D4.8: LEARNING GOALS UPDATED

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DATE: 20-12-2018

PROJECT	Sustainable Integrated Management FOR the NEXUS of water-land-food-energy-climate for a resource-efficient Europe (SIM4NEXUS)
PROJECT NUMBER	689150
TYPE OF FUNDING	RIA
DELIVERABLE	D.4.8 Learning goals updated
WP NAME/WP NUMBER	Serious Game development and testing / WP 4
TASK	4.8
VERSION	1
DISSEMINATION LEVEL	Public
DATE	6-12-2018
LEAD BENEFICIARY	WUR
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DOCUMENT HISTORY

VERSION	INITIALS/NAME	DATE	COMMENTS-DESCRIPTION OF ACTIONS
1.0	RM/ROBBEMOND	6/12/2018	INTERNALLY REVIEWED VERSION FOR DELIVERY
1.1	RM/ROBBEMOND	20/12/2018	INTERNAL FEEDBACK PROCESSED

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Executive summary

Task 4.1 has defined a first version of the SIM4NEXUS Serious Game tool learning goals considering: i) the scope of the game, ii) the contents to be included, iii) the knowledge to be imparted, and iv) the assessment items needed to test the learning. The learning goals are oriented by two main purposes: i) to allow users to learn about concrete facts, terminology, acronyms, concepts, rules, procedures and soft skills related to the Nexus management domain; and ii) to gain insight into the decisions and behaviours of the players.

This report, which is the second deliverable that deals with the learning goals, provides an update considering every particularity of each case study at this stage of the project. A methodology to update the learning goals was developed and has been reused for this update. The approach from the first deliverable forms the basis of this report, and is used in all iterations as the project gains insights on each case study. Thanks to this methodology, which results in a set of guided steps for information collection and learning goals definition, a more comprehensive and precise analysis has been able to be done. More concretely, this has helped: (i) case study leaders and other involved actors to better explain their needs and objectives, (ii) requirements collection in a common framework, (iii) collaborative discussion and evolution of requirements, decisions, and objectives, and finally, (iv) learning goals definition.

This report repeats the general principles of the serious game, to provide a common framework for understanding of potential roles of the game in training and policy processes, making case study leaders and other relevant involved actors understand which the capabilities of a serious game tool are, and leading to a better definition of the learning goals.

A framework to fit the different terms in a common manner has been defined, linked to the methodology. The common framework includes the case studies definitions, together with their indicators, interlinkages, time and spatial scales, objectives, and also relates this entities with their respective missions, roles and learning goals in the Serious Game. In addition to the learning goals, the common framework represents a first inventory of potential assessment items to test the learning for each case study.

In conclusion, great efforts have been devoted at this early stage of the project to fulfil the task objectives (Task 4.1), not just for the report per se, but because of the high complexity of the task, i.e., understanding all the case studies, entities, relations and restrictions. The methodology used has covered successfully the necessities for this tasks, and therefore, it will continue being the basis for any future iterations of this report. Next steps will rely on more results coming from other Work Packages, interviews, and other sources, which are expected to bring more precise information. Accordingly, more concrete learning goals will be able to be defined, tailored to each case study, and maximising impact.

Since the present report is used as a living document in the project, the first version (Month 6 of the project) has been updated according to evolved insights from the case studies in Month 12. When the case studies proceed, further updates may follow.

Changes with respect to the DoA

We collected data directly from the case studies in order to update this second version of the learning goals. The present report must be considered a living document, in which definitions of the learning goals may be adapted to insights gained in the course of the project, and will be updated further later in the project.

Dissemination and uptake

This report is public, so it is accessible for everyone. However, the specific targeted audience of this report are the beneficiaries of the project, in particular the case study leaders and the beneficiaries participating in the development of the serious game and the complexity science models. The purpose of this report is to provide grounding for a common understanding of the principles of the serious game and the leaning goals to be achieved for stakeholders in the case studies. Additionally the methodology presented here can be useful in similar approaches for future/other projects.

Short Summary of results

Data have been collected about the case studies, specifying the policy objectives, the relevant interlinkages between NEXUS components, the indicators to measure policy efficacy, and relevant types of stakeholders for each case study. Based on this information, learning goals for each case study, general learning goals, and a common framework comparing the case studies and realizing instantiations of the game for each case study have been defined.

Evidence of accomplishment

Data collected from the case studies are available in the WP4 documents section of the SIM4NEXUS Projectplace directory. The resulting definitions of learning goals and comparison of case studies with respect to interlinkages, policy goals, indicators, and involved types of stakeholders are included in the present deliverable.

Glossary / Acronyms

TERM	EXPLANATION / MEANING
DE-CZ-SK	EAST GERMANY-CZECH REPUBLIC-SLOVAKIA TRANSBOUNDARY CASE STUDY
FR-DE	FRENCH-GERMAN TRANSBOUNDARY CASE STUDY
KEE	KNOWLEDGE ELICITATION ENGINE
P&R	PENALTIES AND REWARD
SW UK	SOUTH WEST OF THE UNITED KINGDOM (REGIONAL CASE STUDY)
WP	WORK PACKAGE

1 Introduction: Learning goals from D4.1 are updated in D4.8

This document provides an update to the learning goals that were defined in D4.1 as shown in Figure 1. In that previous deliverable much of the input information about the case studies came from case-specific posters and reports while in some occasions there had been intensive interactions with the case studies. In this document all information that was provided then was thoroughly reviewed and updated by the case study leaders. It results in reviewed, updated, and current lists that describe what the specific topics are and focus of the case studies is. Some additional lists are still required and will be added in deliverable D4.9 in which another round of updates will take place.
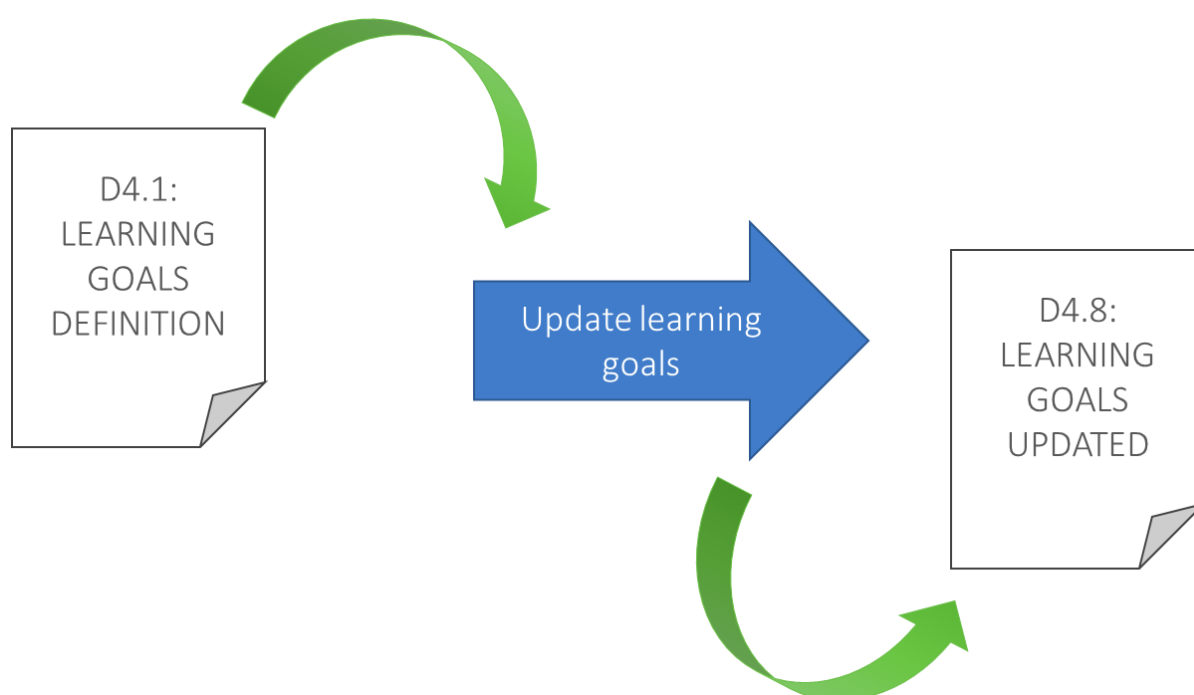
Figure 1. D4.1: Learning Goals Definition forms the foundation for D4.8: Learning Goals Updated

This introduction presents the structure of the present report and a description of SIM4NEXUS Task 4.1, of which this report is the second related deliverable. The first edition of this report was delivered in November 2016. The present version has been revised based on evolved insights from the case studies. In Chapter 4 the characterizations and learning goals of the case studies have been revised.

Two subsections still apply to Section 5.3, describing some preliminary ideas on policy options to be offered to players and learning from their actions. During next phase of updating the document, these subsections will receive more specific attention.

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1.1 Structure of the document

This report is structured in 6 Chapters and 1 Appendix as follows:

Chapter 1 is the introduction.

Chapter 2 explains the principles of the serious game, in order to build a first common understanding of potential roles of the game in training and policy processes.

Chapter 3 elaborates on the approach taken to collect data about the case studies and to define the learning goals and the common framework.

Chapter 4 contains a short description of the case studies in which the serious game is to be applied. The 12 case studies have different regional, national, international and global scales and cover different aspects of the nexus, such as low carbon economy, water quality management, biodiversity, and sustainable food production. The chapter concludes with a presentation of the learning goals, as they have resulted from a first draft by the Task 4.1 team and discussion with the case study leaders.

Chapter 5 compares attributes of the case studies, such as relevant nexus component interlinkages, policy objectives, indicators, and stakeholder types. These attributes are the basis for the development of case study specific instances of the game in a common framework.

Chapter 6 concludes the report with recommendations for further development and maintenance of the learning goals definitions and the common framework.

The format used to describe the case studies is included in Annex A.

The remaining part of the present chapter provides background information on the goals and status in the project of Task 4.1.

1.2 SIM4NEXUS Task 4.8 goals and background

This section is unchanged and identical to the section in deliverable 4.1.

Task 4.1 is part of work package WP4. According to the Grant Agreement, "*WP4 focuses on defining, implementing, testing and validating the Serious Game. The Serious Game will assist policy makers and stakeholders to better understanding and visualizing policies at various geographical and temporal resolutions, leading towards a better scientific understanding of the Nexus via unique immersive experience. WP4's objectives are:*

- WP4-O1: Define and implement the game strategy, users, roles and storylines, taking into account temporal (short, medium and large) and geographical scales (regional, national, European and global) and promoting 'learning by doing' where the users will learn from wins and losses.
- WP4-O2: Determine gaming objectives that permit to understand how complex social-technological water-energy-food systems work under climate change and how to manage the water resources.
- WP4-O3: Define and collect the information requirements among all platform components and flow.
- WP4-O4: Define and implement the mechanisms to accumulate learning from users, incorporating the learnt knowledge into subsequent rounds, and to learn from Nexus knowledge and integration methodology.
- WP4-O5: Define and implement a GUI in order to permit the users to play and re-play scenarios, modifying real-life variables to test changes in components and outcomes.
- WP4-O6: Validate the solution in a development environment."

In particular WP4-O1 and WP4-O2 are relevant for Task 4.1. The task description according to the grant agreement is "*T4.1 will define the SIM4NEXUS Serious Game tool learning goals considering: i) the scope of the game, ii) the content to be included, iii) the knowledge to be imparted, and iv) the assessment items needed to test the learning. The scope of the learning goals is the holistic management of the Nexus, where decisions taken in one part trigger effects on the other. To represent that scope, content to be included encompasses representation of attributes and statuses of all related and relevant actors, entities and infrastructures in the Nexus depending in the concrete scale of analysis. Learning goals will consider different time and geographic scales, making learning process include knowledge at short, medium and large temporal scale, related to regional, national, European and global understanding of the complex interactions in the Nexus. Learning goals will be oriented by two main purposes: i) to allow users to learn about concrete facts, terminology, acronyms, concepts, rules, procedures and soft skills related to the Nexus management domain; and ii) to gain insight into the decisions and behaviours of the players. It will build on the results of WP1 to identify the main issues and interactions involved with the learning goals, and on the results of WP2 to identify the types of policies and decision makers that must be supported by the Serious Game. The learning goals will be formulated based on questionnaires with the partners involved in WP1 and WP2 and verified in a (web-based) workshop with them. T4.1 is closely related to the accomplishment of WP4-O1 and WP4-O2.*"

Figure 2 displays links between WP4 and other work packages. Since data from WP2 describing the international and national/regional policies are not available yet (planned for project months M12 and M14 respectively), we collected data about policy objectives directly from the case studies in order to define a first version of the learning goals. Except from this single exception, we completed the task as required by the Grant Agreement. The next chapters of the present deliverable report the results.

Work package 4

T4.1 Learning goals definition

T4.2 Game logic definition and system requirements

T4.3 Setting up the project database and metadata ontology (Semantic Repository)

T4.4 Development of Knowledge Elicitation Engine

T4.5 Development of the visualization and interaction tool

T4.6 Implementation of all components

T4.7 Testing of the system with scenarios and actors

T4.8 Data Management

WP 5

WP 1

WP 2

WP 3

WP 6   WP 7   WP 8

Learning goals validation for each case study

Game logic validation for each case study

Decision Support validation for each case study

Feedback regarding user experience

Learning Goals
Temporal and geographic scales

Game Logic definition
Users, roles, storylines

Game policy scenarios input
Nexus Policies

Nexus Science

Model runs for the Serious Game

Figure 2. Task-by-Task interactions of Work Package 4 with other Work Packages

2 SIM4NEXUS Serious Game principles

The purpose of this chapter is to present the reader with a brief explanation of the SIM4NEXUS Serious Game principles, as a background for understanding the learning goals. The chapter first presents the goal and the approach, then the process of the game play, and finally the Penalties and Reward (P&R) System.

The goal of the game is to learn about different policies on the nexus and how these policies impact a particular case study through a "learning by playing" approach. This approach is depicted in Figure 3.
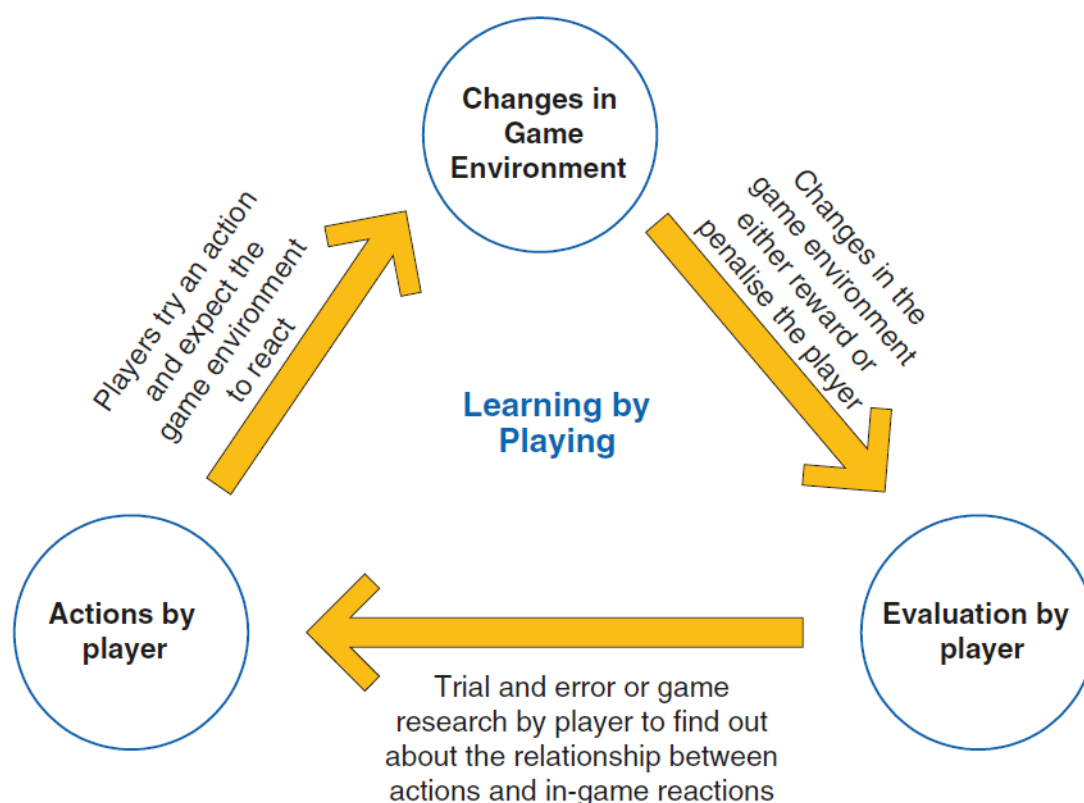
Figure 3. Approach "learning by playing"

Based on this concept the game play for the game is as follows:

As a player, you represent policy makers in the various sectors in a particular area – food, energy, water, climate and/or land use. Your aim is to fulfil the targets (objectives) set out by the national or international bodies by changing or adapting new policies in your area. To succeed in the game, you must learn to fulfil these targets by mixing and matching various cross sector policies without compromising the existing status quo of the other sectors.

Core Experience – What is the player experiencing as they play the game?

The core experience in the game is to play the role of policy makers in food, energy, water, climate, land use. In the game, the player will typically start off with separate "silo-thinking" approaches towards decision making and policy implementation. Over the course of playing the game, they will be

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encouraged to change towards a more integrated NEXUS-compliant policy implementation approach and decision making.

Base Mechanics – What does the player actually do?

The player will have a target at the start of each turn of the game and he/she will have to implement policies to try to achieve the target. The turn ends when the player has decided on the policies which are to be implemented to achieve the targets and clicks on "next turn" button. The game will compute the policies made and an analysis of the decisions will be displayed in the following turn, with a new target to achieve for the turn.

The list of targets for each of the case study will be primarily determined during the case study interactions with the stakeholders, however there will also be targets from the European and Global case studies. The list of targets will also be categorised into the case studies, an example of the classification is presented in Table 1:

Table 1. List of targets classification example

Target case study	Target text	NEXUS Component	Target indicator	Target achievement value
Global, European	Improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and increasing recycling and safe reuse globally	Water	Percentage of water bodies with good water quality	70
Sardinia	Increase renewable energy production	Energy	Percentage of renewable energy production	5
...				

The targets are envisioned to be displayed in a step-by-step manner to the player. This will help guide the player on what to do during the game play.

Penalties and Reward (P&R) System – What behaviour within the game is encouraged or discouraged?

Silo-thinking in decision making and policy implementation within the game is discouraged, whereas integrated NEXUS-compliant decision making is encouraged. For every target in each turn, the player is encouraged to look at policies in all sectors and consider them to achieve a target.

The P&R system will be in 3 parts:
1. **Key indicators across all NEXUS components**. These key indicators are yet to be defined and will require inputs from WP2, WP3, and WP5. It is noted that while it is not possible to have all key indicators showing positive values all the time, the player will be rewarded when there are more indicators showing positive results than vice versa. At this moment of writing, there is also no

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consideration to weigh the indicators yet and the assumption is that all indicators will have the same weight. This may change as the project processes.

2. **Events within the game**. Events are news happening "on the ground" which add a societal and cultural aspect to the game. These events will be triggered based on the decisions the players made in the game and will be narrated in the same tone as they are encouraged to change towards a more integrated NEXUS-compliant policy implementation approach and decision making. There will also be uncertainties in event triggers to add more realism in the game, e.g., the occurrence of extreme events such as economic crisis or disaster events. There will be three categories of events: informational events which are neutral, negative events which will penalise the player by deducting points, and positive events which will reward the player with bonus points.

3. **Score.** There will be a score for the player. This score will indicate how successful the player is applying NEXUS-compliant decision making in achieving the targets in the game. Every progression in the time step of the game will add to the score to encourage the player to continue, every policy implemented will add to this score and the events will add to the score.

3 Approach to updating learning goals

According to work plan including in the grant agreement, Task 4.8 has to result in an update of learning goals for players of the Serious Game, and criteria to assess the extent to which players have achieved these learning goals. Since the game is to be applied in the case studies and the case studies have different policy objectives, **the learning goals are different for each case study**, although there might be overlap. This is an important point that determined the whole approach and added to the complexity of the task. Therefore an approach was developed to define specific learning goals and assessment criteria for each case study. In addition, a **common framework** had to be defined to describe and compare the functionalities, actor roles, policy goals, and assessment criteria (indicators) of the games for the case studies. The present chapter describes the approach taken to collect data about the case studies and define the learning goals based on these data.

The steps for updating the learning goals are presented in Figure 4. The first step in the approach was to collect data about the case studies from the initial deliverable 4.1: Learning Goals Definition. Based on this experience, a format was created in Excel for updating all items from D4.1. The items from that deliverable were added to enable the case study leaders to update the items belonging to their case study conveniently. After an internal review of the structure of the document, it was send to all the case study leaders. The case study leads were requested to review, complete, and update the format to match their case study's descriptions with the current situation. As not all case study leads had the opportunity to fully complete the format in the previous deliverable, because not all the stakeholders had been raised and contacted yet at that stage, this was effectively the first review of the items provided for these case studies.

The method for updating the learning goals and the corresponding data collection has been presented in Exeter on 15 November 2018. After the presentation the data gathering has started by approaching the case study leads and providing them with the format for updating the learning goals.
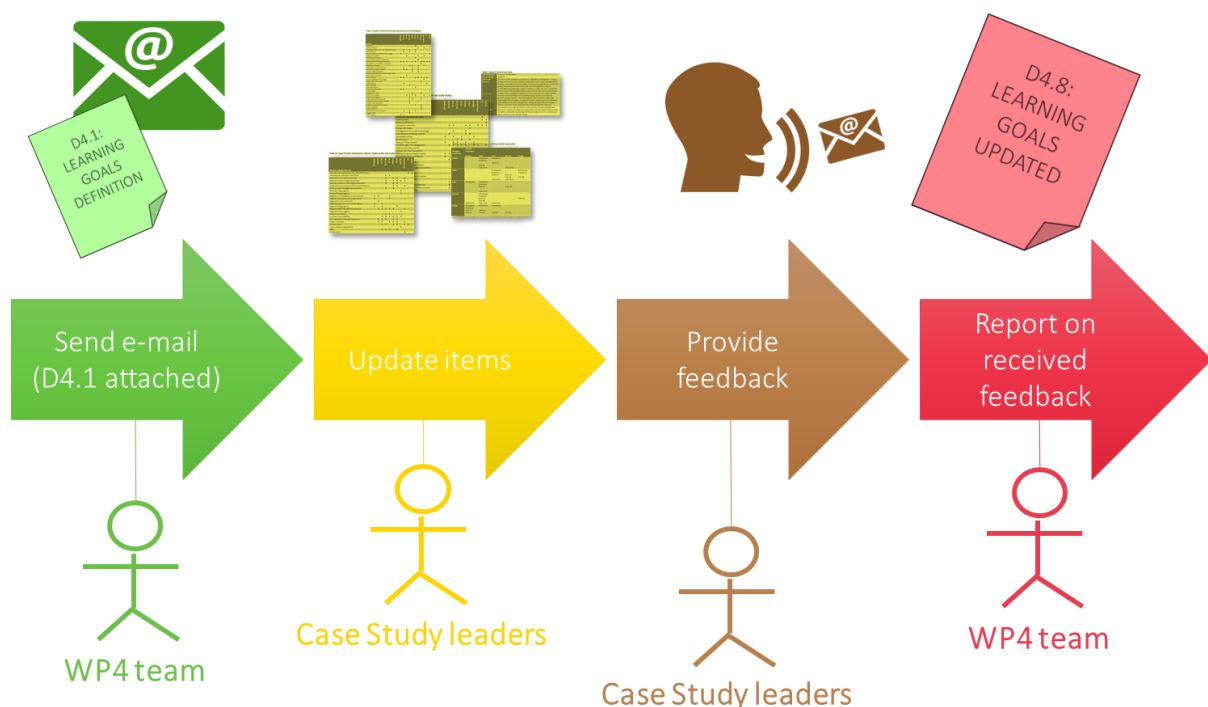
Figure 4. Approach to define the learning goals

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After receiving all feedback from the case study leads, the data has been combined and used for creating an overview spreadsheet. This sheet has once again been shared with all case study leader to provide them with the opportunity to correct mistakes or other correcting remarks. After that step the data was used to create this report which is in fact an update of D4.1.

4 Learning goals

This chapter provides an update of the learning goals for each case study in SIM4NEXUS at this stage of the project.

Current general learning goals are the result of the data collection performed along all case studies, specifying the policy objectives, the relevant interlinkages between NEXUS components, the spatial and temporal scales, the indicators to measure policy efficacy, and relevant types of stakeholders for each case study.

Taking all these inputs as source, the following tables have been drafted by the Task 4.1 team and offered review by the case study leads[1]. In addition, the general learning goal has been defined, which is *to get policy makers and stakeholders to learn about impacts of one policy in the Food-Energy-Water Nexus. In addition, they can identify potential risks and conflicts of interest, trade-offs, and synergies, and learn how to coordinate policies in different domains in order to simultaneously attain multiple goals across the domains*.

Table 2. Region of Andalusia case study

Case study type	Regional
Case study leader(s) name(s)	Maria Blanco and Pilar Martinez
Case study summary	The Andalusian case study will address how agricultural and environmental policies can be integrated to boost economic activity while reducing resource use and promoting sustainable water management, climate change mitigation and renewable energy. The main driver of the study is the water shortage problem, which has been aggravated by climate change. Tourism, as an important sector in the region has also increased the scarcity of water. The demand for water reaches its peak in summer due to tourism and agriculture. The goal is to raise awareness on the interdependence of water, energy and agriculture. A second goal is to advise local authorities. The main research question is: how can the policies become more integrated or coordinated to promote the sustainable use of water under changing climatic conditions.
Case study learning goals	You will learn how policies in the domains of agriculture, sustainable water management, and renewable energy can affect each other under climate change conditions, in a region where high agricultural production and tourism are competing for water.

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[1] Due to formal complications (i.e. change of partner responsible for this Case Study in the Grant Agreement), no specific learning goals could be drafted for the Azerbaijan case study by M6.

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Table 3. Island of Sardinia case study

Case study type	Regional
Case study leader(s) name(s)	Simone Mereu and Antonio Trabucco
Case study summary	The focus of the Sardinian case study is on agriculture, hydropower, tourism, energy, and food security. Sardinia's main sectors are tourism and agriculture. The case study will address how policy, incentives (e.g. agricultural and tourism policy), and eventual new infrastructure can be integrated to support sustainable food production, quality of water for urban use, and a sustainable tourist sector. These policies and incentives have to take into account climate change, internal population migration to the coasts and main cities, and the need for increased reliance on renewable energy sources and reduced greenhouse gas emissions. The main goal is to raise awareness about the interlinkage between water, energy and tourism. Another goal is to influence policy decisions on water management, energy development and tourism. Water is a priority, as it is essential to the biodiversity of the wetlands.
Case study learning goals	You will learn how policies in the domains of agriculture, sustainable water management, and renewable energy can affect each other under climate change conditions, in a region where high agricultural production and tourism are competing for water.

Table 4. Southwest of the UK case study

Case study type	Regional
Case study leader(s) name(s)	Matthew Griffey (SWW/UNEXE), Lottie McKnight (SWW) and Lydia Vamvakeridou (UNEXE)
Case study summary	The case study will address how legislation, policy and its interpretation, with incentives for agricultural policy can be integrated to support both sustainable food production, and provision of water and wastewater services in a region with a significant tourism industry, in the face of climate change, population growth and the need for reduced greenhouse gas emissions. The main focus of the study is to influence land use management policies (where extreme weather causes flooding and washes away soil from intensively-farmed land) constrained by the (economic) importance of agriculture for the region (with three quarters of its land area devoted to it). There is also a significant draw to the region of tourists, which adds an additional pressure on land use and water resources. A second goal of the case study is to understand the way in which governance has the ability to constrain and restrict the move towards a more sustainable, smart, and flexible energy system. Another important issue is water quality which needs to be preserved especially along coastal zones.
Case study learning goals	You will learn how regional policies of land use for agriculture, renewable energy (wind and solar farms), and water management affect each other in a region with high risk of heavy rainfall and flooding.

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Table 5. The Netherlands case study

Case study type	National
Case study leader(s) name(s)	Vincent Linderhof
Case study summary	The goal of the Dutch case study is the role of biomass in the identification of low-carbon and resource-efficient pathways for the Nexus under the condition of climate change. It will focus on biomass in climate mitigation and adaptation strategies and relations with land use, water, agriculture and food production. For example, the shift towards a low-carbon economy will influence energy, land-use and the nutrient cycle, but will also have consequences for the water demand. The case study will assess the socioeconomic, environmental (water, land, climate) and technological consequences of and conditions for roads to a low-carbon and resource-efficient economy in the Netherlands including import and export. The roads to a low-carbon economy should be identified in close cooperation with stakeholders such as private sector, policy makers at different levels and from different sectors, governmental and and research organisations. The case study will investigate mid-term and long-term trends and policy options. The research results will be used to raise awareness among policy-makers and other stakeholders about connections between the sectors in the nexus, sector policy goals and instruments, synergies, conflicts and trade-offs.
Case study learning goals	1. You will learn how policies aiming for a low-carbon and resource-efficient economy in the Netherlands with reduced energy demand, more renewable energy production from biomass and other sources and reduced greenhouse gas emissions, can affect land and water use in the Netherlands and abroad by import and export, agricultural production, and risks of flooding and droughts under different climate change scenarios. 2. You will learn to make choices and balance interests by experiencing how changes in one part of the nexus over time affects other parts. 3. You will learn how the need for biomass as a renewable energy source may conflict with the creation of a biobased and circular economy.

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Table 6. Sweden case study

Case study type	National
Case study leader(s) name(s)	Claudia Teutschbein
Case study summary	The Swedish case study focuses on the Nexus of water-climate-forest. It tries to establish the optimal use of Swedish resources for the purposes of climate change mitigation. Rising temperatures, increasing annual rainfall and the longer growing season are gradually making Sweden a more attractive place to grow forest biomass and agricultural products. The research concentrates on the alternative uses of the additional biomass potential (carbon sequestration in standing forests versus increased bioenergy or agricultural production) and the consequences for the available water supply and quality, and potential impact on other water goods and services, as well as consequences for biodiversity. The goals of the case study are to increase the understanding of forest-water interlinkages in the context of climate change, as well as to bring research and stakeholders together and communicate the results.
Case study learning goals	You will learn how increasing afforestation for biomass and energy production interferes with water management and biodiversity policies

Table 7. Greece case study

Case study type	National
Case study leader(s) name(s)	Maria Papadopoulou
Case study summary	The Greek case study is on a national scale with an emphasis on energy needs and water scarcity issues. Tourism causes a high demand for water, energy and food resources in the summer. Energy, both in the form of fossil fuels and renewables, is therefore a focus. Agriculture, which is also a major sector in Greece, will soon potentially be encumbered with a fee for water. A main drive for this case study is to apply water saving practices in agriculture. One goal for the implementation of the case study is to provide advice stakeholders about the interconnection bt energy, water and food. Another goal is to provide knowledge to adapt innovative agricultural practices to obtain resource efficiency. Water and energy are the main concerns with a focus on tourism and agriculture as key sectors of the economy.
Case study learning goals	You will learn how national policies in the domains of water management, penetration of RES to electricity production, and land use management affect each other and result in changes in food production, electricity prodution patterns to cover the increased demand, expansion of tourist season, adaptation of agricultural practices and tourist services to CC conditions.

Table 8. Latvia case study

Case study type	National
Case study leader(s) name(s)	Ingrida Bremere
Case study summary	The Latvia case study has the key focus on low-carbon development. Energy, climate, agriculture & food production, forestry, land use and water are the key nexus sectors in this case study. The main scope is to seek 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. Latvia has a high potential for renewable energy (e.g., biomass, hydro, wind, solar). Increasing use of RES rises several questions of concern e.g., harvesting of biomass puts a pressure on forestry and growing energy plants compete for land for crop 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. Solutions to increase the use of RES shall be in balance to maintain resource sustainability and ensure the economic feasibility.
Case study learning goals	The case study will help the decision makers to find justified solutions for low carbon development by assessing interlinkages, synergies and acceptable trade-offs on sustainable energy, efficient management of resources - water, land, biomass, reduction of GHG emissions unfoling the potential of economic growth.

Table 9. France-Germany case study

Case study type	Trans-boundary
Case study leader(s) name(s)	Malté Fournier
Case study summary	The case study focuses on the factors enabling or constraining transboundary governance on climate adaptation in the Rhine river basin. The main question is how to identify and decide upon pathways to achieve the below 2°C target in a balanced way. The energy transition in the Rhine region is an example at the heart of the EU new Climate Agenda (post COP21). A second research question relates to specific issues regarding the use of fibres and biomass for energy production and chemical industry, as it reduces the use of fossil fuels but potentially increases competition with land use for agricultural production and biodiversity of water species. Additional research topics concern synergies and trade-offs in policies regarding flood protection, water retention and design of natural habitats, reserves, and wetlands.
Case study learning goals	You will learn about the synergies and trade-offs in policies regarding flood protection, water retention and design of natural habitats, and wetlands on the one hand, and renewable energy policies regarding hydropower and biomass on the other hand, in the densely-populated, industrial area of the Upper Rhine.

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Table 10. Eastern Germany, Czech Republic and Slovakia case study

Case study type	Trans-boundary
Case study leader(s) name(s)	Jan Pokorny (ENKI)
Case study summary	The transboundary case study 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 study is aimed mainly at the agriculture, water and landscape management issues, soil protection, climate change mitigation, renewable energy. 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 study tries to find the answers for following questions: - 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? - 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

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Case study learning goals	You will learn about the interrelations between effects of land use on climate and water retention. Large scale drainage of landscape, supported use of biomass and wood as renewable energy result in overheating of large areas. Marked decrease of summer precipitation in areas inland of Europe can be explained by production of hot air (sensible heat) which dries the landscape and perhaps blocks atmospheric fronts from sea. Since 2015 drought in all transboundary region has increased. Water shortage affects forests and agriculture production. You will learn about land use policies that increase retention of rainwater in forested, agricultural, and urban landscapes; retention in ecosystems will lead to decrease of run-off, increase of cooling effect of evapotranspiration, decrease of sensible heat production: drained overheated fields transfer solar energy into sensible heat which drives warm air up into atmosphere together with humidity/water vapour. It is necessary to evaluate water losses caused by the transport of water vapour from overheated landscape, because they are higher than water outflow via rivers. The case study will also learn how downstream stability of flow may prevent floods and sedimentation, and water availability for irrigation in the Elbe/Labe basin. From the energy point of view the learning goal is to use extreme care in managing the resources to keep risks of grid instabilities below a certain level. It has to be understood that there are no simple solutions, because resistance against new landlines is high, a return to nuclear power supplies in Germany hardly possible, and alternative electricity production, e.g. from bioenergy, will cause problems in other sectors (landscape, climate).
	The other transboundary issue results from transfer of water from The Czech Republic to Germany through Elbe/Labe River. Slovakia is not physically connected but faces similar issues. The greater fluctuation of water supply in downstream Germany leads to seasonal flooding, as well as a shortage of water for agriculture during dry periods, lower water quality, and sedimentation in the Elbe estuary. As another transboundary energy issue is threatening stability of the electrical power grid. This issue is characteristic for our DE-CZ-SK case study, because Germany is phasing out nuclear power completely until 2022, and intermittent renewable sources (wind, solar) are constantly increasing their share in the power mix. While the Czech Republic has been net provider of electrical energy to Germany until 2011, this flux has been reversed during recent years, because Germany's renewables are reaching overcapacity on windy and sunny days. The variability of the transboundary exchange of electrical energy has been increased respectively. Given the fact that there are only two links between the grid systems of Germany and the Czech Republic and that the installation of new landlines is hampered by high costs and resistance of citizens, the risk of grid instabilities or even blackouts is rising. Our case study highlights this under the challenges of climate change which will put even more pressure to the energy sector. The learning goal is to use extreme care in managing the resources to keep risks of grid instabilities below a certain level. It has to be understood that there are no simple solutions, because resistance against new landlines is high, a return to nuclear power supplies in Germany hardly possible, and alternative electricity production, e.g. from bioenergy, will cause problems in other sectors (landscape, climate).

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Table 11. EU continental case study

Case study type	Continental
Case study leader(s) name(s)	Jason Levin-Koopman
Case study summary	The European case study includes all five aspects of the Nexus in examining the transition to a low carbon economy. The goal is not to focus solely on the energy transition itself, but also on the interactions with other elements of the Nexus. The case study will investigate how the transition will affect each sectoral policy's objectives. It will explore both the economic policy incentives to facilitate - as well as the wider economic impacts of making - the transition. The relationships between the various elements of the Nexus will be approached via both technical demands and economic linkages. Examples of technical demands are water demand for food, energy crops and hydropower, and the climate impacts on agricultural yields. Examples of economic linkages via prices for goods and resources; are the impact of climate and energy policy on land prices and how these in turn affect food prices and food accessibility.
Case study learning goals	You will learn how policies targeting a particular GHG emission reduction pathway might interact with EU policy objectives in the Nexus domains of Food, Water, Land and Energy as well as how policies in these other Nexus arenas might help to facilitate synergies or trade-offs with the transition to a low carbon future. In addition, the case study will facilitate learning about the indicators for the sustainable development goals and how these are affected by the policies ment to achieve the policy objectives in the Nexus domains at the European level.

Table 12. Global case study

Case study type	Global
Case study leader(s) name(s)	Jonathan Doelman - PBL
Case study summary	The global case study will focus on global challenges (e.g. increasing food demand) and international trade features, with policy priorities on food security, resource efficiency, low-carbon energy and climate change mitigation, water availability and vulnerability to water stress and floods, water quality, biodiversity and ecosystem services. Given the high level of integration and the low level of detail, the case study will mostly be used to identify the prevailing Nexus policy challenges, and to find broad-scale synergies and trade-offs between options in achieving various Sustainable Development Goals, and to inform about divergence, robustness and flexibility of global development pathways. The global case study is useful to provide the global context to the smaller scale case studies, and to highlight synergies and trade-off at the global scale, which are informative to the regional case studies. The main focus will be on the impact of water constraints on food security and human development as well as the impact of climate change on aggravating or relieving water problems.
Case study learning goals	You will learn how policies targeting indicators for one of the sustainable development goals impact those for other goals, in particular with respect to indicators for renewable energy, water, food security related goals as well as planetary boundaries, in a Global context.

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Table 13. Azerbaijan case study

Case study type	National
Case study leader(s) name(s)	Georgios Avgerinopoulos
Case study summary	Azerbaijan is a transition economy, heavily based on fossil fuel exports (mainly oil and natural gas). Many of the problems facing the country are not linked to one single resource system but rather to the interlinkages that occur between two or more systems. However, while there is much work on individual sectors of economy in Azerbaijan, the connections between these have been little explored in the literature. To fill this gap, this study explores different problems and opportunities in Azerbaijan's economy looking at the synergies and trade-offs between energy, water, food, land and climate, both from a bio-physical and a policy perspective. The analysis includes a desk study, a workshop with relevant stakeholders and the soft linking of three hitherto developed models, namely OSeMOSYS, MAGNET and E3ME. The modelling framework aims at providing insights into what could be the optimal policy options for all aforementioned systems when interlinkages are taken into consideration. Preliminary results of the model integration show an increase in the share of renewable energy into the power generation mix and diversification of the economy and food self-reliance.
Case study learning goals	This case study aims to understand how the different Nexus sectors affect or are affected by the transition of Azerbaijan to a low carbon pattern

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5 Common Framework

The previous section has introduced the case studies and the learning goals. For the SIM4NEXUS serious game we envision a generic game shell in which specific games for each case study can be loaded. This chapter presents the common framework, comprising the generic shell and table formats to specify the unique characteristics of the game loads for the cases studies. The first section (5.1) describes the idea of a generic shell with case specific loads. The second section (5.2) describes how the case specific loads can be characterised. Using these concepts, the third section provides a first characterization of the case studies in terms of involved actors, policy objectives and indicators.

5.1 Generic game structure

The serious games for the cases studies will be implemented in a generic shell, equipped with general facilities for user interfacing, data presentation, data base access, knowledge elicitation, and artificial agents advising the player about possible actions or playing the role of other actors in the system. As depicted in Figure 5, the generic shell can be loaded with specific cases. A case is specified by one or more missions, expressed in policy options and target values of indicators, such as greenhouse gas emissions, employment, GDP, water quality indicators, biodiversity indicators, etc.
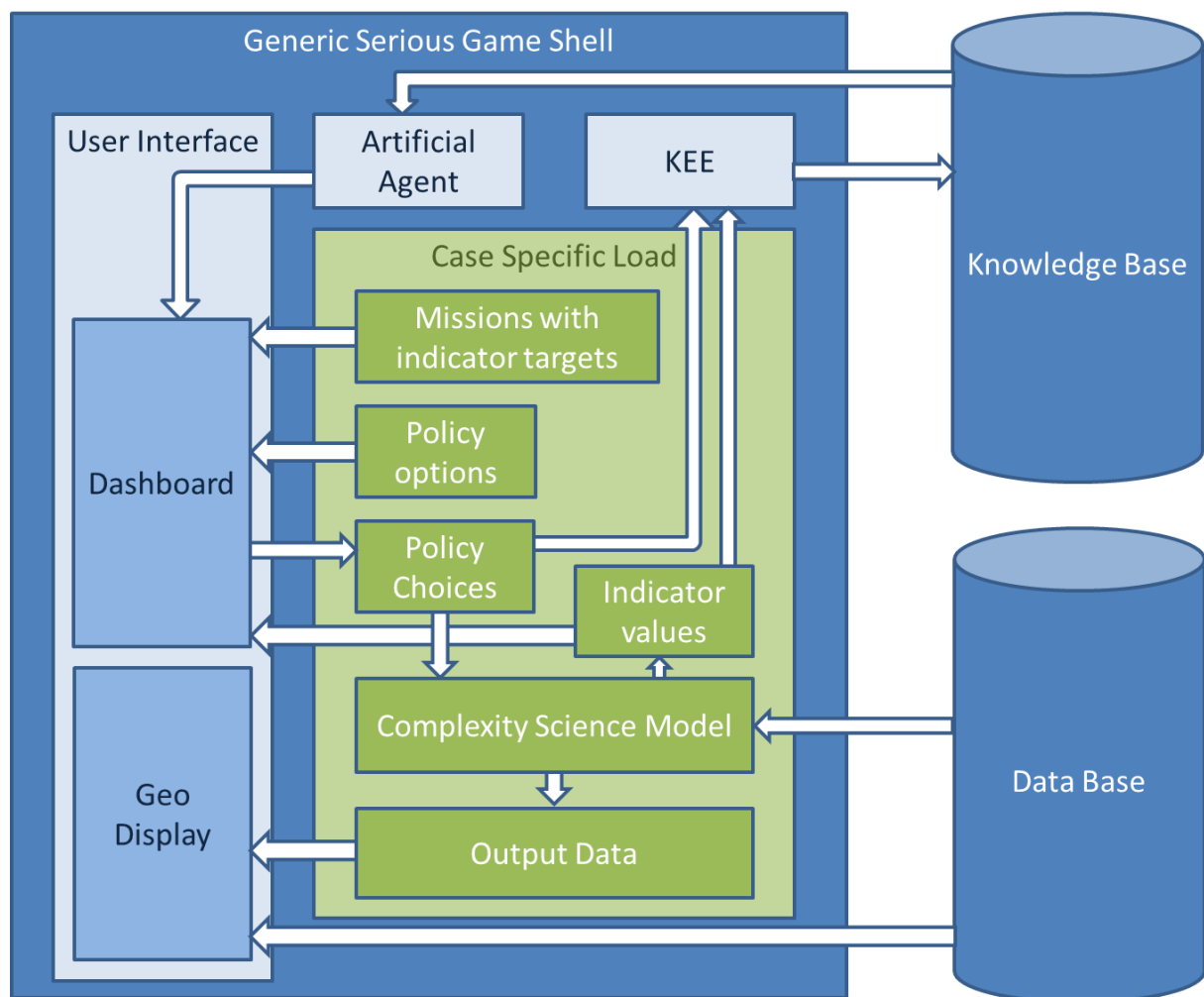
Figure 5. Relations between components of the generic game shell and specific case study load

When the generic shell is loaded with a specific case, the player is presented with a mission in terms of indicator targets, and a set of policy options, as describe in Chapter 2. The player's policy choices are input to the complexity science models (developed in WP3), which simulate the behaviour of the nexus for one period. After the indicator values and the geographic data display have been updated, the player can adjust the policy choices, and so on. In the end the players' performance in the game is assessed by comparing actual indicator values with the missions' target values.

A player can be advised by an artificial agent, using the SIM4NEXUS knowledge base. In addition to nexus knowledge from a diversity of sources, the knowledge base contains information about previous choices made by the current and other players, and the resulting evolution of the indicator values. The Knowledge Elicitation Engine (KEE) continuously records data about policy choices and resulting indicator values, and uses those observations to build an extending body of knowledge about the behaviours of players and the consequences of their actions.

5.2 Concepts to characterize specific games

As described in the previous section, the generic shell can be loaded with specifications of games for different cases. The core of a specific load is a complexity science model, developed for a particular case. The complexity science model simulates the behaviour of the nexus, based on the players' policy choices. As a result, the indicators of the system's status are updated and reported to the players. Important concepts to characterise the case specific load are the interlinkages between nexus components covered by the complexity science model, the policy options available to the players, and the indictors to assess performance. Figure 6 depicts these and other concepts which are required to specify the case specific load.
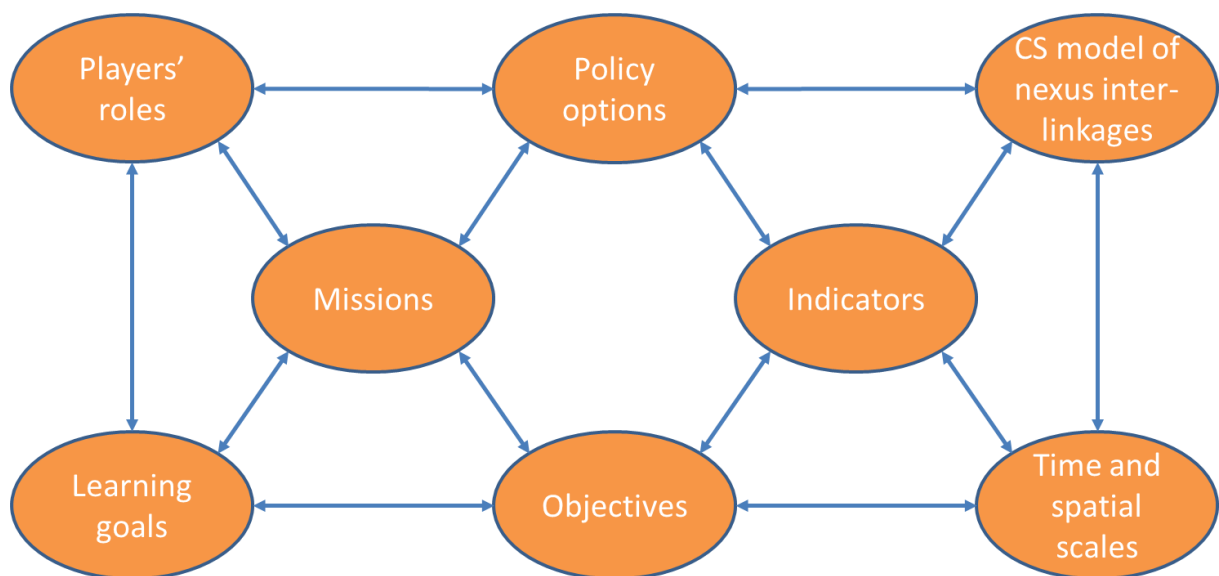
Figure 6. Concepts that specify case studies for the Serious Game

In addition to the interlinkages, policy options, and indicators, the load of a case is characterised by spatial and time scales, the players' roles, and the missions with policy objectives in terms of targeted indicator values that implement the learning goals. These aspects must be precisely specified in order to develop a game load for a case study.

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5.3 Characterization of the case study loads

This section presents a fist characterization of the case studies. The goal of this exercise is to identify the potential players of the game, to provide background for concretizing the learning goals into missions, and to identify indicators that can serve as assessment criteria. We will first compare the case studies with respect to coverage of the interlinkages, and then compare the case studies with respect to actors, policy goals, and indicators, respectively. Preliminary ideas from some case studies on policy choices to be offered to players, and the knowledge to be learnt from their decisions, is presented. The section is concluded by a discussion of the results.

5.3.1 Coverage of the interlinkages by the case studies

Based on the case study descriptions and the learning goals described in Chapter 4, and the data collected with the formats as included in Appendix A, we can compare the case studies with respect to the relevance of interlinkages between nexus components. Table 14 compares the regional and trans-border case studies with respect to the salient interlinkages. As it appears from Table 14, water management and its interlinkages with policies on the other nexus components are the main policy issue in most regional and trans-border case studies.

Table 14. Salient interlinkages for the regional and trans-border case studies

Changing component \ Affected component	Climate	Water	Food	Land use	Energy	Tourism
Climate		T:DE-CZ-SK R:Sardinia T:FR-DE R:Andalusia	R:Sardinia R:Andalusia R:SW UK			
Water	T:DE-CZ-SK		R:Sardinia R:Andalusia R:SW UK	T:DE-CZ-SK T:FR-DE R:SW UK	R:Sardinia T:FR-DE R:Andalusia	R:Sardinia
Food	R:Andalusia	R:Sardinia R:Andalusia R:SW UK		T:FR-DE R:SW UK		
Land use	T:DE-CZ-SK	T:DE-CZ-SK R:Sardinia T:FR-DE R:Andalusia R:SW UK	C:EU R:Sardinia		R:SW UK	
Energy	T:DE-CZ-SK R:Sardinia T:FR-DE R:Andalusia R:SW UK	T:DE-CZ-SK T:FR-DE R:Andalusia R:SW UK	T:FR-DE R:Andalusia	T:DE-CZ-SK T:FR-DE		
Tourism		R:Sardinia	R:Sardinia			

Legend for spatial scale: R: regional; N: national, T: trans-border; C: continental; G: Global

Table 15 compares the national, continental, and global case studies. In these case studies, the interlinkages concerning energy policy are important issues in addition to water management. For the design of the game, we may conclude that water management is the central topic for the regional and

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transboundary case studies, while for national, continental, and global cases the low-carbon economy will be the central topic setting preconditions for policy decisions in other nexus domains.

Table 15. Salient interlinkages for the national case studies

Changing component \ Affected Component	Climate	Water	Food	Land use	Energy
Climate		N:Sweden C:EU N:Latvia G:Global N:Azerbaijan N:Netherlands	N:Greece C:EU N:Latvia G:Global N:Azerbaijan	N:Greece N:Sweden N:Latvia G:Global	N:Greece N:Sweden G:Global
Water			N:Greece C:EU G:Global R:Andalusia	N:Greece C:EU N:Sweden G:Global N:Netherlands	N:Greece N:Sweden C:EU N:Latvia N:Azerbaijan
Food	C:EU G:Global	N:Greece C:EU N:Latvia G:Global N:Netherlands	C:EU	C:EU N:Latvia G:Global N:Azerbaijan	C:EU N:Latvia G:Global N:Azerbaijan
Land use	C:EU G:Global N:Azerbaijan	N:Greece N:Sweden C:EU N:Latvia G:Global N:Netherlands	C:EU N:Latvia G:Global N:Netherlands		N:Greece N:Sweden C:EU N:Latvia G:Global
Energy	N:Greece C:EU N:Latvia G:Global N:Azerbaijan N:Netherlands	N:Sweden C:EU G:Global N:Azerbaijan N:Netherlands	N:Latvia G:Global N:Netherlands	N:Greece C:EU N:Sweden N:Latvia G:Global N:Netherlands	C:EU

Legend for spatial scale: R: regional; N: national, T: trans-border; C: continental; G: Global

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5.3.2 Case studies compared with respect to involved actors

The decision making actor types in the case studies have been reviewed and updated by the case study leaders. The actor types are compared across the case studies in Table 16. Compared to the table in D4.1, an extra column has been added that groups the decision making actor in a specific type:

- Public sector
- Private sector
- NGOs
- Researchers

The case study leaders were requested to group the actor they have selected and confirmed in their update to one of the actor types. For three of the actors from the list the decision making actor type has not yet been provided. Although it seems probable that these belong to the group public sector, a question mark has been provided which will be updated a soon as the group is confirmed.

Table 16. Types of actors mentioned as decision makers by the case studies

Decision making actor	Decision making actor type	Greece	DE-CZ-SK	Sweden	EU	Sardinia	FR-DE	Latvia	Global	Azerbaijan	Andalusia	SW UK	Netherlands
International organisations (EC,UN, OECD, etc.)	Public Sector				X				X				
International river basin committee	Public Sector		X				X		X				
National ministry of environment	Public Sector	X	X					X	X	X		X	X
National ministry of agriculture/food	Public Sector	X	X					X	X	X		X	X
National ministry of planning/development	Public Sector	X	X					X					
National ministry of economy/tourism/infrastruct.	Public Sector	X						X					X
National water management authority	Public Sector	X	X						X	X		X	
National energy agency	Public Sector			X					X	X			
National forestry agency	Public Sector			X								X	
Regional ministry/agency of environment	?					X	X				X		
Regional ministry/council of agriculture	?						X				X		
Regional ministry of tourism	?					X							
Regional water en environment agency	Public Sector					X	X				X	X	
Regional energy agency	Public Sector							X			X		
Regional water management authority	Public Sector	X	X	X		X	X					X	X
Regional forestry agency	Public Sector			X								X	
Local prot authority			X				X						
Counties/municipalities	Public Sector	X	X	X			X	X				X	

Decision making actor	Decision making actor type	Greece	DE-CZ-SK	Sweden	EU	Sardinia	FR-DE	Latvia	Global	Azerbaijan	Andalusia	SW UK	Netherlands
Drinking water/sewerage companies	Private Sector		X			X		X				X	
Power companies	Private Sector	X			X	X	X	X		X		X	X
Farmers union	Private Sector	X	X		X	X		X				X	X
								(NGOs)					
Forest owners/organisations	Private Sector			X									
NGOs	NGOs	X	X	X	X		X	X				X	
								(Researchers)					
Private sector	Private Sector	X						X					X
Academic Institutions	Researchers	X						X					
Research Institutions/organisms	NGOs	X											

5.3.3 Case studies compared with respect to policy objectives

Policy goals are important attributes of the case studies. In the game design they will be used to concretize the learning goals into missions that can be evaluated with respect the player's understanding and ability to influence the Nexus, while taking different interlinked aspects (climate change, water, food, land use, and energy) into account.

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Table 17 presents the policy goals that have been reviewed and updated using the information in the case study posters on www.sim4nexus.eu and the data collected with the format described in Appendix A.

Table 17. Policy goals mentioned by the case studies

Policy goal \ Use case	Greece	DE-CZ-SK	Sweden	EU	Sardinia	FR-DE	Latvia	Global	Azerbaijan	Andalusia	SW UK	Netherlands
Sustainable development goals				X	X			X	X			
Food security	X			X	X			X	X			
Resource efficiency				X	X	X	X	X	X		X	
Low carbon economy	X		X	X	X			X	X		X	X
Energy self-supply				X			X		X			
Management of conventional energy	X	X		X					X		X	
Diversification of energy sources	X	X		X	X	X	X		X			
Renewable energy	X	X	X	X	X	X	X	X	X	X	X	
Bio-economy				X		X	X	X				
Reduce climate risks	X	X	X	X				X	X	X	X	
Flood/drought risk management	X	X		X	X	X		X			X	X
Reduce local heavy storms	X											
Reduce river flow fluctuations	X	X										
Surface and ground water quality	X		X	X		X	X		X	X	X	
Sustainable water withdrawals	X			X	X			X		X		
Biodiversity			X	X	X			X			X	
Protected nature areas				X		X		X				
Green areas (urban and forest)	X										X	
Economically healthy agricultural sector				X	X		X		X			
Sustainable forests			X	X			X					
Land use management	X					X		X			X	
Involve economic sectors in policy				X								X
Economic development				X	X		X					
Employment				X	X		X	X	X			
Improve tourist product/services	X				X						X	
Sustainble/biological food production	X			X	X		X				X	
Food/nutritional quality				X				X				
Increase water retention in landscape		X										
Soil quality improvement		X										
Landscape structure heterogeneity		X										
Improve local climate		X										
Sustainable Land use management		X										

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5.3.4 First inventory of potential indicators

Indicators measure the status of the nexus. When policy changes have been made by players, the indicator changes measure the success of their actions. In training programs the indicator values can be used as criteria to assess a player's learning.

In the case study formats according to Appendix A and in the learning goals reported in Chapter 4, many indicators are proposed (see Table 18). For the learning purposes of the game, the number of indicators must be limited. In the design of the games, a selection of indicators must probably be made, or some indicators may be combined using weight factors. For now, we have this long list, indicating potential assessment criteria that can be used in the games for the respective case studies.

Table 18. Indicators mentioned by the case studies and in the learning goals

Indicator \ Use case	Greece	DE-CZ-SK	Sweden	EU	Sardinia	FR-DE	Latvia	Global	Azerbaijan	Andalusia	SW UK	Netherlands
Population	X			X		X	X	X	X		X	
GDP	X			X	X	X	X	X	X			X
Employment (per sector, esp. agri and tourism	X			X	X			X	X			
Tourist arrivals	X				X							
Resource efficiency (GDP/resource usage)				X	X		X	X	X	X		
Energy consumption	X			X	X	X	X	X	X		X	X
Fossil fuel consumption	X	X		X	X	X	X	X	X			
Imported/exported/total energy consumption	X	X		X			X	X	X			
Renewable/total energy consumption	X	X	X	X	X	X	X	X		X	X	X
Ren./total en. consumption in transport	X		X	X			X	X				
Bioenergy production	X	X		X		X	X	X	X		X	X
Hydropower energy production	X	X	X	X	X	X	X	X	X			
Wind/solar energy production	X	X	X	X	X	X	X	X			X	X
Nuclear energy production		X	X	X		X		X		X		
Energy production/consumption in agriculture	X			X			X	X				
Power supply emissions				X			X	X	X		X	
GHG emissions	X	X	X	X	X		X	X		X	X	X
Use and capacity of CCS storage				X			X	X				X
Length of growing season	X							X				
Water demand	X			X	X	X	X	X			X	
River discharge / balanced water runoff		X		X		X	X	X			X	
Water temperature				X		X		X				
Nutrient concentrations				X		X	X	X		X		
Nutrient loads				X		X	X	X				

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Indicator \ Use case	Greece	DE-CZ-SK	Sweden	EU	Sardinia	FR-DE	Latvia	Global	Azerbaijan	Andalusia	SW UK	Netherlands
Regulation of rivers				X		X		X				
Flood risk & droughts		X			X	X		X			X	X
Heavy storm frequency												
Water retention/flooding area		X		X		X						
Evaporation from diverse landcover types	X	X			X							
Erosion/land degradation		X		X			X					
Surface and ground water quality	X		X	X			X					
Sulphur deposition			X									
Nutrient retention - water conductivity		X	X	X				X	X			
Agricultural water consumption	X			X	X		X	X				
Irrigation area	X			X	X			X				
Water balance	X	X		X	X	X	X	X		X	X	
Cropland area	X	X		X	X	X	X	X			X	
Pasture area	X	X		X	X	X	X	X				
Forest area	X	X		X			X	X			X	
Area set aside for nature				X		X	X	X				
Urban area	X	X				X	X	X				
Green urban area	X	X										
Area for biomass production	X	X		X		X	X	X				
Biomass production (photosyunthesis)		X		X		X	X	X				
Ecosystem services				X		X		X				
Biodiversity intactness/aquatic vegetation				X		X		X				
Fish species and algal blooms				X				X				
Demand agri products (food, feed, biofuel)				X		X	X	X	X			
Crop production	X			X	X	X	X	X	X			X
Livestock production	X			X		X	X	X				X
Farm income (revenue, cost)				X				X				
N, P, K balances				X				X	X			
Trade flows				X			X	X				
Food/crop prices - quantities				X			X	X				
New land												
Water and land requirements for energy	X			X		X	X	X				
Environmental indicators for forestry			X					X				
Sustainability assessment				X								
% sustainable/biological food production												

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Indicator \ Use case	Greece	DE-CZ-SK	Sweden	EU	Sardinia	FR-DE	Latvia	Global	Azerbaijan	Andalusia	SW UK	Netherlands
Food quality and nutritional value	X			X				X				
area of arable land managed by ecological farming		X										
area with intercrops		X										
area of wetlands on arable land		X										
area of landscape features		X										
surface temperature of agriculture land		X										
lenght of restored water cources, area of floodplain		X										
retention ability of forests (m3)		X										

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5.3.5 Policy options

For the first revision of this deliverable, the case studies were asked for preliminary ideas on policy options to be implemented in the game. Due to the stage of definition and stakeholder interaction, most case studies could not yet provide a good overview at the time of data collection for the report. Some case studies could already present some ideas. Table 19 presents ideas on the type of policy choices to be presented to players. Now all case studies have provided their updates for their learning goals, decision makers, policy goals, and indicators, the next update will additionally focus on the policy options, user learnings, and timeframes.

Table 19. Suggestions for policy choices to be realized in the game, for some case studies

Case study name	Policy choices/interventions available to players
European	The policy choices and interventions will be related to major EU policy initiatives related to the elements of the NEXUS (e.g. water framework directive, Natura 2000, Energy Roadmap etc…). The tools for policy interventions would be in the form of taxes (such as a carbon tax or a tax on meat consumption), subsidies (such as subsidies for renewable energies, organic farming etc…) and regulations (such as restrictions on land, fertilizer and water use).
Sweden	- Subsidies for different types of renewable energy production (biogas, biofuel from forest biomass, hydropower, etc.) - Taxes on different types of energy (e.g. biofuel from biomass) - Regulations regarding groundwater abstraction - Regulations regarding felling rates
Latvia	We would wish to include the existing support mechanisms operated in Latvia: feed-in tariffs for electricity, net-metering, VAT tax allowance on the supply of biomass and biogas, biofuels (info source: www.res-legal.eu/search-by-country/latvia/)
Greece	- Subsidies - Funding opportunities - Taxes - Policy goals - Policy means (to achieve the respective goals) - Business opportunities

5.3.6 Learning from player's decisions

One purpose of the game is to learn from policy choices made by players. The Knowledge Elicitation Engine (KEE) is to facilitate this learning. For the first revision of the present deliverable, the case studies were asked what to learn from players' choices in the game. As for the policy options, most case studies could not yet provide a good overview at the time of data collection for this report. Some case studies could already present some preliminary ideas. Table 20 presents ideas on learning from players' actions.

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Table 20. Suggestions for learning from players' actions

Case study name	What to learn about the decisions
European	It is currently envisioned that the players of the game would be staff at NGOs and EU policy departments that would typically be focused solely on their single element of the NEXUS. The hope it that this game would facilitate a common understanding on the importance of coherent EU NEXUS policy. The knowledge we would hope to elicit from them when they play the game would be - How narrow is their current focus? Are they just looking for solutions for their area of the nexus in a zero sum game type of thinking or are they also looking for solutions that involve synergies between nexus areas? Are they aware of the effects of policy in their nexus area would have on other areas in the nexus? - Do their strategies change during game play? How do they respond to threats to their area of the nexus after some experience in the game? Do they actively look for synergistic solutions? Do they understand the importance of the other elements of the nexus? Do they understand the impact of policy in other elements of the nexus on their own nexus element? And the other way around; do they understand the impact of policy in their element of the nexus on the other nexus elements.
Sweden	- Which sector is prioritized by players (e.g. forest versus water)? - To what extent can players be influenced by information about previous choices made by other players?
Latvia	We would like to learn on players choices with regard: - Use of imported fuel/electricity import versus local production from RES e.g., biomass. - Many small energy generation installations versus 1 large scale installation; - Centralised electricity production versus decentralised electricity production in small scale CHP on biomass, biogas or from wind or solar power. - Export of biomass/biofuels versus promotion of local use.
Greece	- Strategic-future plans of players - Preferences of players - Priorities of players - Investment options of players - Issues that the players change after the 'inspection' of the consequences - How they change their future plans with respect to the consequences - Possible alternative future solutions / scenarios of players

5.3.7 Discussion of the results

In the work presented in this chapter we have identified commonalities and differences across the case studies. This information is useful for the design of the generic game shell and the specific game loads for the case studies. Table 18 identifies potential assessment criteria. Actual indicators and assessment criteria to be used, must be specified in the next steps of the game design.

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Tables to compare policy options and time scales and time/spatial resolution across the use cases must still be composed. This will be the focus of the next round of updates. An assessment template has already been provided to the case study leaders.

Furthermore, the information presented in this chapter represents a snapshot of the current state of case study design. The data may require updating in the course of the project, which makes this report a "living document".

In Table 21 the elements for updating the learning goals have been listed and their status in different updates of the deliverables is represented.

Table 21. Progress of the capturing of game aspect inputs from the case studies

Game aspect	D4.1	D4.8	D4.9
Case study summary	First recording	Reviewed and updated	Reviewed and updated
Case study learning goals	First recording	Reviewed and updated	Reviewed and updated
Salient interlinkages	First recording	Reviewed and updated	Reviewed and updated
Decision makers	First recording	Reviewed and updated	Reviewed and updated
Policy goals	First recording	Reviewed and updated	Reviewed and updated
Indicators	First recording	Reviewed and updated	Reviewed and updated
Policy options	Structure supplied	Update started	Reviewed and updated
Learning by playing	Structure supplied	Update started	Reviewed and updated

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6 Conclusions and recommendations

A reviewed and updated version of the learning goals has been provided in this report in Chapter 4, considering every particular and specific characteristics of each case study at this stage of the project. As mentioned in previous sections, this report has to be considered as a living document which will evolve along project execution, iterating learning goals definition, to better fit case studies' necessities while maximising project results and impact.

However, this report goes far beyond this specific objective. In Chapter 2, the general principles of the serious game have been repeated to maintain a common understanding of potential roles of the game in training and policy processes, making case study leaders and other relevant involved actors understand which the capabilities of a serious game tool are, and leading to a better definition of the learning goals.

In addition, in Chapter 3, a methodology to review and update the learning goals has been defined. This approach has been used to support this report, and will also be used in future iterations as the project gains insights on each case study. Thanks to this methodology, of which its basis had already been introduced in deliverable 4.1, a comprehensive and precise analysis has been carried out in a set of guided steps for information collection and learning goals definition. More concretely, this has helped: (i) the case study leaders and other involved actors to better explain their needs and objectives, (ii) the collection of requirements in a common framework, (iii) a collaborative discussion and evolution of requirements, decisions, and objectives, and finally, (iv) the definition of the learning goals.

A framework to fit the different terms in a common manner has been defined in Chapter 5, which is linked to the methodology. The common framework includes the case studies definitions, together with their indicators, interlinkages, time and spatial scales, objectives, and also relates this entities with their respective missions, roles and learning goals in the Serious Game.

In conclusion, great efforts have been devoted at this stage of the project to fulfil the task objectives (Task 4.1), not just for the report per se, but because of the high complexity of the task, i.e., understanding all the case studies, entities, relations and restrictions. The methodology used has covered successfully the necessities for this tasks, and therefore, it will continue being the basis for any future iterations of this report. Next steps will rely on more results coming from other Work Packages, interviews, and other sources, which are expected to bring more precise information. Accordingly, more concrete learning goals will be able to be defined, tailored to each case study, and maximising impact.