the GHG emission targets as there a less emissions associated with the production. Because entire supply chain including transmission of energy and the production of the panels still causes emissions and a mix of electricity sources may be preferable, there is no complete synergy between the objectives.
FE2>FL3	-1/0	Depending on what fuel is used for biogas, a limited share could come from crops which would either replace another form of monoculture or a field that was used less intensively before, in the latter case the monoculture for energy crops could limit biodiversity. The effect on biodiversity depends on how the land was used before.
GE1>TBC2	+2	See GE1>TBC2
FE1>TBF1	+1	Through the production chain and it may be a farmer who installs the digester or else it outsources but still may receive part of gains this can enhance the security of income for farmers.
GE1>TBF2	-1	PV installation can take up valuable farming land and limit food production, if producing electricity is economically more viable.
GL2>TBF2	-1	Compensations measures for biodiversity often claim agricultural land for their implementation. This may limit food production to some extent.
FL4>TBF2	-1	Compensations measures for biodiversity often claim agricultural land for their implementation. This may limit food production to some extent.
FE2>TBF2	-1	Although there is a cap on energy crops for digesters, framers may use their land for energy crops instead of food crops.
FE2>TBW1	-1/0	Leakage of digesters and nitrates from plants may leak into waters such as those discharging in the river; but leakage should be prevented and there may not be additional nitrates waste is used. However, this issue could not be substantiated by the literature.
TBW1>GL1	+2	Prevention measures can go hand in hand with restoring natural

		ecosystems. In the case of the Upper Rhine, the recent flood prevention plans combine restoration of ecosystems with flood prevention measures.
TBW1>FL3	+2	See GL1> TBW1
TBW2>GL1	+2	Since the prevention in this context means the construction of polders that will be flooded (even more regularly to improve the adaptation of vegetation) the alluvial ecosystem will be restored. In the short terms however, its mainly forest areas in Germany that are flooded and those current ecosystems will die off but this is replaces by ones that are considered more rich.
TBW2>GL2	+1	Flood protection should enhance the development of polycentric urban areas in the long term, because they contribute to the protection of housing and infrastructure, depending on their location.
TBW2>GL3	+2	See TBW2>GL1
TBW2>FL4	+1	See TBW2>GL2 In the long term it ensures sufficient housing in Strasbourg, a city that carries flood risks.
TBW3>GL1	+2	Sufficient groundwater is vital for sustaining biodiversity of ecosystems and species because they rely on this resource. While groundwater organisms may contribute to biodiversity, it also enables biodiversity of flora and fauna. As an interviewee mentioned, for example, forests in Baden-Württemberg rely on the availability of sufficient groundwater
TBW3>FL3	+2	See TBW3>FL3
TBW3>GL5	+1	Maintaining the cultural landscape requires sufficient groundwater for forests and grassland to grow.
TBW3>GC1	+2	Forests demand large amounts of water, depending on how they are managed. Sufficient resources enable their growth in the long term. Interviews illustrate the importance to ensure this availability in the long term.
TBW3>TBF2	+1	Agricultural production in both countries relies on the aquifer for irrigation purposes, which may become more important in the future under climate change

1.12.1 Assessment of horizontal and transboundary interactions between nexus critical instruments and nexus critical objectives

The analysis of policy coherence on paper shows that advancement on selected instruments overall enhances the achievement of objectives across policy domains and the geographical border. In total there are 53 positive and 13 negative interactions between instruments and objective (see Table 15 and 16).

Synergies occur due to selected urban development, diversification and ecological farming subsidies. The selected urban development instrument is defined in such a way that it contributes to biodiversity maintenance in cities. The selected farming instruments are coherent with environmental objectives. Water instruments are synergetic in many cases with other objectives. Again, this can be understood as good water quality and quantity is of relevance for many water-using sectors. Moreover, ecological floods, prohibition of the use of pesticides in cities and polders enhance the achievement of biodiversity objectives of both countries because water resources are shared regionally. Finally, energy instruments are both coherent and incoherent with objectives of various domains. They also give way to different scenarios because the effects of certain renewable electricity technologies are unknown. The selected climate instrument for forest adaptation is coherent with other objectives as forests provide an ecological function for other sectors.

Table 15: Policy coherence between objectives and instruments using Nilsson's et al. (2012) scoring range

	GL1	GL2	FL3	FL4	GL5	GL6	GC1	TB C2	TBF 1	TBF 2	GE1	FE2	TB W1	TB W2	GW 3	posi tive	nega tive	
GLa	+2	-1	0/+2	0	0	+1	0	+1	0	-1	-1	0	+1	0	0	5	3	
GLb	+1	-1	0/+1	0	0	0	0	+1	0	-1	-1	0	+1	0	0	4	3	
GLc	-1/+1	0	-1/+1	0	-2	0	0	0	+2	-2	+2	0	0	0	0	2	2	
FLd	0/+1	0	+2	-1	0	0	0	0	0	0	0	0	0	0	0	2	1	
FLe	0/+2	0	+2	0	0	0	0	+1	0	0	0	0	+1	0	+2	5	0	
FLf	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0/+1	1	0	
GLg	+1	0	+1	0	-2/+2	0	0	0	+3	0	0	0	+1	0	0	4	0	
GLh	0/+1	0	0	0	0	0	0	0	+1	0	0	0	+2	0	+2	3	0	
FGi	+1	0	+2	0	0	0	0	0	0	0	0	0	+2	0	0	3	0	
GCa	+1	0	+1	0	0	0	+3	+1	0	0	0	0	0	0	+1	5	0	
GFa	0	0	0	0	0	0	0	0	+3	0	0	0	0	0	0	1	0	
FFb	0	0	0	0	0	0	0	0	+3	0	0	0	0	0	0	1	0	
FEa	0	0	+1	0	0	0	0	+2	+2	-1	0	+3	0	0	0	4	1	
GEb	-1/+1	0	-1/+1	0	-2	0	0	+2	+2	-2	+3	0	0	0	0	3	2	
GWa	+2	0	+2	0	0	+3	0	0	0	0	0	0	+2	0	0	4	0	
TBWd	+2	-1	+2	0	0	+2	0	0		0	0	0	0	+2	+3	0	5	1
																	53	13

Table 16: Justifications for attributed scores between objectives and instruments

Interaction	Score	Justification objectives - instruments
GLa>GL1	+2	The logic of this measure is no net loss and if possible an additional gain of biodiversity by preserving the same ecological function and value near the region that was subject to an intervention. Therefore this regulation enables safeguarding biodiversity.
GLb>GL1	+1	The logic of this measure is no net loss and if possible an additional gain of biodiversity by preserving the same value but a different function of the region that was subject to an intervention. Therefore this regulation enables safeguarding biodiversity, although it may be less good in preserving biodiversity overall because the ecological functions change.
GLc>GL1	-1/+1	There are very limited restrictions on that land that is made available for PV installations, giving way to potential biodiversity loss depending on the exact area in use before. Although nature parks and nature reserves are excluded, the strength of the environmental impact assessment can be criticized[69]. Moreover, PV on land may impact biodiversity through direct and indirect effects e.g. fragmentation, soil and habitat disturbance, depending on the chosen site and construction of the installation used while in other cases biodiversity increases[70].
FLd>GL1	0/+1	The selected objective for urban development is synergetic with biodiversity objectives. Plans for Strasbourg with integrated 'trams vertes et bleues' or ecological corridors, should enable the maintenance of biodiversity. This measure is considered one of the most successful tools to maintain biodiversity in urban areas.
FLe>GL1	0/+2	The logic of this measure is no net loss and if possible an additional gain of biodiversity by preserving ecological functions. The impact of this hierarch may be limited of there are no cross-border migration routes although some species will benefit from preserved biodiversity regardless. Therefore two scenarios have been given a score: one in which this synergy takes place and the second in case of no corridors.
GLg>GL1	+1	One of the requirements for the investment in expanding activities is environmental and climate protection, especially

[69] Landesnaturschutzverband, 'Freiflächenanlagen Suchergebnisse › Landesnaturschutzverband' <https://lnv-bw.de/?s=Freifl%C3%A4chenanlagen> [accessed 21 June 2018].
[70] Lovich and Ennen, 'Wildlife Conservation and Solar Energy Development in the Desert Southwest, Unites States', 2011 <https://www.researchgate.net/publication/281120784_Wildlife_Conservation_and_Solar_Energy_Development_in_the_Desert_Southwest_Unites_States> [accessed 13 July 2018]; Montag, Parker, and Carkson, 'The Effects of Solar Farms on Local Biodiversity Study', 2016 <https://www.solar-trade.org.uk/wp-content/uploads/2016/04/The-effects-of-solar-farms-on-local-biodiversity-study.pdf> [accessed 13 July 2018].

		water use. Moreover, about half of farmers have already diversified and the slight majority has done so by producing renewable energies. In combination with the ambitions to increase energy production and the allowance for land use change, this remains an attractive path. Thus the impact is likely somewhat positive.
GLh>GL1	0/+1	Subsidizing sustainable agricultural production may reduce the pollution of soil en water and allow some enhanced biodiversity in fields, assuming that it replaces more intensive agricultural practices. But a smaller area of intensive production may preserve a wider variety of species compared to the larger land surface that ecological production demands[71]. But it is questionable whether less land will be used for food production in the case of intensive farming.
GCa>GL1	-1	Diversification of tree species in the long term allows for the preservation of species diversity, especially in the context of climate change because is enhances resilience of forests and other species residing in these ecosystems.
GEa>GL1	-1/+1	See GLc>GL1; same logic applies to wind turbines they may threaten biodiversity; however the impact of both solar and wind on biodiversity may be limited by the fact they have to go through an environmental impact assessment and this can obstruct the construction of turbines.
GWa>GL1	+2	Ecological floods restore the alluvial ecosystems that are natural to the Rhine in this region, enhancing biodiversity although in the short term it affects forests mainly.
FWc>GL1	+1	Decrease of water pollution from cities runs off into water bodies and may affect the biodiversity of shared water bodies such as the Rhine, depending on their geographical situation.
TBWd>GL1	+2	See Gwa>GL1 because these polders are ecologically flooded to restore natural biodiversity such as alluvial forests.
GLa>GL2	-1	Compensation measures may hamper the spatial development for social demands in the long-term future my claiming land. Although the compensation regulation includes a section on taking into account different land uses and cannot take land that has already a purpose in planning, future planning that requires land may be affected.
GLb>GL2	-1	See GLa>GL2
TBWd>GL2	-1	Flooding areas (although mainly forests affected in Germany) limits the long term potential to use these lands for urban development.
GLa>FL3	'0/+2	See GLa>GL1 but possibly no added value the transboundary transfer of safeguarded biodiversity is partially dependent on corridors.

[71] Ben Phalan and others, ‘Reconciling Food Production and Biodiversity Conservation: Land Sharing and Land Sparing Compared’, *Science*, 333.6047 (2011), 1289–91 <https://doi.org/10.1126/science.1208742>.

GLb>FL3	0/+1	See Fla>FL3
GLc>FL3	-1/+1	See GLc>GL1 although the transboundary transfer of safeguarded biodiversity is partially dependent on corridors.
FLd>FL3	+2	Planning of a city including water and land corridors reduces the negative effect of the city. It may even safeguard biodiversity. Especially corridors and patches are considered one of the most effective factors for urban biodiversity[72].
FLe>FL3	+2	The hierarchy that puts prevention of biodiversity harm first aims to protect this objective, however, it also leaves room for other interests that create a trade off. Therefore the instrument is not fully indivisible with the objective.
GLg>FL3	+1	See GLg>GL1 and impact may be limited because the transboundary effect on biodiversity is partially dependent on corridors.
GCa>FL3	+1	See GCa>GL1
FEa>FL3	+1	See GLh>GL1 and impact may be limited because the transboundary effect on biodiversity is partially dependent on corridors.
GEb>FL3	-1/+1	Depending on what fuel is used for biogas, a limited share could come from crops which would either replace another form of monoculture or a field that was used less intensively before, in the latter case the monoculture for energy crops could limit biodiversity.
GWa>FL3	+2	See GWa>GL1
FGi >FL3	+2	See FWc>GL1 but stronger relationship because the water biodiversity of France is directly impacted by French cities that do not use pesticides, limiting run off into waters.
TBWd>FL3	+2	See GWa>GL1.
FLd>FL4	-1	The corridors in the city of Strasbourg set a condition that makes it somewhat more difficult to achieve the expansion and construction of houses.
GLc>FL5	-2	Using land for solar installations constrains the achievement of managing cultural landscape by farmers because the installations take up land that could also be sustained in a 'cultural' manner.
GLg>FL5	-2/+2	Non-agricultural activities may constrain or enhance the management of cultural landscapes, depending on what these are: tourism may strengthen while electricity production may hamper the achievement of the objective.
GEa>FL5	-2	Tenders render solar relatively competitive, and in combination with the changed land use law for solar PV on agricultural land, this could contrain on the achievement of cultural landscape maintenance.

[72] Joscha Beninde, Michael Veith, and Axel Hochkirch, 'Biodiversity in Cities Needs Space: A Meta-Analysis of Factors Determining Intra-Urban Biodiversity Variation', ed. by Nick Haddad, *Ecology Letters*, 18.6 (2015), 581–92 <https://doi.org/10.1111/ele.12427>.

GLa>GL6	+1	Offset measures for biodiversity loss also applies to forest areas and should in this manner contribute to sustain their ecological functioning.
GWa>GL6	+3	Ecological floods restore alluvial forest ecosystems, which is indivisible with the ecological state of any type of forest, even if the previous cover disappears to give way to a new one over time.
TBWd>GL6	+2	See GWa>GL6; flood prevention mainly exists of the construction of polders, which are flooded to establish ecosystems.
GCa>GC1	+3	Diversification of tree species is a means to adapt forest management to climate change.
GLa>TBC2	+1	Restoration measures of biodiversity lead to plantation of trees and restoration of the carbon storage function of soils, which contribute to reducing GHG emissions if they are counted as negative emissions.
GLb >TBC2	+1	See GLa>TBC2
FLe >TBC2	+1	See GLa>TBC2
GEa >TBC2	+2	Renewable electricity production, from solar PV installations, is one of the main strategies to achieve the GHG emission targets as there a less emissions associated with the production. Because entire supply chain including transmission of energy and the production of the panels still causes emissions and a mix of electricity sources may be preferable, there is no complete synergy between the objectives.
FEb >TBC2	+2	See GEa >TBC2
GCa>TBC2	+1	Although forest diversification is a climate adaptation strategy, the long term maintenance of forests contributes to so called negative emissions.
GLc>TBF1	+2	The possibility to give "less favorable" a more economically interesting purpose would generate additional income for farmers that are rather stable due to the long term fix of prices and despite seasonal weather changes.
GLg>TBF1	+3	Investment in diversification directly improves the income security of farmers, although there is a small chance that in the long term a new business will fail.
GLh>TBF1	+1	More sustainable production methods may only limited improve income security because they are more efficient and thus the farmer pays less for sources such as electricity and water. Organic farming, however, also requires more time and can provide less output per hectare, which is partially compensated by the subsidy and the selling price, but may not result in additional income.
GFa>TBF1	+3	Direct payments directly contribute to income security for farmers.
FFb>TBF1	+3	Redistributive payments directly contribute to income security for farmers.
GEa>TBF1	+2	Farmers, who may now use their "less favorable land", can respond to calls for. This would increase their income stability

		especially since the price is guaranteed for 20 years.
GLa>TBF2	-1	Compensation measures claim land, and agricultural land is most easily available. Farmers are monetarily compensated for this. Moreover, the regulation for compensation aims to limit the taking of agricultural land. If the intervention is agricultural, there is no effect.
GLb>TBF2	-1	See GLa>TBF2
GLc>TBF2	-2	Increase of solar PV production for electricity may come at the cost of food production since it takes up land, which could be on agricultural plots. The limits to what land can be converted are considered somewhat weak, therefore there is a threat that energy production will economically be more appealing for farmers.
FEa>TBF2	-1	Increase of biomass production for biogas may come at the cost of food production since it takes up land.
GEb>TBF2	-2	See GLc>TBF2
GLa>GE1	-1	Areas that are claimed by biodiversity compensation measures can no longer be used to expand renewable energy on land.
GLb>GE1	-1	See GLa>GE1
GLc>GE1	+2	More land that is available for solar, is indivisible linked with achieving an installed capacity objective of solar, especially since the space of roofs in Baden-Württemberg is not sufficient to achieve this.
GEa>GE1	+3	In call for tenders for renewable energy sources solar PV will perform relatively well, especially in Baden-Württemberg, which has less suitable land available for wind turbines.
GEf>GF1	+3	Subsidies for bio-digesters are indivisible with an objective to achieve a certain installed capacity
GLa>TBW1	+1	Compensation may improve or maintain the ecological state surrounding areas of rivers, which have impact on the status of the river through so-called riparian zones and amongst others their vegetation also the maintenance of biodiversity goes together with that of ecosystems, which may prevent pollution of rivers that discharge in the Rhine[73].
GLb>TBW1	+1	See GLa>TBW1
FLe>TBW1	+1	See GLa>TBW1
GLg>TBW1	+1	Depending on what activities entail and where they are situated, they may improve the status of the water that is discharged elsewhere to the Rhine, for example through less nitrogen run-off.
GLh>TBW1	+2	Sustainable production would improve the status of the water that is discharged elsewhere to the Rhine, for example through less nitrogen run-off.

[73] Gregory and others.

GWa>TBW1	+2	Ecological flooding enhances the overall ecological status of the Rhine because of the ecosystem and its water quality improving functions that can be reestablished.
FGi >TBW1	+2	Less matter that can end up in rivers and stream that discharge in the Rhine.
TBWd>TBW1	+2	Flood retention polders as such improve the ecological status of the Rhine.
TBWd>TBW2	+3	The establishment of flood retention polders should directly contribute to achieving the goal of flood protection.
FLe>TBW3	+2	Groundwater quantity is improved through compensation of biodiversity because it ensures an ecosystem that is likely to enable infiltration of precipitation to replenish the aquifer.
FLg>TBW3	0/+1	Capping food for feeding bio-digesters may reduce the amount of water demanded for irrigation or leave it unaffected.
GLh>TBW3	+2	Sustainable production methods should reduce water quantity demands for irrigation proposes through more efficient technologies for example.
GCa>TBW3	+1	Depending on the type of forest management, this type of land cover can help replenish ground water although it also takes up water. Because the aim is to adapt to long-term climate change, the assumption is that this type of forest management with diversification also takes the amount of water use into account.

1.13 Policy coherence in implementation and policy integration

As this study aims to investigate the links between policy development and implementation, it is highly relevant to present results on this matter that were obtained through interviews. Interviewees provided information about the barriers to coherence both within the regions and on a transboundary level. In some cases they referred to specific policy instruments and objectives but the barriers also occur at other stages of the policy development process.

1.13.1 Regional policy implementation and integration

The interviews illustrate that incoherence, a lack of integration and other barriers to coherence can occur at the level of policy implementation, input, processes and even preconditions. This provides insights into the regional barriers in addition to those identified between instruments and objectives, as discussed in the previous section. Interviewees explained how discrepancies between policy coherence on paper and implementation could come about. After summarizing the findings, two nexus issues are elaborated upon that embed the results in the regional context.

Firstly, preconditions such as an enabling environment and policy inputs influence horizontal coherence. Certain issues may be prioritized over others during the agenda setting stage. Water quantity, for example, is not perceived as an issue in the region according to multiple stakeholders (Workshop, ENGEES). As a consequence incoherence may occur because it is not sufficiently addressed and integrated into other policy domains. Governing this resource sustainably may thus require additional efforts. Moreover, cross-disciplinary research may inform policy makers and enable coherence between domains based on scientific knowledge. However, this type of research may be less suitable for funding, publications in journals and requires a shared understanding at the part of researchers (KIT2). Another barrier to establishing coherence may be that it is considered non-strategic to introduce another potentially conflicting issue (ENGEES). Also there may be a lack of the right resources to develop policies on a regional level. For example, additional funding was made available by Baden-Württemberg for an insect protection program but there was not enough staff to put these funds to use. This indicates vertical incoherence as the state ministry may misunderstand what is needed to implement and develop policies on a regional level.

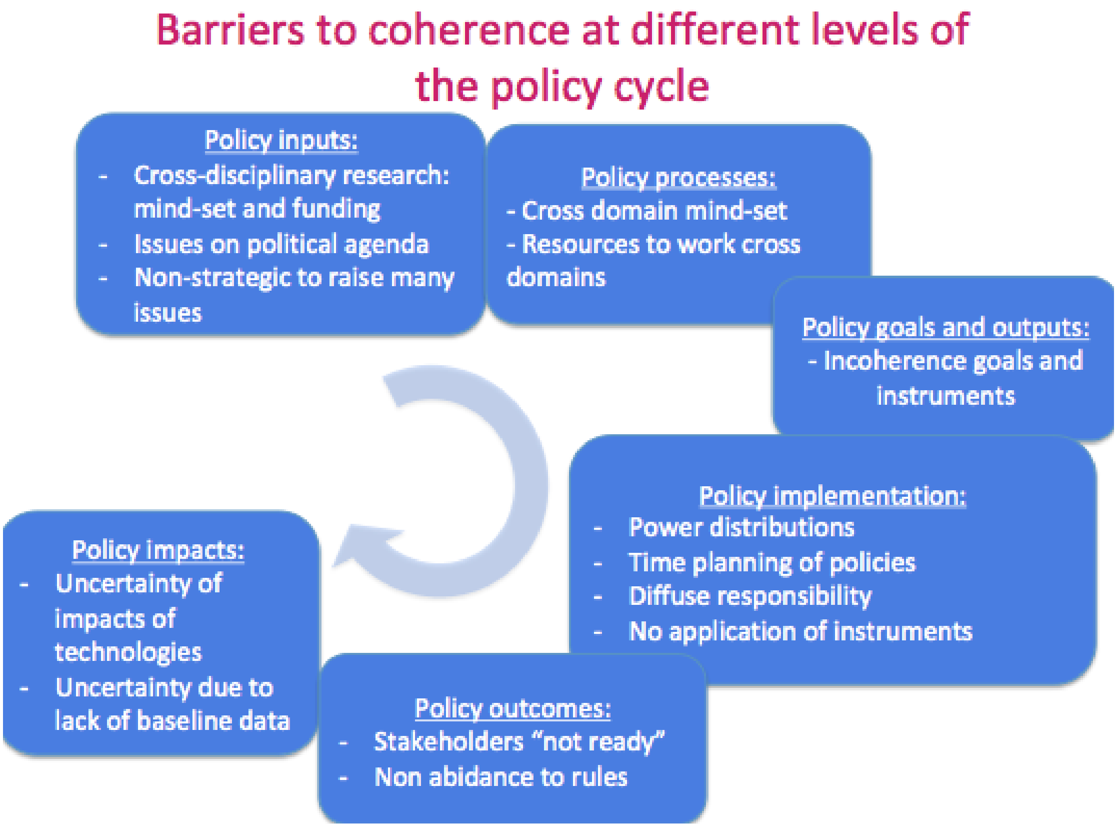


Figure 22: Barriers to coherence at different levels of the policy cycle

Barriers to policy coherence may occur when policies are in development, see Figure 22 the box with policy process. Public officials may be required to think beyond their policy domain, which is not always evident (ICLEI, DREAL/SGARE). Crossing policy domains is limited not only by the mind-set of people but also an overload of work (ICLEI). At this stage of policy processes, power distribution plays an important role. Stakeholders addressed the power of political parties, private businesses and civil society organizations. Their relative weight in decision-making seems to fluctuate over time and depending on the issue. Some negotiation processes may take place internally between departments. Such is the case in the Regierungs Präsidium in Freiburg where biweekly meetings are held to determine the development of a new railway project. The location of this railway could be adapted in order to reduce the impact on certain species. Due to the 'black-green' government, a coalition between the Green Party and the Christian Democratic Union party, of Baden-Württemberg and the heavy involvement of environmental NGOs there is a strong support for nature conservation (ICLEI, RePrFr, StaWein, LUBW, BUND). The case of the plans for a highway between Breisach and Freiburg illustrates that political power can be of great importance. Plans have been on an off the table as governments changed (RePrFr). Drawing from the interviews however, economic interests represented by various kinds of enterprises prevail more often. Interviewees, especially from research organizations, stress that political power to influence to management of trade-offs is limited.

Multiple actors conveyed the message that policies may be coherent on paper, but that this does not guide reality. A high level public official underlines the limitation of a policy domain to create truly cross-domain policies: "public policies stay in the world that created them" (DREAL/SGARE). At the implementation level impacted actors try to suit their own interest while navigating rules. As an interviewee states: "There are not just public policies, there are also markets!" The wood industry, for example, is very powerful and well structured the Alsace region. This leads to overexploitation of the forest. It was also stated that actors manage to comply with environmental regulations and standards because they develop in such a way to match the projects. Another problem is that certain stringent regulations are never used. For example, articles 69 and 74 of the French biodiversity law have never been used. These laws should protect biodiversity by preventing intervening projects and closing down agricultural practices. The hierarchy of prevent, reduce, compensate is surpassed in the negotiation processes of defining what instrument applies, as further discussed in the following section. Moreover, diffused responsibility may give way to not achieving objectives. This is especially relevant for strategies that aim to integrate various policy domains. "No one feels responsible for the implementation of general strategy documents" is what a public officer stated after being asked about the importance of an integrated strategy.
Finally, barriers occur that cause incoherence at the level of outcome and impact, see Figure 22. The absence of implementation may be the result of stakeholders "not being ready" for it, for example in the case of restoring pastures in France. Inconsistencies may also occur due to incoherent time planning of policy renewal and implementation. At the impact level, policies may not achieve the desired results. Instruments to protect biodiversity may fail, as suggested in interviews. Some consider there to be insufficient state control of compensation measures. Private individuals may not comply with rules and regulations purposefully or because the complexity is too high. Therefore regulations do not lead to the desired change of behavior. Lastly, there may be uncertainty about the impact of certain technologies that are deployed to achieve objectives.

1.13.2 Coherence analysis at the transboundary level

In addition to regulatory differences, governance structures and lacking resources may prevent managing trade-offs and exploiting potential synergies across the border. According to one representative from the Upper Rhine Conference "establishing cooperation is very difficult, we have been trying for 30 years". In the transboundary context, cooperation is a common strategy to enhance coherence and overcome these barriers. Language and culture did not come up in interviews as a major barrier.

Firstly, regulatory incoherence at the level of policy objectives and instruments and implementation issues are addressed in the interviews. Representatives of the Upper Rhine Conference bring to light differences in fishing and hunting regulations, amongst others. As a consequence of distinctive seasons and species a fish may be spared on one riverbank, but caught at the other. A lack of knowledge and information sharing of regional plans developed by the neighboring state obstructs transboundary coherence, see figure 25 the first box. Nature conservation areas are not aligned for instance, which disables a true synergy through connecting biotopes and corridors to enhance overall biodiversity of the region. Likewise, different nature conservation approaches were considered an issue and the result of dissimilar gained experiences. Another example of a barrier at the implementation level is insufficient communication about environmental impacts of projects. This conflicts with the Espoo convention that was ratified by the European Union, which specifies that environmental impacts of planned projects should be communicated across the border [74].

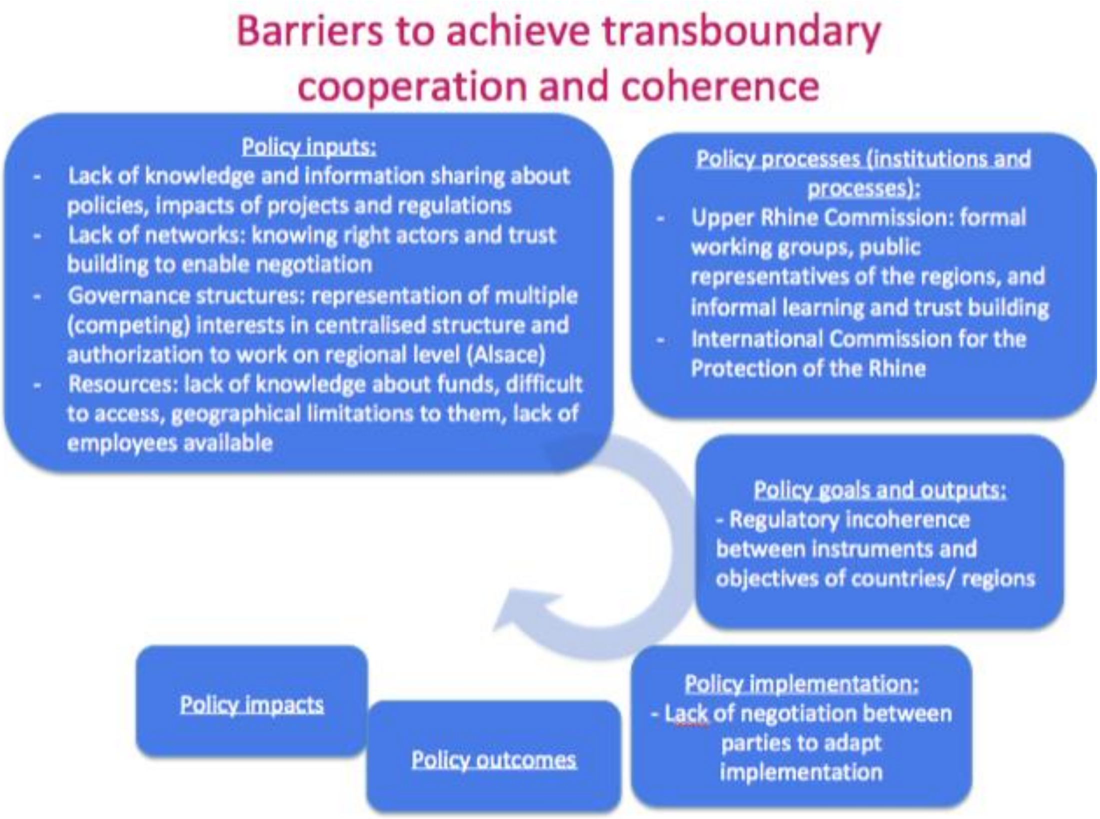


Figure 23: Barriers to transboundary coherence

Moreover, the difference between the French centralized and German decentralized governance structure may limit cooperation, see Figure 23. As a consequence decision makers represent the interests of a large area. Many stakeholders mentioned the recent reforms that merged the former Alsace with two other regions to establish Grand Est as a potential threat to enhancing cooperation and coherence. Not only do decision makers represent the interests of a vast area, but it may also limit the mandate of the former Alsace the develop transboundary policy proposals and projects. Identifying the right person in different governance structures is also a time consuming activity that may slow down a decision making process. Once the right links have been established, these may not persist over time due to a turnover in office. The additional costs to establish networks and share information further pressure another barrier, which may be the simple lack of employees available to work transboundary.

[74] United Nations, 'Convention on Environmental Impact Assessment in a Transboundary Context', in *Convention on Environmental Impact Assessment in a Transboundary Context (As Amended on 27 February 2001 and on 4 June 2004)*, by United Nations (UN, 2018), pp. 3–11 <https://doi.org/10.18356/cbfd9988-en>.

Another reoccurring theme during interviews is the difficulty to obtain financial resources for transboundary projects and research, but at the same time the available budget is not fully used. Regional Cohesion or Interreg funds may be present, but not effectively applied. This may be due to a lack of awareness about available funds and difficulties obtaining them. Successful projects may not be transferrable to a neighboring country due to geographical limitations of funding schemes. This was the case for the sector networks of energy and climate solutions that wanted to work together transboundary. Moreover, there may be internal incoherence within the Rhine Conference, resulting in funds not being spent in line with public needs. This is the result of non-alignment between the secretariat and the working groups within the Conference.

1.13.3 Focus 1: the limitations of compensating environmental and biodiversity loss

A lack of implementation and secondary consequences of biodiversity compensation measures put pressure both on achieving agriculture and biodiversity objectives. Agricultural land is under a double impact from urban and infrastructure expansion projects and compensation measures in both countries (RePrFrNa; RePrKaURC; ForstBW). Compensation measures claim land and thereby cause a trade-off with urban and agricultural objectives. This may be enhanced by the ratio of land that is considered necessary to compensate, depending on the size of the environmental impact. Often the compensation surface is twice the size of the lost service. German nature conservation law aims to mitigate this effect. Measures that enhance biodiversity more efficiently and demand less land, such as connecting biotopes, should be prioritized (BNatSchG, 2017). The farmers themselves profit from monetary compensation, but the perception is that agriculture is losing importance in terms of surfaces.

Fluctuating political powers and economic interests influence the implementation at which policies are put into practice. An interviewee states: “decisions are based on a political consensus from which ecosystems are disconnected”. Preventing negative impacts should be prioritized over compensation in both regions. However, in negotiation processes power differences and political realities are prominent. The “boomerang effect” on agricultural land has been considered a failure to use the hierarchical principle of prevent, reduce and compensate. This may be the outcome of unequal negotiation powers in the process of determining which and how instruments are implemented. The government of Baden-Württemberg strongly supports nature conservation objectives. Still the status of certain protected land categories can be erased to give way to construction projects such as railways and barns (RePrFr). Also in Grand Est, economic interests prevail over nature conservation objectives (AlNa; Workshop ENGEES). As a consequence, compensation measures are preferred over prevention of projects. The regulation that allows for closing an agricultural enterprise because of its environmental impact has never been applied, which substantiates this argument.

1.13.4 Focus 2: trade-offs between energy, biodiversity and food

Renewable energies are synergetic with climate objectives but may produce trade-offs with food production, water quality and affect biodiversity in either a positive or negative manner according to interviewees. Precise impacts are unknown, because of various views on the stringency of regulations.

Despite a 15% annual cap on food crops for biodigesters in France, many interviewees mention food crops for biogas as a pressing issue creating a trade-off with food production. Moreover, bio-digesters can cause ground water pollution (EARM, DREAL, ENGEES). Interviews and desktop research provide insufficient information to judge the size and likelihood of trade-offs. The amount of biodigesters in the region has increased rapidly over the past years and projects are in the pipeline: 35 projects are being finalized, 49 were added in 2016 and in the first quarter of 2017 another 55 [75]. These projects are funded through the Fonds de chaleurs and call for tenders. The 15% cap on energy crops used in digesters is set relative to the increasing number of digesters needed to produce 300MWe electricity and 900 toe heat by 2023 in Grand Est [76]. Thus, absolutely speaking more crops could be fed to the digesters over the years. This may explain the worry of certain interviewees. Early biogas projects in France were established on farming land, where nitrogen pollution was an issue [77]. As a consequence it was difficult to detect what caused water pollution. Current issues regarding the pollution of ground water in relation to anaerobic digestion in the Grand Est region cannot be confirmed through desktop research. There seems to be quite some civil opposition to these projects. In Laon, however, a public inquiry took place about the construction of a project that was build closely to an aquifer. To reduce the risk of water pollution measures had to be taken by the project developer [78]. It is thus unclear whether trade-offs occur at the impact level of biogas policies. Potential trade-offs may be managed through a national strategy for biomass implemented in 2018. It is yet to early to discuss its impacts but the fact that this is a non-binding document may limit its effectiveness. None of the stakeholders referred to this recently launched strategy.
Whereas in France the impact of energy crops for biogas production was discussed widely, this topic has passed in Germany. The trade-off between food and energy production may have stabilized but a future increase of solar PV on land may reinforce the food trade-off and hamper biodiversity. Whether this trade off exists is unclear due to different expectation about regulations. Also research on the physical impact of technologies is non-conclusive. Solar PV is financially attractive due to the tenders that the revised national electricity law from 2017 introduces (BUNDBW). A law specifically put in place for the revised electricity law enables the expansion of PV on land: since 2017 less favorable arable and grassland areas are open for PV tenders. The size of the trade-off on the impact level remains unknown due to limited research and differences in technologies. Projects cannot take place within nature parks and reserves and are subject to the Bauplanungsgesetz that applies to any building project. However, according to a group of NGOs this regulation is not stringent enough to protect biodiversity. Multiple NGO’s have expressed their concerns with regards to this law before it was enforced. As a response they have proposed a planning guide to prevent trade-offs with agriculture,

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[75] L’ADEME Grand Est, ‘Méthanisation’, 2016 <https://grand-est.ademe.fr/expertises/energies-renouvelables-reseaux-et-stockage/methanisation> [accessed 18 June 2018].
[76] L’Assemblée nationale, *LOI N° 2015-992 La Transition Énergétique Pour La Croissance Verte*, *2015*, 2015; Ministère de l’Environnement, de l’Energie et de la Mer, *Synthese Progammation Pluriaunnele d’Energie* <https://www.ecologique-solidaire.gouv.fr/sites/default/files/Synth%C3%A8se.pdf> [accessed 25 June 2018].
[77] François-Joseph Daniel and Victor Bailly, ‘Socio-Technical Structuring of Biogas in France’, 2015, 16.
[78] L’Artifex, ‘Memoire En Reponse’, 2017 <http://www.aisne.gouv.fr/content/download/19179/130787/file/MEMOIRE-EN-REPONSE_AM-ATHIES-METHANISATION_22112017.PDF> [accessed 27 June 2018].

biodiversity and cultural landscape maintenance[79]. Their concern is mainly that nutritious and ecologically valuable land will be used for more financially attractive electricity production.

1.13.5 Limits beyond apparent policy coherence

More than often, the regulatory frame does take into account Nexus relations and potential conflicts and gives the tools to solve them. However in the field such conflicts are not solved or addressed. How is that so? Many regulations can be bypassed or adapted, depending on the relations of power between the actors. Some regulations are just not implemented. A typical example in this case is the land use sector and the Avoid – Reduce – Compensate regulation. Despite the clearly identified goal of preventing wetlands, alluvial forest and pastures losses – and more generally land take, and despite the goals and tools in the relations, land-consuming projects often manage to find their ways and are eventually implemented. Formally, the French law does possess the tool to prevent a project where an actual compensation is proven impossible.

Should we fix or should we switch the system? Many coherence issues are addressed by suggesting a new technology or practice that aims at fixing the system. For example, a chemical can be banned and replaced by another to address a specific challenge. This prevents from switching to another production system and rethinking the way in which we produce (in the food sector for example).

Time frames also play a big role in some cases. For example, hydroelectric dams have been identified for a long time as a key element of the coherence between the energy transition and the continuity of ecosystems. However, the time frame associated with such infrastructures is very long. In 2010 the hydroelectric dam concession of Kembs has been renewed and only then its reserved flow for biodiversity has been increased (at the expense of some electricity production). Because of the integrated nature of the river, this sole change does not ensure on its own an improvement in the ecological continuity. In this regard, a compromise has to be found between step-by-step improvements (that may result in a lower cost/efficiency ratio) and an integrated reworking (that may be harder to achieve).

1.13.6 Policy coherence against economic pressures

In all Nexus sectors, economic factors often play a crucial role. Therefore, the Nexus cannot be understood at the sole light of the interactions between sector policies. The issue is particularly significant in the food sector that is progressively opening to the world open market while trying to remain competitive. This leads local cultivation methods (maize, beetroot…) that are increasingly intensive but also increasingly hard to switch from because they create an economic dependence. In this sector, public policies try to guide and manage the economic trajectory of the various sectors.

Land use is also heavily affected: transportation and building projects often drive urban planning decisions. Lands purchases create links among the Nexus between natural spaces, fields and urban spaces. In this regard, compensation measures also create a direct monetary link between biodiversity, natural spaces and the economy.

[79] Landesnaturschutzverband, 'Solarfreiflächenanlagen und Naturschutz', 2017 <https://lnv-bw.de/solarfreiflaechenanlagen-und-naturschutz/> [accessed 17 June 2018]; Landesnaturschutzverband Baden-Württemberg, 'Kritik an Photovoltaik-Freiflächenanlagen › Landesnaturschutzverband', 2017 <https://lnv-bw.de/kritik-an-photovoltaik-freiflaechenanlagen/> [accessed 17 June 2018].

The example of the Leipzig municipality is often quoted. What remains of the Leipzig alluvial forest is comprised almost entirely inside the city's borders. This allowed for a better forest management among the Leipzig bay that was otherwise almost entirely deforested to the profit of urbanizing, mining and farming.

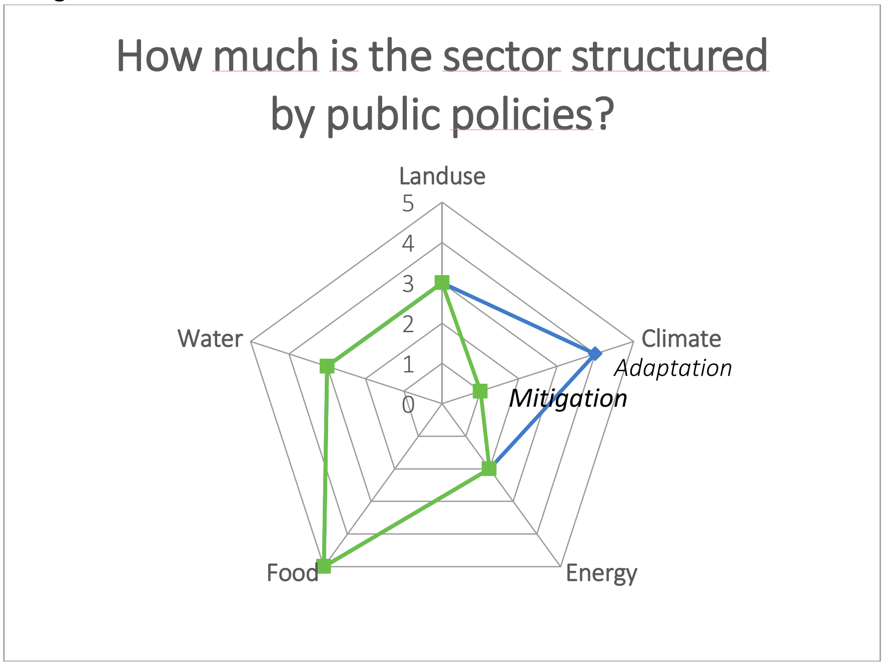
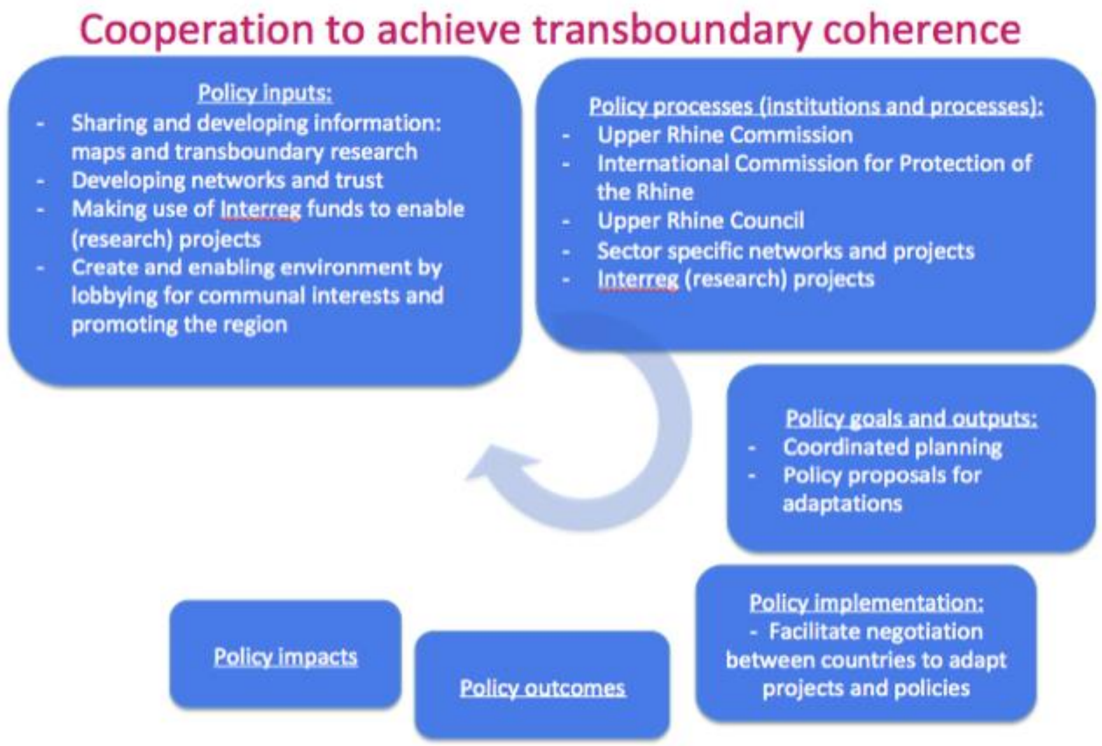


Figure 25: Influence of public policies on various sectors

It is possible to draw from the interviews an estimation of the strength with which public policies structure each Nexus sector (see Figure above). For example, the food sector was often quoted as a sector that is heavily structured by the European CAP. At the same time, economic pressures such as the international competition and the markets opening are also quoted. But they seem to be strongly incorporated and dealt with by public policies in comparison to other sectors. Water and land use management are also sectors that are traditionally regulated by public actors. However, the effective management seems to be balanced between a broad variety of actors such as private companies, farmer and various projects promoters. In that sense, public actors do not seem to hold a full grasp on the effective management and control of these sectors' trajectories. The energy sector is heavily demand-driven. Moreover, both countries are heavily dependent on energy importation and in particular fossil fuels. Despite numerous policies in the fields of renewable energy and energy efficiency it appears that the energy sector depends much more on the decentralized choices of multiple actors. Even in the electricity sector, the relative power of the state seems to decrease. The same analysis prevails for climate mitigation that is strongly related to energy consumption, only with even more decentralized stakeholders. Climate adaptation, on the other hand, seems to be dealt with mostly by public actors and in public policies, even though it remains an emerging topic.

5 Formal and informal arrangements adopted to address conflicts, negotiate trade-offs and exploit synergies in practice

The third and fourth research questions address ways to enhance coherence between policy domains and cooperation between the regions. The following section describes institutional arrangements that currently allow for managing trade-off, minimizing conflicts and exploiting synergies. By analyzing how these formal and informal arrangements work, ways to further enhance policy coherence and cooperation can be found. The OECD describes institutional mechanisms and processes as ways "to harmonize and manage often competing policy objectives and interest"[80]. This may occur at the level of policy process that lead to outputs and on the level of implementation, in the form of arrangements between authorities and other actors. Transboundary and regional arrangements are merged in the table that presents the results. Moreover, the final section describes how these results and the information about policy coherence retrieved from interviews were verified. See Figure 24 for a summary of the findings presented in Table 17.



[80] OECD, 'Better Policies for Sustainable Development 2016 - A New Framework for Policy Coherence', 2016 <http://www.oecd.org/publications/better-policies-for-sustainable-development-2016-9789264256996-en.htm> [accessed 26 June 2018].

Figure 24: Arrangements to enhance transboundary cooperation and coherence

1.14 Formal and informal institutional arrangements

Transboundary governance institutions such as the Upper Rhine Conference, the International Commission for the Protection of the Rhine and multiple EU funded research projects enhance cooperation through generating shared knowledge, network building and informal learning to create outputs such as coordinated plans and policy proposals. Most of these processes and activities are rather formalized but they may carry informal components. As a representative framed it: "there is no region where information sharing is as formalized a in the Upper Rhine" (SDGSURC).

Table 17: Formal and informal institutional governance arrangements

Name of arrangement	Description
International Commission for the Protection of the Rhine (ICPR)	**Type of arrangement (formal/informal)** Formal: Transboundary governance organization **Description of arrangement** International Commission for the Protection of the Rhine (ICPR) of which 29 European countries are members. The Commission derives its legitimacy from the renewed international convention between riparian countries of the Rhine and European directives such as the Water Framework Directive and the Floods Directive. The ICPR published a 2020 Program on the Sustainable Development of the Rhine. **Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)** Coordination of policies. **Why it is working or not working (enabling and limiting factors)** Little information was retrieved firsthand about the International Commission for Protection of the Rhine. **How the arrangement affects the achievement of nexus critical objectives** It enhances transboundary coherence between water sectors and between water and water using sectors to preserve the ecological functions of the river area. An example of coherence between policy domains is that habitat network connectivity is one of the goals outlined in the Climate adaptation strategy.
Upper Rhine Council	**Type of arrangement (formal/informal)** Formal: Transboundary governance organization **Description of arrangement** Upper Rhine Council exists since 1997. It can make resolutions, for example on flood protection.

	The parliament consists of representatives from regions in France, Germany and Switzerland amongst which Alsace and Baden-Württemberg. **Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)** Coordination of policies. It is described in interviews as the political counterpart of the Conference. **Why it is working or not working (enabling and limiting factors)** Multiple interviewees hinted towards competition in the past between these organizations. This was related to the fact that the Conference has existed for longer and therefore the agenda of the Council seemed less credible and potentially less aligned with regional needs. Currently, agendas are aligned. **How the arrangement affects the achievement of nexus critical objectives** In theory the Conference enhances cooperation and coherence of multiple sectors. Lack of information about practice.
Upper Rhine Conference	**Type of arrangement (formal/informal)** Formal and informal characteristics: Transboundary governance organization **Description of arrangement** The Upper Rhine Conference enhances transboundary cooperation across multiple issues. The Government Commission connects Germany, France and Switzerland through their Foreign Ministries. Administrations and specialized authorities are represented in the Conference. There is a common secretary, 11 working groups and 36 expert committees. Projects are largely financed by European Fund for Regional Development (ERDF) via Interreg and regional government. **Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)** The Conference has multiple functions: - Knowledge sharing - Building networks - Coordination of policies through proposals - Fostering negotiation - Promotion of the regions - Research - Lobbying The Conference implements projects and events and can commission new associations with their own projects. The regions organize calls for projects. Main outputs are: maps, projects, educational programs, proposals for changes of law. **Why it is working or not working (enabling and limiting factors)** Enabling factors: - See the section below “informal arrangements”

	- Formulate policy proposals slightly different in respective language to navigate legal possibilities imposed by different legal systems - Interreg fund provides means to enable transboundary research and policy coordination through projects - Make use of certain formulations in policy proposals that align incoherent policies - Trust building next to formal meetings through eating and cultural activities Limiting factors: - Complex decision-makings structures: difficult to find right person in various layers (also within regions a problem) - Centralization of France governance structure limits Alsace independence to operate and representation of transboundary interests at more centralized Grand Est level - Changes in persons in office every 2-3 years provides little stability to build on (trust) networks - Lack of time and human resources to invest in transboundary relationships and address issues - Funding barriers in research and projects: difficult to access funds and lack of knowledge about them, while not all is spent - Lack of information exchange - Differences in legal systems **How the arrangement affects the achievement of nexus critical objectives** Some examples: - Proposals to make policies coherent: maintain biological diversity objective: through proposals to align of e.g. hunting and fishing regulation - Recent guideline for implementation of the Espoo convention should enhance negotiation processes of environmental impact assessments. However, it is yet too early to judge its success since the first project has been declared recently. - Successful alignment of interests may carry an impact up to the European level: the Conference lobbied for limitations to the liberalization of the wine market. The satisfying outcome of the reform was an increase of land authorized for wine production that represents 1% of the planted area per year (EU No 1308/2013).
Ramsar'Rhinatur	**Type of arrangement (formal/informal)** Formal: Interreg projects "operational arm of Upper Rhine Conference" and experts groups of the Conference **Description of arrangement** Project to cooperatively manage Ramsar and Natura 2000 zones along the Rhine River. The project is lead by LPO Alsace (Ligne Protection Oiseaux, member of the NGO Alsace Nature). It receives half of the total 804.000 euros budget through Interreg, the European Regional Development Fund. The 11 partners in the projects are administrative governance bodies in charge of nature protection, research institutes and private businesses.

	Function of the arrangement (coordination, decision-making, knowledge sharing, etc.) Currently: - Knowledge sharing and development Objective: - Development and coordination of plans - Establish network **Why it is working or not working (enabling and limiting factors)** Enabling factors: - Stakeholder participation: various organizations ranging from public to private and across the border. **How the arrangement affects the achievement of nexus critical objectives** Enhance cooperation and coherence for biodiversity protection on the level of instruments.
APRONA	**Type of arrangement (formal/informal)** Formal: Interreg projects **Description of arrangement** The organization APRONA surveys the status of the Alsace and Sundau groundwater bodies. One of the partners is the Upper Rhine Conference expert group on water. The river impacts ground water quality because some of its water seeps through into the aquifer. About 30 to 40% of the investigated points surpass limitations for pesticides [81]. **Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)** - Research: create common transboundary knowledge - Coordinate plans **Why it is working or not working (enabling and limiting factors)** Enabling factor: - Funds **How the arrangement affects the achievement of nexus critical objectives** Increase transboundary ground water quality through communal research.
ERMES	**Type of arrangement (formal/informal)** Formal: Interreg projects **Description of arrangement** ERMES Interreg project evaluates ecological resources and monitors ground water in France, Germany and Switzerland

[81] Frédéric APRONA, 'Premiers résultats de qualité d'eau de la nappe phréatique d'Alsace et des aquifères du Sundgau sur les nitrates et les pesticides', 2017.

	Function of the arrangement (coordination, decision-making, knowledge sharing, etc.) - Research: create common transboundary knowledge **Why it is working or not working (enabling and limiting factors)** Enabling factor: - Funds **How the arrangement affects the achievement of nexus critical objectives** Increase transboundary ground water quality through shared knowledge. It has allowed a joint work with agriculture, industries and institutions on the ground water table.
Nature conservation area alignment	**Type of arrangement (formal/informal)** Formal: Regional cooperation through administrations **Description of arrangement** Transboundary cooperation for biodiversity protection through alignment of areas and species along the Rhine. Regional administrations work on this together. **Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)** - Creating shared knowledge - Coordinating plans **Why it is working or not working (enabling and limiting factors)** Limiting factors: - Different governance structures: getting to know these takes time - Different national categories of protected areas and species Enabling factors: - Time and willingness on the behalf of people participating **How the arrangement affects the achievement of nexus critical objectives** Transboundary coherent biodiversity instruments.
IdeeAlsace	**Type of arrangement (formal/informal)** Formal: Regional non-profit organization with transboundary potential **Description of arrangement** The non-profit organization IdeeAlsace works on a circular economy in the port of Strasbourg for more efficient use of resources. Initially funded by Eurometropole Strasbourg (grouped municipalities) and the port of Strasbourg. Currently through a tender by the region Grand Est, ADEME (Environment and Energy Management Agency) and group of enterprises. **Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)** Developing business case and projects.

	Why it is working or not working (enabling and limiting factors) Enabling factors: - Funds (would have been available for transnational cooperation, but a willing partner was lacking) Limiting factors: - Unsuitable regulations to reuse resources such as certain wood types - Lack of willingness at the port and city of Kehl to work together **How the arrangement affects the achievement of nexus critical objectives** Energy, water and agriculture efficiency helps to maintain ground water quantity
Renewal Kembs hydropower station contract	**Type of arrangement (formal/informal)** Formal: transboundary participatory policy development processes **Description of arrangement** Process for the development of conditions for the renewal of the EDF hydropower station contract at Kembs in the 2000's. Implemented measures aim to increase the ecological flow and control bank erosion and gravel inputs. **Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)** - Policy coordination and development **Why it is working or not working (enabling and limiting factors)** Enabling factors: - Stakeholder participation process to define restoration measures. Further action regarding other power plants situated on the Grand Canal d'Alsace [82] **How the arrangement affects the achievement of nexus critical objectives** Transboundary coherence and coherence between water quality and quantity objectives.
Integrated Forest and Nature conservation strategy	**Type of arrangement (formal/informal)** Formal regional participatory policy development processes **Description of arrangement** Integrated Forest and Nature conservation strategy (policy document), GER. Need for integration of nature conservation laws in forestry policies, which deal with a relatively long time frame of 50-100 years.

[82] Agnes Barillier and A Garnier, 'Improvement of the Kembs Environmental Project through Cross-Border Discussions. Hydro 2017-Sevilla', 2017; Vera Lúcia Meira Marmelo, 'Definition of Ecological Flows for Rivers Located in the North and Center of Portugal', 10.

	Function of the arrangement (coordination, decision-making, knowledge sharing, etc.) - Policy coordination and development **Why it is working or not working (enabling and limiting factors)** Enabling factors: - Through these practices implementation is more likely to take place: “politics of being heard” are necessary - Planning and developing a business based on the reuse and recycle of resource coordination - Increased changes implementation because less likely resistance in this phase from stakeholders Forestry is subject to the critical look of other stakeholders: “what we do in the forests is displayed in a shopping window”. **How the arrangement affects the achievement of nexus critical objectives** Enhances coherence between biodiversity and forestry objectives. The latter serves different interests such as commercial and ecological and climate interests. Also coherence in implementation is improved.
Integrated Climate and Energy Strategy	**Type of arrangement (formal/informal)** Formal regional participatory policy development processes **Description of arrangement** Integrated Climate and Energy Strategy, GER. Strategy for electricity transition from nuclear to renewable electricity sources. **Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)** - Policy coordination and integration **How the arrangement affects the achievement of nexus critical objectives** Baden-Württemberg’s strategy has been an example for other states to create coherence between climate and energy policies.
SRADDET	**Function of the arrangement (coordination, decision-making, knowledge sharing, etc.)** - Policy coordination and integration **Why it is working or not working (enabling and limiting factors)** Cannot yet fully be judged since it is not implemented yet: Enabling factors: - Early involvement of (transboundary) stakeholders in development - Vague nature of the binding status allowed for a broader discussion even on conflicting topics. Hindering factors:

- Vague status of the binding nature of the document limits the ambition and the effort put in the preparatory work (and likely in the implementation phase)

How the arrangement affects the achievement of nexus critical objectives
Aims to achieve coherence between sectors on a strategic level.
Transboundary coherence: international stakeholders are involved
One piece in the construction of a long term trend in policy integration.

1.15 Reporting of the validation of assessment done with stakeholders

Stakeholders were invited to a workshop during which results from the interviews about policy coherence were validated and solutions to improve coherence discussed. The workshop had the title and aimed to answer the question "Which challenges for policy integration in the Upper Rhine region?" The invitation was sent to 138 stakeholders from whom 10 could attend the workshop out of which three came from Baden-Württemberg. Among present people two were from NGO's, five from research organizations and one from a non-profit sector networks and only two had been interviewed. Results on policy coherence based on the information from interviews were briefly presented and then discussed with stakeholders. Moreover, hindering and enabling factors and institutional arrangements to deal with incoherence were debated.

Regional and transboundary water, energy, food and biodiversity issues were discussed during the workshop, based on the information from interviews. Moreover, stakeholders and organizers came up with some solutions. The issues were separated into four smaller nexus issues that were briefly introduced with a power point. Problems were identified on the output level, implementation and impact level. The participants validated the relevance of the issues presented and the policy instruments and objectives related to this. They also added information during a discussion after each nexus issue raised. Firstly, urban development, biodiversity, food and forestry trade-offs were discussed for Germany and stakeholders provided more information on the situation in France. Secondly, the renewable energy, food, biodiversity and climate nexus was discussed both for Germany and France. Thirdly, transnational cooperation on biodiversity and water issues, ranging from ecological restoration, ground water pollution and floods, were discussed. In all cases reference was made to specific instruments to obtain more information for the scoring of interactions between the instruments and objectives. However, the numbers that have been attributed to interactions were not validated. Also some institutional arrangements that are in development were probed during the discussion.

6 Success stories and failures

The interviews provided with local examples of particularly well-managed environmental issues and of poorly designed policy approached. This sections aims at analyzing the determinant factors that lead to success of failure. Due to the extreme complexity of environmental issues, it is of course very challenging to try to boil down these examples to a few crucial factors. However, this section attempts to draw conclusions from the interviewees' perspectives. In most cases, desktop research on the issue was needed to complete the analysis.

1.16 Success stories

Table 18: Success stories in the Upper Rhine region

Type of successful policy arrangement	Description	Factors of success, do's
Idée Alsace	Idée Alsace is a network of companies gathered around the harbor of Strasbourg and under the status of an association. They implement industrial ecology on a local level (part of circular economy including energy, climate, land use and resources aspects). Their project was created in a bottom-up fashion (no direction regulation incentive) but managed to meet the circular economy funding at the right moment, when it became a popular topic in the regional political agenda.	• Match between a bottom-up project and a top-down funding from the region. • Stay aware of bottom up initiatives from the civil society or private sector that already meet the political objectives and already have expertise.
Leipzig forest management	What remains of the Leipzig alluvial forest is comprised almost entirely inside the city borders and is one of the biggest in Europe. The Leipzig bay was otherwise almost entirely deforested to the profit of urbanizing, mining and farming. The public management of the forest allowed for a better management and protected it from a more aggressive management (see picture below).  Figure 25: Southern Leipzig mining region (above) and Leipzig alluvial forest (below)	• Economic pressure on the forest was successfully handle by the city that bought the land • The city managed to keep control over the management of the forest inside its borders whereas the other parts of the alluvial forest were left without any coherent management.
State wine culture	The Baden-Württemberg Land funds a wine research institute that produces	• Research fund over a long timescale is adapted for systems where uncertainty

institute's research	practice-oriented research in a context of climate change. They research and create new plants, new methods of wine production, wine preservation and oenology. By doing so, they create a bridge between the agriculture and the climate sectors on a long timescale – adapted to the challenge of climate change.	prevails (climate change adaptation) and where choices can lock the system for a very long time (typically several decades for wine production, forest management…)

1.17 Failures

Table 19: Failures the Upper Rhine region

Type of unsuccessful policy arrangement	**Description**	**Factors of failure, don'ts**
Biodiversity law not implemented or bypassed	The French biodiversity law of 2016 includes several tools to address conflicts with other sectors such as agriculture and land use. Precisely, article 69 allows the cancellation of a land-taking project when its ecological compensation is proven impossible. Article 74 authorizes the head of the region to decide the agricultural cover on a precise area when there is a severe ecological stake. Both tools seem relevant to avoid major conflicts (in addition to other planning schemes). But in fact, these articles were never used. The decision to apply them is left to authorities who have many other political and economic factors to take into account. As a result, these attempts to address inter-sector conflicts in the law ended in no effect in the region.	• Although ambitious and coherent on paper, the interpretation of the law was left to the power relations of stakeholders. • Economic pressures (both from agricultural and infrastructure projects) were neglected
Ecophyto plan	This plan aimed at decreasing pesticides use by a factor of 2. Such chemicals are mostly use by the agriculture sector, generate water pollutions and are harmful to many ecosystems. The chosen mode of action was to try to reduce the required quantities for existing agricultural systems through efficiency (doses, equipment…) while maintaining or increasing food production. After 10 years, the plan was considered a total failure: the quantities increase by 22% instead of the 50% reduction objective that was postponed to 2028. The failure comes from the fact that the mode of action neglected the dependency of the system to pesticides. Linear, marginal reductions of the use not only proved inefficient but also locked even more the production system by comforting it (by	• Attempt to fix the intensive production system backfired and increased even more the conflicts with other sectors • A strategy to make new systems emerge (organic…) instead of trying to improve the intensive system may have proven more efficient

	promoting more efficient equipment for intensive farming for example).	
Organic food production in Alsace	Demand for organic food has recently risen rapidly in the Alsace region. The region didn't manage to foster the production at a sufficient level in an area where intensive cereals production prevails. As a consequence, Alsace is now a net importer of organic food. This represents a missed opportunity since intensive farming and in particular cereal production is at the core of several Nexus conflicts such as mudflows and water pollutions.	• The timescale associated with agriculture subsidies did not allow a sufficiently rapid switch to new systems • Existing bottom up initiatives (alternative agriculture) did not find matching funds in time
Soils management regulation loophole	Soils are at the core of many Nexus issues. Not only land use but also agriculture, erosion, mudflows, floods, carbon sinks, biodiversity, … As a consequence, this issue is partially addressed in several laws or directives. But these do not add up to a consistent, exhaustive regulation. It creates regulation loopholes but also prevent the topic to be properly addressed in political discussions. In addition to that, this is a missed opportunity since properly addressing the issue could be a common lever to also address related issues such as mudflows and agriculture issues. The stake is to fill this gap without adding another sector-specific regulation.	• Sector-specific laws and directives left a regulation loophole for the soils issue.
Flood retention basins	Floods are an important issue in particular in the eastern part of the Grand Est region since almost all areas are at risk of flooding. The issue is multifactorial since it involves for example water management, soils and agriculture management and urban management. This systemic problem has been addressed in some places by flood retention basins. This "end-of-pipe" answer aims at addressing the effects rather than the causes. It is a purely technical answer that is also very expensive for the local authorities. Moreover, it strengthens the existing system by offering a temporary fix to the problem, preventing a broader questioning of the sources of the problem. It is worth mentioning that other stakeholders worked on more integrated plans. But it takes more time and legitimacy to build the network required for coordinated actions. On the other hand, local authorities that were vulnerable to the problem had very few options apart from the technical ones.	• Opting for the easier technical solution • Addressing the effect rather than the cause • Strengthening the issue rather than dismantling it with a systemic approach

7 Improving policy coherence & Policy recommendations

1.18 Overview of the results

The mains discrepancy comes from the difference between policy coherence on paper (in the content) and in the implementation stage. Apparently there are limitations to policy coherence on the level of instruments and objectives because actors affected by the implementation manage to put their interests first and because there are barriers to policy integration, resulting in incoherence in implementation, outcome and impacts.

Prominent regional trade-offs between policy instruments and objectives on paper were related to competing land uses. Advancement on one policy restrains that of another by claiming a piece of land that is consequentially no longer available for other purposes. It is not surprising that competing land uses dominate regional conflicts. Laws that openly permit pollution and depletion of biodiversity, water and soil would be criticized and changed accordingly. But if various policy domains want to advance on their objectives, this may require a claim on land and consequentially pose conflicts. Synergies occurred where objectives or instrument of one domain integrate the interest of another. For example, urban planning efforts to integrate ecological corridors could truly create a synergy. Between countries, water and biodiversity policies interacted mainly. This makes sense because these sectors are physically connected. France and Germany have different electricity governance approaches, but since France to a limited extent follows Germany in enhancing biogas production sharing knowledge may be valuable.

It is relevant to highlight the finding that implementation and proceeding policy processes pose barriers to policy coherence. Overrepresentation of economic interests may be one of the reasons for incoherence in practice. The fact that private parties were not interested to participate in the research project is potentially a sign of their high power and interest. Moreover, even when integrated policies are written, barriers occur due to diffuse responsibility. For resources that cross national borders decentralized governance may be valuable. The results show the trade-off that are of interest for one region are not always represented on a more centralized level, with consequences for the neighbor state. Various resource governance approaches have proposed decentralized models to deal with complex human and natural systems on a suitable scale. Such models may prove valuable for managing transboundary sectors. Additionally cooperation and collaboration can enhance information flows to arrive at coordination.

Finally, results illustrate that stakeholder participation processes are relevant institutional arrangements to improve coherence both within regions and transboundary. The emphasis on stakeholder involvement at the level of policy processes suits the proposals for policy coherence in the OECD guidelines. These guidelines stress a critical component: that criteria for decision-making in stakeholder processes should be clearly defined. Stakeholders confirmed this during the workshop.

1.19 First tracks for more policy coherence in the content and the implementation

Since policies are rather coherent on paper, improvements in implementation are needed.

- For transboundary cooperation, suitable inputs such as funding are key. Therefore communication about funding possibilities should be improved to better match with potential projects. One interviewee suggested editing a document gathering the various funding possibilities for a project at the regional level.
- The workshop attendants emphasized the need to avoid “end-of-pipe solutions”. The instruments to avoid this are sector specific. Someone proposed that before policies are

developed it should be verified that there are no major consequential conflicts. Also using prices that reflect the impact of one sector on another are recommended as a tool. But such policies could be difficult to develop, because political will could be lacking to implement instruments that heavily impact voters and vested interests.

- When policy coherence on paper is achieved, it is important to transfer it to the implementation stage. The common method is to ensure coherence by translating it into technical requirements to be matched by the projects. Field analysis shows however that technical requirements do not always work since they are easily bypassed when ratios of power are too unbalanced in the territory. In other words, stakeholders manage to match new technical requirements while maintaining almost the same state and while achieving coherence on paper. This is particularly obvious in the land use sector where very restrictive environmental protections have not achieved to stop biodiversity collapse and land take. One interviewee suggested that trying to decree technical coherence is insufficient if not useless if coherence has not been achieved on a political level.

Finally, promising for coherence and successful implementation may be the potential of stakeholder processes. Clearly defined responsibilities for implementation and monitoring of impacts are also relevant. Different interests should in this manner be included when determining objectives and instruments. Thereby trade-offs are managed beforehand rather than at implementation. Moreover, participation can lead to less resistance from impacted actors at the implementation level. A crucial requirement for successful mitigation of trade-offs is that the criteria for defining the final objectives and instruments are defined up front. Otherwise there is a risk of non-transparency and unequal representation of power after all. Lastly, monitoring of impacts may give insights into the desired state change and reasons why this has (not) been achieved. Such insights could be used to redesign instruments, objectives and implementation.

1.20 Methodology limitations

Some of the limitations of this research are related to the methods of the coherence analysis and the representativeness of interviews. The coherence analysis may be limited for a number of reasons. Firstly, the scores only reflect direct interactions and exclude feedback loops. Secondly, the analysis may be prone to subjectivity. The selected most critical instruments and objectives and the coherence these produce have been verified with stakeholders during the workshop. Still, the scores themselves are reliant on a certain assumptions. Moreover, they are meant to reflect the specific parameters of the case study. There may not always be enough information available or time limitation may hamper the retrieval to judge each instrument and objective in the specific case study context. Additionally, by not including all objectives and instruments from one document the overall coherence of a policy may not be fully assessed. Consistency in justifications of coherence scores is of great importance to minimize these issues. The scores are especially limited because they do not include any information on quantitative changes at the impact level.

Stakeholders that were interviewed did not fully represent all interests of the various sectors in the Upper Rhine region from different organizational perspectives. The private sector was not represented well, while public, civil society and research perspectives were. This is partially a consequence of a bias in the selection of stakeholders as well as a lack of response from the people contacted. The results potentially reflect more the interests than the reality of interviewees, if they believe that framing problems could enhance their interests. Moreover, the flow of the interviews may have guided the analysis of input coherence towards negative interactions. This is because when talking about the nexus problems come more easily to mind of interviewees than synergies.

Conclusion

In Grand Est and Baden-Württemberg there are a number of water, land, energy food and climate policies that produce synergies and trade-offs amongst one another. These need to be managed as they may cause exploitation and pollution of natural resources and ecosystems. Instruments and objectives are rather coherent on paper and cause some conflicts in practice. Trade-offs are produced at different levels of the policy-making process. These range from input to implementation and impact issues. Transboundary cooperation to achieve coherence may be limited due to differences in governance structures, amongst others. Research projects and transnational governance bodies enable cooperation and coherence. Cooperation and coherence are established through formal mechanisms such as policy proposals, stakeholder processes for coordinated planning and informal learning and trust building. Participatory stakeholder processes are also tools to overcome regional incoherence between policy domains.

Future steps of this research could look into the transboundary processes that enable cooperation. Synergies were less easily detected, despite the Upper Rhine region being a case study for potential learning points on this matter. The role of the private sector and industries to create synergies, for example through circular economy and innovation, can also further be developed. The potential of the many strategic documents that demonstrate policy integration, especially when developed with stakeholders, could further be evaluated. Although some interviewees addressed to problems of diffuse responsibility, the Integrated Climate Strategy in Baden-Württemberg may be an interesting example that served as a model for other regions. As a new strategy will be under development from September 2018 onwards, following the process may prove a learning opportunity. For conditions to govern sectors more coherently, it is important to look beyond policy instruments and objectives. As a regional and transboundary public representative stated: “It is not the document that is important, it is its implementation. And the implementation is the actor”. Therefore the involvement of actors, meaning public officials, civil society groups and the private sector, early on in the policy process is a promising way to enhance synergies and manage trade-offs.

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Appendix A: Territorial organization

In France, since the 1st January 2016, 3 formers regions (Alsace, Lorraine and Champagne-Ardenne) merged into one: Région Grand Est. These regions are territorial authorities, which elect a regional council (conseil régional). The regions are subdivided into smaller departments (département) and the smallest unities are the municipalities (commune).

In August 2015, the law about the New Territorial Organization of the Republic (NOTRe) entrusted the regions with the responsibility of developing, by the summer of 2019, a Regional Plan for Sustainable Development and Equality of Territories called SRADDET. The SRADDET will generate a real prescriptive scope for subregional communities and associations. Its provisions will henceforth be opposable to the urban planning documents prepared by the municipalities and public institutions of inter-municipal cooperation.

One of the objectives of the SRADDET is "to contribute to the clarification of the role of local and regional authorities, by giving to the region a major role in regional and prescriptive planning". This enhanced prescriptiveness should not, however, lead us to forget that the SRADDET, is a "simple" local management plan especially in front of urban masterplans. Its added value lies above all in its contribution to the coherence of the territorial development of large regional complexes. By combining various existing regional schemes, the SRADDET should take more into account the interdependence of the various thematics: mobility, ecological coherence, climate and energy, and waste prevention. The SRADDET thus presents itself as an integrative document, which raises the question of its contents and the limits of its thematic perimeter.

According to the law, it is mandatory for the following master plans to be replaced by the SRADDET:

- the Regional plan for Climate-Air-Energy (SRCAE);
- the Regional plan for Ecological Coherence (SRCE);
- the Regional plan for Intermodality (SRI), and pending its possible elaboration, the Regional Plan for Infrastructure and Transportation (SRIT);
- the Regional plan for waste prevention and management (PRPGD).

The law specifies that the SRADDET may also cover any area contributing to regional planning and for which the region has exclusive planning competence (it is the case for water management for example in Grand Est). A "stuffed dolls" mechanism for the master plan is now being organised, a multi-thematic master plan document intended to set out broad orientations considering the local planning documents which need to be integrated into the SRADDET. It sets first and foremost broad orientations on the various themes it covers, transcribed in terms of medium and long-term objectives. It gives a vision for the regional development over several years, framing the strategy of the regional stakeholders. Working groups have been established for the sectors planning, transportation, water and biodiversity, as well as energy and climate[83].

In contrast, the Federal Republic of Germany consists of 16 federal states (Bundesländer). Each federal state is subdivided into administrative districts (Landkreise) which are decentralised entities of the government on the federal level. These territorial authorities are elected directly. The smallest independent level consists of the municipalities (Gemeinden).

A distinctive feature of the Upper Rhine region is the transnational cooperation, namely the Upper Rhine Conference or Franco-German-Swiss Conference of the Upper Rhine[84].

[83] http://www.grandest.fr/politiques-publiques/sraddet

[84] http://www.oberrheinkonferenz.org/de/services/english.html

Appendix B: List of interviewees and workshop attendants

Informant	Format	Abbreviation	Country	Name	Type	Organisation	Department	D2.2
1	1 Interview	RePrFrAgURC	Germany	Dieter Blaeß	Regional government	Regierungspräsidium Freiburg & Upper Rhine Conference	Landwirtschaft, Ländlicher Raum, Veterinär- und Lebensmittelwesen & Working group Agriculture	OK
2	2 Interview	RePrKaAg	Germany	Ulrich Roßwag	Regional government	Regierungspräsidium Karlsruhe	Landwirtschaft, Ländlicher Raum, Veterinär- und Lebensmittelwesen	OK
3	3 Interview	KIT1	Germany	Jérémy Rimbon	Research	Karlsruhe Institute of Technology		OK
4	4 Interview	KIT2	Germany	Kira Schumacher	Research	Karlsruhe Institute of Technology		OK
5	5 Interview	SDGSURC	Germany	Hans-Jürgen Seimetz	Regional government	Struktur- und Genehmigungsdirektion (SGD) Süd & Upper Rhine Conference	Working group Environment	No
6	6 Interview	RePrFr	Germany	Bernd-Jürgen Seitz	Regional government	Regierungspräsidium Freiburg	Naturschutz und Landschaftspflege	OK
7	7 Interview	StaWein	Germany	Bernhard Huber	Regional government	Staatsweingut Freiburg & Former Director Staatlichen Weinbauinstituts Freiburg		OK
8	8 Interview	BUNDBW	Germany	Firtz Mielert	NGO	Bund fur Umwelt und Naturschutz Deustchland (BUND)	Climate and Energy	OK, Regionalverband Mittlerer Oberrhein

9	9 Interview	DREAL1	France	Nicolas Jurdy	Regional governm ent	Directions régionales de l'environnement , de l'aménagement et du logement (DREAL)	Rhin-Meuse Bassin	OK
10	10 Interview	ENGEE S1	France	Sara Fernande z	Research	École Nationale du Génie de l'Eau et de l'Environnement de Strasbourg (ENGEES)		OK
11	10 Interview	ENGEE S2	France	Anne Rozan	Research	École Nationale du Génie de l'Eau et de l'Environnement de Strasbourg (ENGEES)		OK
12	11 Interview	ICLEI1	Germany	Barbara Anton	NGO	International Council for Local Environmental Initiatives (ICLEI)		OK
13	11 Interview	ICLEI2	Germany	Carsten Rothballe r	NGO	International Council for Local Environmental Initiatives (ICLEI)		OK
14	12 Interview	IdAl	France	Simon Pingeon	Sector network	IdéeAlsace		OK
15	13 Interview	KlOb	Germany	Fabian Burggraf	Sector network	Klimapartner Oberrhein		OK
16	14 Interview	SGARE 1	France	Stella Jelden	Regional governm ent	Secrétaire Général pour les Affaires Régionales et Européennes (SGARE) Upper Rhine Conference	Working group Energy and Climate	OK
17	14 Interview	DREAL2	France	Emmanu el Braun	Regional governm ent	Directions régionales de l'environnement , de l'aménagement et du logement (DREAL)	Directeur de projet Rhin & Espaces Rhénans DREAL	OK
18	14 Interview	SGARE 2	France	Laurent Kirchhofe r	Regional governm ent	Secrétaire Général pour les Affaires Régionales et Européennes (SGARE)	Agriculture , forêts, énergies renouvelab les SGARE Préfecture	OK
19	15 Interview	ForstB W	Germany	Gabriele Wicht-Lückge	Regional governm ent	Forst Landesbetrieb Baden Wurttemberg		OK

20	16 Interview	AERM1	France	Marina Pitrel	Regional government	Agence de l'Eau Rhin Meuse (AERM)		OK
21	17 Interview	AlNa	France	Stéphane Giraud	NGO	Alsace Nature		OK
22	18 Interview	RePrFr NaURC	Germany	Siegfried Schneider	Regional government	Regierungspräsidium Freiburg & Upper Rhine Conference	Working group Nature Conservation	OK
23	1 Focus group	WAlNa	France	-	NGO	Alsace Nature		OK
24	2 Focus group	WKlOb	Germany	-	Sector network	Klimapartner Oberrhein		OK
25	3 Focus group	WKIT1	Germany	-	Research	Karlsruhe Institute of Technology		OK
26	4 Focus group	WDREAL	France	-	Regional government	Directions régionales de l'environnement, de l'aménagement et du logement (DREAL) Grand Est		OK
27	5 Focus group	WITG	Germany	-	Sector network	ITG mbH & Co. KG		No
28	6 Focus group	WAPRONA	France	-	NGO	APRONA Observation de la Nappe Alsace		OK
29	7 Focus group	WTUD	France	-	Research	Technical University Of Denmark		No
-	8 Focus group	WENGEES	France	-	Research	École Nationale du Génie de l'Eau et de l'Environnement de Strasbourg (ENGEES)		OK
-	9 Focus group	WENGEES	France	-	Research	École Nationale du Génie de l'Eau et de l'Environnement de Strasbourg (ENGEES)		OK
30	10 Focus group	WKIT2	Germany	-	Research	Karlsruhe Institute of Technology		OK
31	19 Interview	DDT67	France	Valérie Rougeau	Sub-regional government	Direction Départementale du territoire 67 (DDT67)		OK
32	20 Interview	AERM2	France	Philippe Goetghebeur	Regional government	Agence de l'Eau Rhin Meuse (AERM)		OK

33	20 Interview	AERM3	France	Claire Riou	Regional government	Agence de l'Eau Rhin Meuse (AERM)	OK
34	20 Interview	AERM4	France	David Bourmaud	Regional government	Agence de l'Eau Rhin Meuse (AERM)	OK
35	20 Interview	AERM5	France	Guillaume Monaco	Regional government	Agence de l'Eau Rhin Meuse (AERM)	OK
36	20 Interview	AERM6	France	Katia Schmintzberger	Regional government	Agence de l'Eau Rhin Meuse (AERM)	OK
37	20 Interview	AERM7	France	Amélie Heuzé	Regional government	Agence de l'Eau Rhin Meuse (AERM)	OK
38	21 Interview	GE1	France	Anne Monasson	Regional government	Région Grand Est	OK
39	22 Interview	EIFER1	Germany	Loraine Roy	Research	EIFER	OK
40	23 Interview	CAA1	France	Nathalie Brobeck	Regional government	Chambre d'agriculture d'Alsace	OK
41	24 Interview	CCIA1	France	Amandine Amat	Sub-regional government	Chambre du Commerce et de l'Industrie Alsace	OK
42	24 Interview	CCIA2	France	Danièle Schmitt	Sub-regional government	Chambre du Commerce et de l'Industrie Alsace	OK
43	25 Interview	TRION	Germany	Vulla Parasote	Sector network	TRION	OK

Appendix B: Interview grid in German and English

Bevor dem Anfang des Interviews

- Mein Nahmen ist Maya Taselaar und das ist Mein Kollege Thomas Desaunay, wir arbeiten zusammen am europäischen Forschungsprojekt im Namen des französischen Forschungs- und Beratungsinstitut ACTeon.
- Wir danken Ihnen herzlich für Ihre Zeit und Mühe
- Das Interview hat als Ziel ihre Vision und Meinung über Gesetzestexte und Strategien verschiedener Ressourcen und Sektoren heraus zu finden. Es gibt daher keine richtige oder falsche Antwort zu den Fragen.
- Einer unserer Voraussetzungen ist dass verschiedene natürliche Ressourcen miteinander in Verbindung stehen. Wir möchten wissen ob Sie diese Erfahrung teilen, und Ihre Meinung dazu.
- Das Interview besteht aus fünf Fragen, insgesamt dauert das Gespräch 45 bis 60 Minuten. Ein semi-strukturiertes Interview hat einen Informellen Charakter. Das heißt, dass wir sowohl an Ihrer Meinung interessiert sind als auch an Themen die Sie als wichtig erfahren.
- Interviews sind Grundsätzlich nicht anonym, außer Sie bevorzugen das. Nicht amtliche Aussagen werden mit Achtung behandelt. Falls wir Ihren Namen aufführen dürfen werden wir Sie informieren und können Sie Änderungen vorschlagen. Indem Sie lieber Anonym bleiben, wird der Nahmen Ihrer Organisation benutzt.
- Sie werden eine Kopie des Studiums erhalten zudem Sie einen Beitrag liefern.
- Dürfen wir das Gespräch bitte aufnehmen? Wir können die Aufnahme jederzeit pausieren wenn Sie möchten und Sie können Fragen unbeantwortet lassen.
-

Ihre Rolle und das Ziel Ihrer Organisation

- Was ist Ihre Rolle in der Organisation?
  - Welche Verantwortungen tragen Sie?
  - Womit beschäftigen Sie sich im Allgemeinen?

Wichtige Gesetzestexte und Kohärenz im eigenen Sektor

- Welche Gesetzestexte und Strategien sind für Ihren Sektor am wichtigsten, Ihrer Meinung nach?
  - Welche strategischen Ziele haben Einfluss auf ihrem Sektor?
  - Welche politischen Instrumente sind wichtig für Ihre Aktivitäten?
- Auf welcher Art verhalten sich diese Strategien und Gesetzestexte gegenüber einander?
  - Gibt es Ziele oder Instrumente die einander zu gute kommen, auf Grund Ihrer Erfahrung?
  - Was sind die Auswirkungen der Strategien auf verschiedene Politische ebenen: regional und national?
  - Was können Sie, auf Grund Ihrer Erfahrung, erzählen über den Effekt Französischer Politik und Richtlinien?
  - Wie würden Sie einen vorbildhaften Fall internationaler Kooperation in Ihrem Sektor beschreiben?
  - Welche Interessen die das Gegenteil von einander erzielen kennen Sie, wenn überhaupt?

- Welche Fälle von Instrumenten die einen hemmenden Einfluss auf einander haben kennen Sie, wenn überhaupt?
- Wie gehen Sie mit weniger Koordinierten politische Strategien und Richtlinien um?
- Gibt es Vereinbarungen oder Institutionen die daran Beitragen die Konflikte zu vermindern?

Kohärenz zwischen Ihrem Sektor und andere Sektoren

- Jetzt sprechen wir über Sektoren die wichtig für Sie sind: welche Sektoren sind das?
  - Von welchen Sektoren sind Ihre Aktivitäten abhängig?
  - Ihrer Meinung nach, was ist die Auswirkung der Strategien und Gesetzestexte dieser Sektoren?
  - Welcher Sektor hat vergleichbare Ziele?
  - Gibt es Instrumente eines anderen Sektors die Ihrem Sektor zu Gute kommen?
  - Welche übrigen Fälle von Kohärenz, vielleicht eines anderen Sektors, kennen Sie?
  - Wie wurden Sie einen vorbildhaften Fall den Sie kennen von Sektoren die einander zu Gute kommen beschreiben?
  - Welcher Sektor hat unterschiedliche Ziele?
  - Welche politischen Strategien stehen einander im Weg, Ihrer Kenntnis nach?
  - Kennen Sie mehrere solcher Fälle?
  - Wie gehen Sie mit weniger koordinierten politischen Strategien und Richtlinien anderer Sektoren um?
  - Gibt es noch mehr Strategien um bessere Ergebnisse zu ergänzen?
  - Gibt es Vereinbarungen oder Institutionen die dazu beitragen Konflikte zu vermindern?

Wichtige Akteure und Referenz

- Mit welchen anderen Organisationen oder Personen würden Sie uns raten zu sprechen?
  - Gibt es Akteure in anderen Sektoren mit denen Sie uns in Kontakt bringen könnten?

Herzlichen dank für ihre Teilnahme an dem Interview, Sie haben uns sehr gut weiter geholfen.

- Wir werden Sie über den Fortschritt des Projektes informieren.
- Sie sind eingeladen zu einem Workshop Beginn Juli. Während dem Workshop werden sowohl die Modelle des Natürlichen Ressourcen der Oberrhein Region als auch die Ergebnisse der Interviews präsentiert. Einige Akteure werden auch präsentieren.
- Falls Sie daran interessiert sind, schicken wir Ihnen gerne eine erste Version des Serious Games.

English Translation of interview grid
Before starting the interview

- Introduce yourself: name, affiliation, your role
- Introduce the research project: objectives, outputs so far
- **Quick word about the project**

Water, land, food, energy, and climate are interconnected, comprising a coherent system (we call it the 'Nexus'), dominated by complexity and feedback. Putting pressure on one part of the Nexus can create pressures on the others. Management of the Nexus is critical to securing the efficient use of our scarce resources. Through the five nexus sectors, the research project SIM4NEXUS aims to predict society-wide impacts of resource use and relevant policies on sectors such as agriculture, water, biodiversity and ecosystem services through a model-based analysis.

- The Horizon2020 project SIM4NEXUS aims to facilitate the design of policies within the Nexus by anticipating all possible conflict and potential synergies. The project will deliver a Serious Game, a cloud-based, integrated tool for testing and evaluating policy decisions.

During this interview we'd like to know:

- Your views on public policies and their coherence
- Your specific needs of information, knowledge and modelling that SIM4NEXUS could address
-

- Tell what the interview is about: 9 questions, that should last for about 45 minutes, that aim to understand the interviewee experience of policy coherence in practice from the perspective of his/her sector.
- Inform the interviewee about how the interview information will be used:
  - Interviews will not be anonymous unless explicitly requested. Off the record statements will be treated with confidentiality. If we quote you directly, you will be informed and will be able to comment and suggest improvements. If anonymity is preferred, only the name of the organization/group will be quoted.
  - Results will be used to assess the coherence among policies, and will be included in the policy analysis report. He/she will receive a copy of the final report.
- Ask for tape recording. State that you can turn the recorder off any time during the interview, if requested and that they can always decline to answer a question.

Interview questions

1. What is your role in your organization?

2. What are the most important policies in your sector at the European, nation and regional levels? Instruments and objectives.

3. To what extent are these policies aligned with policies at other governance levels? National and regional. Synergies and conflicts. Negotiation of trade-offs.

4. How do these main policies relate to policies in the same domain across the border? Means and objectives. Synergies and conflicts. Dealing with these policy interactions. Formal and informal agreements, institutions, public/private organizations.

5. Are there examples of cross-border cooperation that work particularly well? How so?

Coherence between sector domains, within one country and institutional governance mechanisms, success and failure stories

"Let's now talk about the other environmental sectors of the Nexus that are related to yours: "water/energy/land use/agriculture/climate change"

6. According to you, what are the most important sectors for your sector to operate successfully?

7. To what extend are policies between your sector and these other sectors aligned? Means and objectives. Synergies and Conflicts. Dealing with these policy interactions. Formal and informal agreements, institutions, public/private organizations.

8. Are there examples of cooperation with other Nexus sectors that work particularly well? How so?

9. Who would you recommend us to talk to about coherence of European policies in the water, energy, land, food and agriculture, and climate nexus? Anybody, public and private actors.

Thank the interviewee for his/her time and promise you will follow up with the results.

Outcomes of the project and how the organization can be involved

- Invitation for the workshop early June. We'll present the interviews and the modelling results. Key stakeholders are also invited to present one issue. Announce guests list.
- If you like, we can keep you updated about the project results and you can be a beta tester of the serious game.

If strong interest, ask if interested in hosting a Nexus-related workshop

Documents that could be handed to tease the project

- Flyer
- Case study flyer
- Conceptual model screenshot