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

NEXUS POLICY IMPROVEMENTS

DELIVERABLE 2.4 : EXECUTIVE SUMMARY OF NEXUS-RELEVANT POLICIES AND RECOMMENDATIONS FOR POLICY IMPROVEMENTS

LEAD AUTHOR: Trond Selnes WUR-LEI

OTHER MAIN AUTHORS: Robert Oakes UNU, Maria Witmer PBL.
OTHER AUTHORS:
Georgios Avgerinopoulos, Marek Baxa, Maria Blanco, Malgorzata Blicharska, Ingrida Bremere, Javier Castaño, Bente Castro, Camille Chanard, Tobias Conradt, José Costa-Saura, Thomas Désaunay, Maïté Fournier , Michal Gažovič ,Matthew Griffey, Anaïs Hanus, Petra Hesslerová, Chris Hodel, Nicola Hole, Daina Indriksone, Jaroslav Karahuta, Gitta Köllner, Martin Kováč, Michal Kravčík, Lenka Kröpfelová, Gavril Kyriakakys, Chrysi Laspidou, Vincent Linderhof, Fabio Madau, Roos Marinissen, Pilar Martinez, Verena Mattheiß, Lottie McKnight, Simone Mereu, Catherine Mitchell, Loudes Morillas, Anar Nuriyev, Chrysaida-Aliki Papadopoulou, Maria. P Papadopoulou, Camille Parrod, Carolyn Petersen, Jan Pokorný, Daniele Pulino, Ornella Puschiasis, Alexandra Rossi, Trond Selnes, Julie Smith, Vania Statzu, Elisabetta Strazzera, Pierre Strosser, Maya Taselaar, Claudia Teutschbein, Antonio Trabucco, Ben Ward, Stefania Munaretto

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement NO 689150 SIM4NEXUS

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.2.4 EXECUTIVE SUMMARY OF NEXUS-RELEVANT POLICIES AND RECOMMENDATIONS FOR POLICY IMPROVEMENTS
WP NAME/WP NUMBER	Policy analysis and the nexus / WP 2
TASK	T2.4
VERSION	24 May 2019
DISSEMINATION LEVEL	Public
DATE	31/05/2019
LEAD BENEFICIARY	WUR-LEI
RESPONSIBLE AUTHOR	Trond Selnes WUR-LEI
ESTIMATED WORK EFFORT	6 person-months
MAIN AUTHOR(S)	Trond Selnes (WUR-LEI), Maria Witmer (PBL), Robert Oakes (UNU),
ESTIMATED WORK EFFORT FOR EACH CONTRIBUTOR	TS (3), MW (2), RO (1) (person-months)
INTERNAL REVIEWER	Vincent Linderhof

DOCUMENT HISTORY

VERSION	INITIALS/NAME	DATE	COMMENTS-DESCRIPTION OF ACTIONS
1	TS	7 FEB	DRAFT SET-UP
2	TS	19 FEB	DRAFT REVIEW FLOOR BROUWER
3	TS	28 FEB	PROJECT TEAM
4	TS	22 MAY	REVIEW
5	TS	31 MAY	FINAL

Table of Contents

Executive summary

The objective here is to identify improvements to the governing of s current policy problems for water, land, energy, food and climate (WLEFC). We conclude the following:

1. Much attention to energy and climate but this comes with negative effects on water, land and food The objectives are rather coherent but in the implementation stage there are incoherencies.

2. More synergies than conflicts on objectives - synergy or conflicts depend largely on the way policies are implemented. There are conflicts regarding biofuel production, hydro - energy production, agricultural competitiveness, CCS technology and competing claims on scarce water and land.

3. Implementation vulnerable to conflicting interests rooted in a dominance of the short-term economy: often there are less priority to environmental issues and soil quality.

4. Success factors identified build on more democratic science, participation and support. We identified fifteen success factors. 1. A strong scientific baseline; 2. Scenario building for increased awareness; 3. Plan for adaptability and allow policy revisions; 4. stakeholder involvement; 5. Dynamic knowledge sharing and capacity building; 6. A fair distribution of costs and benefits and equal opportunity to participate; 7. Ownership to increase engagement and sustainability; 8. Political and social willingness to change and facilitate the implementation; 9. Public awareness for increased acceptability; 10. Common understanding and vision; 11. Legitimacy (avoid empty promises); 12. Clear guidelines and measurable targets; 13. Monitoring for a shared understanding and building trust; 14. A scale-matching governance; 15. Build long-term support (enduring access to resources).

We recommend:
1. Compare and share insights on conflicting regulations and facilitate conflict resolutions and opportunities offered by synergy (joint benefits were possible). All the major institutions should engage in this work, the European Commission, the European Parliament, the Member States, regions, non-governmental organizations, business community, knowledge organizations and citizens should engage in joint initiatives.

2. Celebrate the small wins & facilitate the spreading of success: More work is needed on making policy work. Success should be better spread out and scaled up. Demonstrate how progress can be achieved with mutual gains, seemingly minor progress can be essential

3. Regulatory renewal based on a positive framing. The work on regulatory renewal of the EU and MS should be continued based on the success factors All the sectors of water, land, energy, food and climate should be engaged in sector-crossing work with a broad foundation in society, based on sharing, joint awareness, recognized ownerships of problems and legitimate rule. This is a multi-level and multi-actor message to all the involved: the United Nations, (SDGs and climate); the EC and MS.

4. Nexus compliant EU policy making: enrich the policy assessment tools by engaging WLEFC sectors. Assessments tools can then be very useful for more integrating planning. Circular and low-carbon economy might serve as binding issues across the EU DGs, the national and regional governments and a broad range of non-governmental parties.

Changes with respect to the DoA

No changes with respect to the DoA.

Dissemination and uptake

The report is targeted at the general public, policy makers and stakeholders at global, European, national and regional scale, researchers inside and outside SIM4NEXUS, students.

Short Summary of results (<250 words)

The objective here is to identify improvements for governing water, land, energy, food and climate (WLEFC). Today much attention to energy and climate. This comes with negative effects on water, land and food. Incoherency is mainly found in the implementation stage where it often is vulnerable to conflicting interests and incoherent regulations. Success is seen as more democratic science, participation and support. We recommend to 1. Compare and share insights on conflicting regulations and facilitate conflict resolutions and opportunities offered by synergy (joint benefits were possible). All the major institutions should engage in this work, the European Commission, the European Parliament, the Member States, regions, non-governmental organizations, business community, knowledge organizations and citizens should engage in joint initiatives. 2. Celebrate the small wins & facilitate the spreading and upscaling of success, with emphasis on mutual gains and how seemingly minor progress can be essential for triggering change. 3. Base regulatory renewal on a positive framing. Focus on benefits for all sectors: water, land, energy, food and climate. Engaging these in sector-crossing work, with a broad societal foundation, based on sharing, joint awareness, recognized ownerships of problems and legitimate rule. This is a message to all: the United Nations, (SDGs and climate); the EC and MS. 4. Support a nexus compliant EU policy making by enriching the policy assessment tools by engaging WLEFC sectors for more integrating planning. Circular and low-carbon economy might serve as binding issues across the EU DGs, national and regional governments and non-governmental parties.

Evidence of accomplishment

This report was published as weblink at the SIM4NEXUS.

Glossary / Acronyms

Acronyms

CAP	Common Agricultural Policy
CCS	Carbon Capture and Storage
DG	Directorate General
EC	European Commission
EU ETS	European Emission Trading System
EU	European Union
FAO	Food and Agriculture Organization
GHG	Green House Gas
WRM	I Integrated Water Resource Management
MS	Member State
NCO	Nexus Critical Objective
NCS	Nexus Critical System
OECD	Organisation for Economic Co-operation and Development
RES	Renewable Energy Systems
SDG	Sustainable Development Goal
UN	United Nations
UNFCCC	United Nation Framework Convention on Climate Change
WEF	Water-Energy-Food
WFD	Water Framework Directive
WLEFC	Water-Land-Energy-Food-Climate

Glossary

NEXUS	An interconnected biophysical and socio-economic system of several interdependent sectors and each sector is equally important and addressed.
NEXUS APPROACH	A way of governance that equally addresses the interests of different sectors involved and that takes the biophysical, socioeconomic and governance connections between the sectors into consideration.
NEXUS DOMAINS	Water, land, energy, food, climate
POLICY OUTPUT	Direct result of a policy-making process, for example a plan with goals and objectives, implementation programme and instruments such as laws, levies, education programmes.
POLICY DOMAIN	Policies for water, land, energy, food, climate
POLICY IMPACT	Changes in society, economy, governance, environment, brought about by policy output. Impact always starts with changing behaviour of people.
POLICY-MAKING PROCESS	The process that leads to the policy output: the problem definition, decision-making about goals, objectives, implementation pathway and instruments.
POLICY CYCLE	The cyclic process of policy-making and revision of a policy: problem definition, decision-making about goals, objectives, implementation pathway and instruments, the implementation itself, monitoring and evaluation, back to problem definition.

SUCCESSFUL WLEFC NEXUS POLICY OUTPUT	WLEFC nexus policy output is successful if goals of all sectors involved in the WLEFC nexus, implementation pathway and instruments were defined in a transparent way, while maximising synergies between policies and instruments, and managing conflicts and trade-offs at bio-physical, socio-economic, and governance level.
SUCCESSFUL WLEFC NEXUS POLICY-MAKING PROCESS	A policy-making process that is fair and transparent, equally respects interests of all stakeholders involved from the WLEFC sectors and leads to successful policy output and impact. Decisions are made well-informed about WLEFC nexus relations and interdependencies.
SUCCESSFUL WLEFC NEXUS POLICY IMPACT	Changes in society, economy, governance, environment, caused by the policy, that lead to reaching the agreed WLEFC goals effectively, efficiently and sustainably.
WLEFC 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.
WLEFC NEXUS	The interconnected biophysical and socio-economic system of the water, land, energy, agriculture/food, climate (WLEFC) sectors and each sector is equally important and addressed.

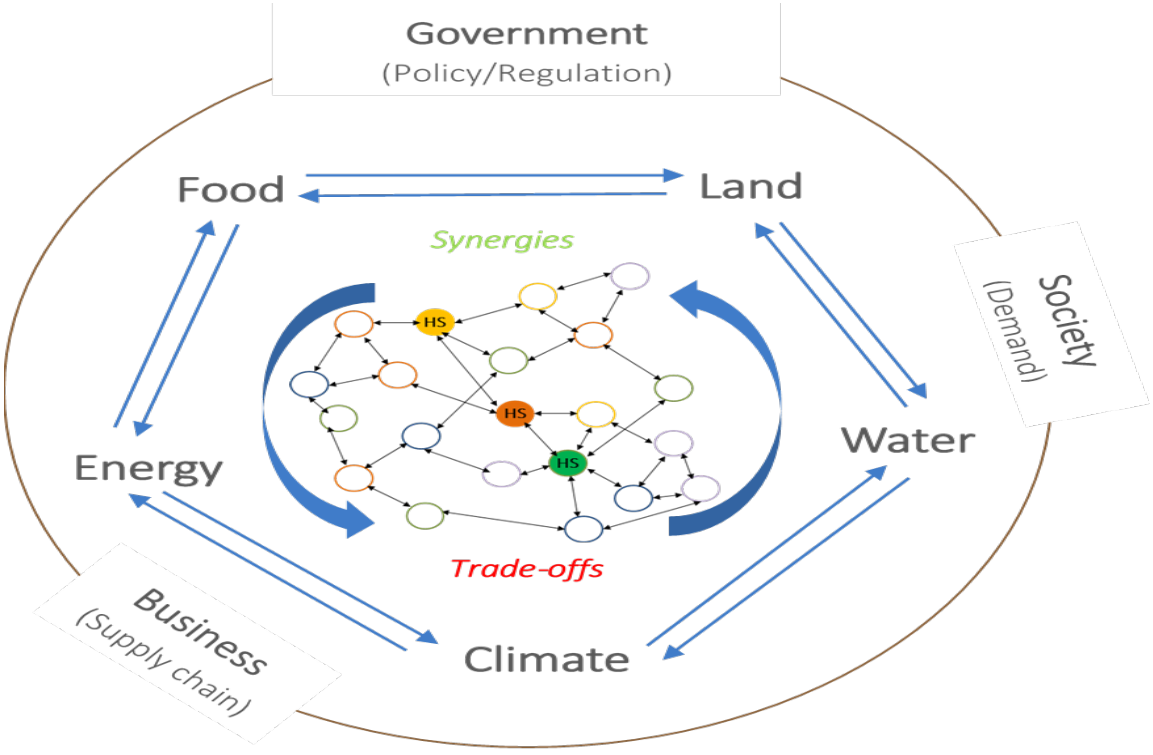
1 Introduction

1.1 Context

Achieving both the Paris Agreement on climate and the Sustainable Development Goals (SDGs) is an ambitious endeavour that requires coherent policies. Domains such as water, land, energy, food and climate (the 'WLEFC Nexus') are connected to each other in complex ways and pressure on one part of the Nexus may create pressure on the others and cause major challenges for polities and societies (Brouwer et al 2018; Zhang et al 2018, Hoff, 2011). In this context, the Nexus is a conceptual approach to policy that emphasizes the sectoral and scalar interconnected nature of many domains. In the horizon2020 project SIM4NEXUS, the domains are water, land, energy, food and climate (Figure 1.1). This concept is appropriate because the interlinked nature of the challenges calls for an approach that integrates management and governance across sectors and scales (Hoff, 2011). In this manner, a nexus approach can support "the transition to a Green Economy, which aims, among other things, at resource use efficiency and greater policy coherence." (Hoff, 2011). More specifically, a focus on the interconnectedness and interdependencies across scales and sectors might help reduce negative economic, social and environmental externalities by more efficient resource use, provide dynamic benefits and secure the human rights to water and food (Hoff, 2011). This means that in contrast to conventional policy and decision-making which can take place in silos, a nexus approach aims to reduce trade-offs and build synergies across sectors and scales.

Climate goals are also part of the SDGs, namely SDG13 Climate Action. In general, each nexus domain within SIM4NEXUS relates to one or more SDGs: food relates to Zero Hunger (SDG2), water to Clean Water and Sanitation (SDG6), Affordable and Clean Energy (SDG7), Climate Climate Action (SDG13) and Land to Responsible Production and Consumption (SDG12).

Figure 1.1 WLEFC nexus framework in the SIM4NEXUS project (adapted from Mohtar and Daher, 2016). HS = hotspot of nexus relations.



1.2 Objective and research questions

The Horizon2020 project SIM4NEXUS acknowledges the interdependency and complexity of the WLEFC Nexus. It runs till May 2020 and focuses on identifying and analysing the interconnectedness, the (in)consistency and (in)coherency in policy between the WLEFC Nexus domains. It identifies solutions to the problems at hand.
This report is part of the SIM4NEXUS policy analysis that investigates policy coherence for the Nexus at different scales and different phases of planning and implementation. It aims to provide a better understanding of how the Nexus-relevant and related policies work. The objectives of the policy analysis are:

- Identify and review the critical policy areas relevant to the Nexus across scales, considering near- and long-term policy initiatives and objectives;
- Analyse interactions, coherence or conflicts between policies and identify trade-offs. This will consider how 'nexus-compliant' current policies are. The policy analysis provides increased understanding of how water management, food and biodiversity policies are linked together and to climate and sustainability goals;
- Provide recommendations on these policies especially for removal of implementation barriers; and
- Develop systemic, integrated strategies and approaches towards a resource efficient and low carbon Europe.

The objective of this report is to identify improvements to the governing of the Nexus. The assessment of improvements are our own expert judgements using the reports from the case studies. For this purpose, we offer insights in horizontal and vertical coherence between the Nexus domains and administrative scales, the variety of national and regional tailor-made solutions, considering factors that foster coherence and avoids gaps, ambiguities and inconsistencies which hamper coherence.
More in detail the objectives are to identify:
1) horizontal interactions between sectors, 2) the variety of national and regional tailor-made solutions to nexus-problems, and 3) regulatory gaps, ambiguities and inconsistencies in order to asses where improvements can be made to governing the nexus and its elements in a more holistic, integrated manner. The information gathered to this point has been synthesised and rationalised.

Based on these objectives, the main research question of this analysis is:

Which improvements can be made to governing the Nexus in a more holistic, integrated manner?

Three sub research questions are included to answer the overriding research question:

1. How do horizontal and vertical interactions between sectors influence the governing of the Nexus? (Chapter 2)
2. What are the regulatory gaps and inconsistencies where governance can be improved? (Chapter 3)
3. Which national and regional tailor-made solutions exist to the Nexus challenges and which success factors can be identified? (Chapter 4)
4. Which improvements for the WLEFC nexus governance are recommended? (Chapter 5)

The prime sources for this report are the results of previous analyses in the project SIM4NEXUS (Munaretto et al, 2017; Munaretto et al, 2018; Witmer, et al 2018). These analyses focused on respectively:

1. coherent goals and policy means at global and European scales,
2. policy coherence at regional, national and transboundary scales, and interdisciplinary policy arrangements among nexus sectors (case based), and
3. Nexus policy success stories focussing on the policy making process and implementation.

2 Horizontal and vertical policy coherence

Key messages

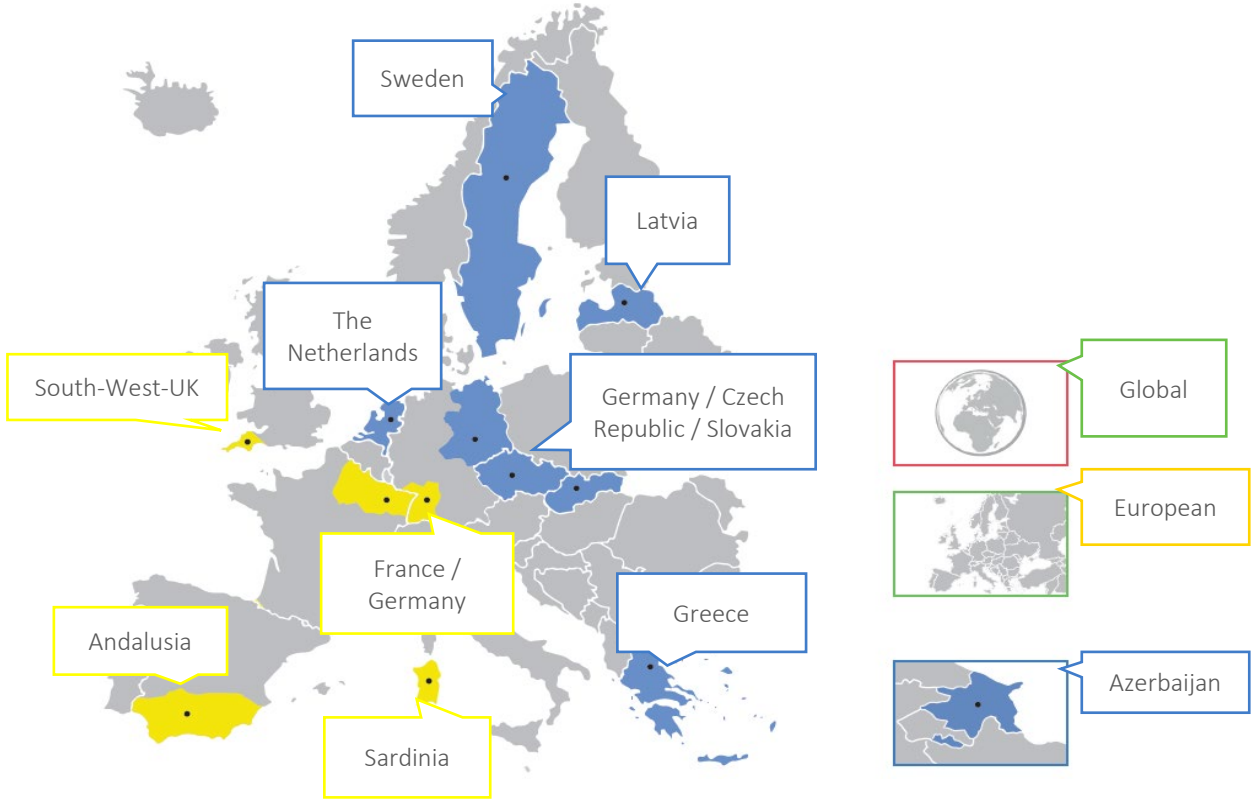
- The translation of global policies for water, land, energy, food and climate (WLEFC) into European policies and national policies of member states is currently focusing on energy and climate, with potential negative impacts on water, land and food production.
- Impacts on land caused by renewable energy production are better addressed and more strictly regulated in UNFCCC and EU policies than impacts on water.
- European policies for WLEFC have been fully integrated into national policies of the cases. The main factors that hinder implementation of these policies are: horizontal incoherence of EU policies causing conflicts in implementation; unequal progress of policies and implementation between member states leading to different needs for support from EU policies; conflicts between socioeconomic and environmental interests; incoherence in regulations between scales; overregulation.
- More synergies than conflicts exist between European and national policy objectives for water, land, energy, food and climate. However, some policy objectives have a risk of causing conflicts with most other objectives. These are: 'Increase biofuel production', 'Increase hydro-energy production', 'Improve competitiveness of the agricultural sector' and 'Support the development and uptake of safe CCS technology'. These conflicts are only partly addressed in the current and proposed EU policies.
- Synergy or incoherence between policies become manifest when objectives and measures are detailed and implemented in practice. Policy coherence issues concentrate around a limited number of 'nodes' within the WLEFC nexus:
  - The policy objectives 'Resource and energy efficiency' and 'Good practices in land and water management including nature-based solutions' are beneficial for the whole nexus.
  - Competing claims on scarce water and land are inherently conflicting and thus need a political choice.
  - For the objectives 'Improve the competitiveness of agriculture', 'Water supply' and 'Combatting droughts and floods', synergy or conflicts depend on the way policies are implemented. Nature-based solutions offer the best opportunities for synergy.

2.1 Introduction

In this Chapter, we describe the horizontal and vertical policy coherence in the nexus between water, land, energy, food and climate at global, European, national, regional and transboundary scales. We focus on how global policy is translated into European and national policy, and European policy into national and regional policy. Also, horizontal coherence was explored for European, national, regional as well as transboundary policies. Information was delivered by twelve case studies ranging from regional to global scale (Figure 2.1).

The analysis of policy coherence focused on policy objectives and instruments described in policy documents, not on the policy-making process that lead to these objectives and instruments. The policy-making process in a nexus approach is described in Chapter 4.

Figure 2.1. The twelve SIM4NEXUS case studies ranging from regional to global scale.



2.2 Critical policy areas for the WLEFC nexus

SIM4NEXUS is analysing the nexus between water, land, energy, food and climate (WLEFC). Many policy areas influence this nexus, as described in Tables 2.1 and 2.2. Only the coherence between policies specifically aiming at the five nexus sectors of SIM4NEXUS was investigated (Table 2.1), not the coherence with external policies (Table 2.2). The external policies are described because they are important drivers that change the nexus, for example economy and investment, or are closely related to the nexus, for example biodiversity and regional policy. This list of external policies influencing the nexus is not exhaustive. Depending on the issues at stake, these external policy areas must be considered in an analysis of the WLEFC nexus.

Table 2.1 Policy areas within the WLEFC nexus at EU and Global level

WLEFC-nexus domain	Policy domains
Water	**EU** Ecological and chemical water quality Emissions to surface water and groundwater Wastewater collection and treatment International agreements and protected areas Surface water and groundwater quantity, water supply and combatting drought Sustainable water use, efficiency and re-use Drinking water supply and quality Flood risks and climate change adaptation **International**

WLEFC-nexus domain	Policy domains
	Water management, incl. water availability, water quality, water scarcity Drinking water and water related health Transboundary waters Sustainable water use and water efficiency Sanitation, wastewater treatment and re-use Freshwater ecosystems, including benefit sharing Flood risks and climate change adaptation
Land	**EU** Sustainable land use including indirect land use change (ILUC) REDD+ Soil protection and sustainable use Forest management, including timber **International** Desertification Management of forests, including timber
Energy	**EU** Renewable sources of energy Energy efficiency Internal energy market and competitiveness Energy supply security Innovation and technology Energy poverty
Food and agriculture	**EU** Farmer's income Food production and security Natural resources and climate action Territorial development and regional funds Food supply chain, incl. food waste, consumption and food-related health **International** Food security Sustainable food consumption and production incl. food waste Food market and trade Climate change mitigation and adaptation
Climate	**EU** Greenhouse gas emissions in ETS sectors Greenhouse gas emissions in non-ETS sectors Low-carbon technology, including CCS Land use, including forestry and agriculture Climate change adaptation **International** Temperature rise and greenhouse gas emissions Financing Technology Capacity building Climate change adaptation

Table 2.2 Policy areas outside the WLEFC nexus that are relevant for the nexus.

Policy domain	Relevance for WLEFC nexus
Economy including circular economy and waste	Water, land, energy are key production factors and food is a key economic sector. Climate change has been and will be caused by production and consumption. Strategies and approaches towards a resource efficient and low carbon economy can only be investigated in the context of existing and planned policies for the economy.
Investment and financing	Several WLEFC policies mention steering of financial flows at all levels of investment in private and public sectors as key factor to reach a shift towards sustainability goals. There are policies and guidelines for investments by multinationals, banks and funds to meet sustainability criteria. How do these take WLEFC linkages into account? The shift towards a resource efficient and low carbon economy needs investment in research, innovation and upscaling of alternatives to replace existing practices.
Innovation and research	In all WLEFC domains and in the total WLEFC nexus, innovation and research play a key role to move on to goals.
Ecosystems, biodiversity, nature and forestry	Ecosystems are closely related to water, land, agriculture and climate. Nature and forests buffer floods and droughts, forests are a source of biomass but also compete for land with energy crops.
Environment	Water and land are part of the broader environment. Environmental policies address WLEFC issues, for example policies for resource efficiency and waste, natural resources, emissions to water, air and soil.
Air quality	Nitrogen deposition pollutes land, water and ecosystems. Production of energy and food may emit other pollutants than greenhouse gases; policies to increase production efficiency and reduce GHG-emissions may also reduce emissions of these other pollutants into the air.
Regional EU policies and funds	WLEFC policies are implemented in regions. Here all WLEFC policies come together in one area and here potential conflicts and synergies are encountered in practice.
Development	The water-energy-food nexus approach is often applied in development policy. Policy coherence is a prominent issue for the implementation of the SDGs that can be considered as the ultimate nexus approach.
Risk and vulnerability	Risk policies are relevant to address the consequences of climate change for the other WLEFC domains. Prevention, preparedness and response to risks in the WLEFC domains should take interlinkages between domains into account to be effective.
Trade	International trade barriers and protectionism may hinder the distribution of technologies and undermine investments in and uptake of new technologies.

2.3 Policy coherence in the WLEFC nexus

2.3.1 What is policy coherence?

Policy coherence is defined as the result of systematic efforts to reduce conflict and promote synergy within and between individual policy areas at various administrative and spatial scales. The

investigation of policy in the SIM4NEXUS project focuses on the analysis of the coherence between policy objectives and instruments related to water, land, energy, food and climate.

Policy synergy is achieved when the combined efforts of two or more policies accomplish more than the sum of the separate results from each policy. Policies, thus, reinforce each other. For example, the combination of investment in research and innovative pilot projects with a legal emission target may boost innovation and the uptake of new clean technologies, whereas investments without a legal target or a target without related investments would not be as effective.

Policy conflict arises when the goals and instruments of one policy impede those of another. 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. This choice requires political compromise, such as revision of objectives that have become unfeasible, spatial segmentation of conflicting activities, mitigating negative impacts of the dominant policy on other interests, implementation strategies that minimise trade-offs, and compensation for the injured parties. For these choices to be made, first of all, conflicts between policies need to be identified and analysed. Coherent policy does not mean the absence of conflict, but rather refers to a policy that finds solutions for any conflicts, in a transparent way.

Vertical policy coherence implies that higher level policy at International, European or national scales supports lower level policy at national, regional and local scales, and vice versa, lower level policy supports higher level goals, implements policy instruments and takes measures to reach the higher-level goals.

Horizontal policy coherence between selected EU, national and regional policy objectives for water, land, energy, food and climate was scored using the typology of interactions developed by Nilsson et al. (2012, 2016a, 2016b). The scoring was applied to direct interactions between two objectives in both ways, objective x influencing objective y and vice versa. In a nexus, interactions between objectives and instruments are multiple, direct and indirect with feedback loops. It is too complicated to add a coherence score to these multiple interactions in complex systems without applying modelling.

Coherence between policy objectives described in policy documents is not a guarantee for coherence in practice. This depends on how the policy is implemented and the context. For example, the CAP contains environmental objectives that are coherent with objectives for water, land, energy and climate, but economic motives may be more powerful in practice and prevent that the environmental objectives are reached.

2.3.2 Vertical policy coherence in the WLEFC nexus

UNFCCC dominates over SDGs

All national cases reported the implementation of global climate policy into their national policy, but only one mentioned the implementation of the Sustainable Development Goals. Also, all ten national and regional cases mentioned a dominance of energy and climate policy that gets more priority than policy for water, land and in some cases agriculture. There is an incoherence between international water and climate policies, that also manifests itself at European level (Munaretto and Witmer, 2017). The objective 'Fully consider water and ecosystem footprints of alternative climate change mitigation measures' in the UNEP Operational strategy for fresh water 2012–2016 (UNEP, 2012), has not been incorporated in UNFCCC climate policies, nor in EU energy and climate policies. EU policy on renewable energy does request reporting of effects on water caused by bio-energy production, but on a voluntary basis. Potential effects on land and terrestrial ecosystems are regulated more strictly and in more detail.

European WLEFC policy integrated in national and regional policy

All ten national and regional SIM4NEXUS cases reported that EU policies for water, land, energy, agriculture and food, and climate were fully integrated into policy documents at national and regional scale and supported their policy making. An exception is mentioned by the Czech Republic. The European Landscape Convention, adopted in the year 2000 by the Council of Europe, has only been partly implemented in the Czech national Agricultural Land Protection, while full implementation would support national and regional landscape restoration.
However, this does not necessarily translate into full implementation in practice. Several factors may hinder the implementation both of EU into national policy and national into regional policy. Most of these issues concern interactions between administrative levels within countries but inevitably, these domestic problems also affect the implementation of EU policies (Table 2.3).

Regulatory gaps and inconsistencies that cause vertical or horizontal incoherence between policies are described in more detail in Chapter 3.

Table 2.3 Factors hindering vertical coherence in policy implementation

Administra-tive scale	Vertical coherence issue	Nexus sectors affected	Examples from case studies
EU-national	Implementation of EU directives requires major adjustments of national policy frameworks and infrastructure	Energy	Latvia - The transposition of the EU directive on the promotion of production and use of alternative fuels (2014/94/EU) requires significant, time consuming policy and infrastructure adjustments.
	National measures insufficient or unsuitable to achieve EU targets	Energy	Latvia – Current measures to increase the use of renewables and energy efficiency are insufficient to achieve the EU targets. Latvia – Design and application of national economic incentives for natural gas in cogeneration do not promote energy production from renewable energy sources, thus making it difficult to achieve the EU renewable energy targets. Germany - Measures taken are not sufficient to reach the EU energy targets within the expected time frame.
	EU energy policy causes conflicts with environmental policy at lower scale	Energy Nature conservation Water Forestry	Sweden – Conflict between Habitat and Birds Directives and bio-energy production targets from forests. Czech Rep. - National financial support to the production of energy crops hampers the achievement of EU good water quality objective.
	Conflicts between socio-economic and environmental interests	Forestry Rural economy Agriculture	Netherlands and Latvia - Nature conservation in Natura 2000 is at odds with local economic development. Latvia – National social, economic, and EU driven environmental objectives in forest management can be conflicting, need for better management of trade-offs in forestry management plans. Germany - Water objectives collide with the interests of other sectors, particularly agriculture.
	Partial or limited support to national regulation by EU policy because: - it is not an EU policy domain; -EU policy put on hold;	Energy Agriculture Livestock Soil Landscape Water	Czech Rep. – The resolution of conflicts between agriculture interests and soil and landscape protection could benefit from the EU soil quality framework directive that has been put on hold. The Czech government uses this impasse to postpone action.

-national ambitions are higher than EU ambitions.	Forestry Climate	Czech Rep. - The EU water legislation does not address spatial water retention in the landscape, a major problem in the Czech Republic. Germany – lack of guidance on forestry management due to lack of EU policy framework on forestry. Sweden - the EU climate policy does not fully support the ambitious Swedish emission reduction targets. Germany - The level of animal protection, especially of livestock, established by the EU regulations is considered insufficient by German standards.
Lack of coordination of implementation actions	Water Climate Energy	Sweden - the Water Framework Directive 2000/60/EC is partially implemented due to limited coordination with the implementation of the directive on flood protection and groundwater directive. Sweden - Lack of coordination between different sectors affects water management. Water authorities do not have much power over forestry authorities and municipalities on water issues. Voluntary collaboration is not sufficient. Latvia - Need for close cooperation and involvement of stakeholders from various sectors to develop national legislation supporting practical implementation of the law requirements to achieve climate targets.
Lack of clarity of rules in EU policy documents	Nature conservation Agriculture Water Energy (biomass) Waste	Netherlands - Lack of clarity regarding the production and usage of biomass in the EU Natura 2000, CAP, and water policy; no clear and binding sustainability criteria for biomass production. Some biomass is identified as waste for which strict processing and transportation rules apply.
Lack of communication to affected parties on the provisions of EU and national regulations	Land Nature conservation	Latvia- Insufficient information on new restrictions of land uses, and on the amount and procedure for receiving compensations in Natura 2000 protected areas.
Overregulation: too many EU rules make EU policy difficult to implement	Nature conservation Agriculture Water	Netherlands - Policies on nature (Natura2000), agriculture (CAP) and water (Water Framework Directive) hard to combine. Czech Rep. – Agri-environmental measures of the CAP: farmers are discouraged to apply for the funds due to the heavy administrative burden.
Regulations not fully operational because implementation acts are not yet available	Energy	Latvia – Some Latvian energy regulations still miss implementation acts.
Lack of finances, manpower and capacity for proper management Lack or fragmented knowledge due to poor monitoring and evaluation	Water Forestry	Latvia - Implementation of the river basin management plans stagnates, resistance towards new measures because lack of knowledge about effectivity former actions. Latvia - Need to increase knowledge and capacity of forest owners to take responsibility for sustainable forest management.

	EU regulation implemented to meet minimum requirements with little impact in practice	Agriculture	Czech Rep. – Greening measures implemented to the minimum, often reported as already implemented practices. Czech Rep. - Member states can choose the stringency of the GAEC measures under the CAP; implementation in the Czech legislations is voluntary.
	Presence of a complex governance structure with multiple administrative levels having responsibility on nexus sectors	All nexus sectors	Germany - Establishment of the EU on top of the German federal structure has slowed down and further dispersed responsibility for policy implementation. Diffuse responsibility makes it difficult to identify whether projects should be funded by the national government or the federal states in water management.
National-regional	'Siloed' thinking in policy making and different policy interpretation across scales	All nexus sectors Water	Sweden – "Siloed" thinking can lead to a failure to recognize cross-sectoral issues across different scales. Sweden - Inconsistencies between national and regional level in how national water regulations are interpreted and enforced by regulators at the regional level.
	Partial or limited support for regional regulation/initiatives by national policy because regional ambitions higher than national ambitions	Energy	Andalusia - Andalusia Energy Strategy 2020 sets more ambitious renewable energy, energy consumption and saving targets than the national law.
	Lack of coordination of implementation actions	Water	Sweden - Lack of coordination between activities for the implementation of the Water Framework Directive. As a result, opportunities for a holistic implementation at regional level are missed.
	Uncertainty about continuity of policy instruments	Energy	Sweden – Policy change can hamper implementation of local policies, e.g. reductions to the feed-in tariff in the energy sector. An additional uncertainty arose because of changes in funding structures associated with the Brexit process.
Trans-boundary	Regulatory differences	Fishery	Germany-France - Because of different regulation on fishing season and on the size of fish that can be caught, a fish may be spared on one riverbank, but caught on the other.
	Insufficient sharing of information on planning and management rules for shared resources	Water Energy Agriculture	Germany-France - Insufficient sharing of information between the two neighbouring states concerning plans and regulations for the management of shared resources as well as about environmental impact assessments.
	Different natural resource management approaches	Nature conservation	Germany-France - The two countries have different nature conservation approaches stemming from their different management experiences.
	Differences in governance structures	Nature conservation Water Agriculture	Germany-France – Identification of the right counterpart to interact to, trust building, human resources availability and capacity make transboundary cooperation difficult.
	Lack of financial resources for shared projects or lack	Nature conservation	Germany-France - Difficulty to obtain financial resources for transboundary projects and

	of commitment about spending	Water Agriculture	research; but also available budget not always fully exploited by eligible partners due to disagreement on project design and implementation.

Source: Munaretto et al., 2018.

2.3.3 Horizontal policy coherence in the WLEFC nexus

Bilateral horizontal policy coherence between EU objectives for water, land, energy, agriculture and food, and Climate was assessed, using a sub-set of all identified objectives in EU policy documents, as shown in Table 2.4. The selection of this sub-set was guided by the following criteria:

- Relevance for the achievement of a low carbon and resource efficient Europe, the goal of SIM4NEXUS.
- Potential of the objectives to have a high number of interactions in the WLEFC nexus.
- Unambiguous and clear definition of the objectives. This is necessary to apply the coherence scores. It implied that some objectives were specified compared to the original description in the policy document.

The ten national and regional cases selected objectives that were relevant for their own cases. Most of these objectives overlapped with the EU selection but were more specified for the local situation. The selection was completed with specific national and regional objectives (Munaretto et al., 2018). The coherence between policy objectives was analysed and scored according to Nilsson et al. (2016a and b). Scores ranged from -3 (Cancelling) to +3 (Indivisible, Table 2.5).

Table 2.4 Selected EU policy objectives for the horizontal coherence assessment of bilateral interactions in the WLEFC nexus. Coherence between the numbered objectives were scored.

EU WATER POLICY	
W1	Achieve at least good water status for each river basin and good groundwater status by 2027[1)]
W2	Ensure sufficient supply of good quality surface water and groundwater for people's needs, the economy and the environment[1), 2)]
W3	Increase water efficiency[2), 3)]
W4	Reduce water consumption[2), 3)]
W5	Assess and manage flood risk and mitigate flood effects in EU[4), 5), 6)]
W6	Address and mitigate water scarcity and drought in EU[7)]
EU ENERGY POLICY	
	Reach a 20% share of energy from renewable sources in the EU by 2020[8)] and at least a 32% share of renewable energy consumption by 2030[9), 10)]
	Have 10% of the transport fuel of every EU country come from renewable sources by 2020[8)]
E1	Increase production of biofuel[8), 11)]
E2	Increase consumption of biofuel[8), 11)]
E3	Increase production of energy from biomass (excluding biofuel)[10), 12), 13)]
E4	Increase consumption of energy from biomass (excluding biofuel)[10), 12), 13)]
E5	Increase hydro-energy production[10)]
E6	Increase hydro-energy consumption[10)]
E7	Increase energy efficiency by 20% by 2020[14), 15), 16)] and by at least 32,5 % by 2030[9), 17)]
E8	Reduce energy consumption[9), 17)]
E9	Push forward important energy infrastructure projects (grid, network, interconnectors, etc.)[9)]
E10	Ensure a stable and abundant supply of energy for European citizens and the economy[9)]
EU LAND USE POLICY	

L1	Restore degraded soils to a level of functionality consistent with at least current and intended use[18)]
L2	Prevent soil degradation[18)]
L3	Maintain and enhance forest cover[9)]
L4	Prevent indirect land use change from nature to productive use[11), 19)]
EU FOOD AND AGRICULTURE POLICY	
	Viable EU food production and EU food security (through support to farm income)[20)]
F1	Contribute to farm incomes (if farmers respect rules on environment, land management, soil protection, water management, food safety, animal health and welfare - 'cross-compliance')[21)]
F2	Improve competitiveness of agricultural sector (including sector-specific support and international trade issues)[22)]
F3	Ensure provision of environmental public goods in the agriculture sector[21)]
F4	Support rural areas economy (employment, social fabric, local markets, diverse farming systems)[21), 23)]
F5	Promote resource efficiency in the agriculture, food and forestry sectors[21)]
F6	Reduce and prevent food waste[3)]
F7	Reduce intake of animal protein in human diet (non-binding objective; expressed intention on a research phase)[24)]
EU CLIMATE POLICY	
C1	Reduce GHGs emissions to keep global temperature increase within 2 degrees[9)]
C2	Increase efficiency of the transport system[25)]
C3	Support the development and uptake of low carbon technology[9), 26)]
C4	Support the development and uptake of safe CCS technology[27)]
C5	Incentivize more climate-friendly land use[9), 28)]
C6	Promote adaptation in key vulnerable EU sectors and in MSs[29)]

1) Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy.
2) EC_2012_Blueprint to safeguard EU water resources.3) EC_2015_Closing the loop an EU action plan for the circular economy.
4) EC_2016_Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030: A disaster risk informed approach for all EU policies.
5) EU_2013_Decision No 1313/2013/EU of the European Parliament and of the Council of 17 December 2013 on a Union Civil Protection Mechanism.
6) Directive 2007/60/EC of 23 October 2007 on the assessment and management of flood risks.
7) EC_2007_COM: Addressing the challenge of water scarcity and droughts in the European Union (SEC(2007)/993; SEC(2007)/996).
8) Directive 2009/28/EC 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/EC.
9) A policy framework for climate and energy in the period from 2020 to 2030 [COM(2014) 15].
10) DIRECTIVE (EU) 2018/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 on the promotion of the use of energy from renewable sources (recast).
11) DIRECTIVE (EU) 2015/1513 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable source.
12) Commission Communication of 7 December 2005 on A biomass action plan (COM(2005) 628).
13) Report on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling (COM/2010/11).
14) Energy 2020 A strategy for competitive, sustainable and secure energy [COM(2010) 639].
15) Directive 2012/27/EU of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.
16) Energy Efficiency Plan 2011.
17) DIRECTIVE (EU) 2018/2002 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 amending Directive 2012/27/EU on energy efficiency.
18) EC_2006_Thematic Strategy for Soil Protection.
19) Commission Communication of 8 February 2006 'An EU Strategy for Biofuels' (COM(2006) 34 final).
20) EC_2010_The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future.
21) Regulation (EU) No 1307/2013 of 17 December 2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/200.

22) Regulation (EU) No 1308/2013 of 17 December 2013 establishing a common organisation of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007.
23) EC_2015_European Structural Investment Funds 2014-2020: official texts and commentaries.
24) Grant SFS-15-2014 proteins of the future in Horizon2020 programme for Safe food, healthy diets and sustainable consumption.
25) A European Strategy for Low-Emission Mobility [COM(2016)501].
26) Horizon 2020 - The Framework Programme for Research and Innovation - Communication from the Commission [COM(2011)0808].
27) Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/200.
28) REGULATION (EU) 2018/841 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU. An 29) EU Strategy on Adaptation to Climate Change [COM (2013) 21].

Table 2.5 Typology of interaction between policy objectives.

Type of interaction	Score	Description
Cancelling	-3	Progress in one objective makes it impossible to reach another objective and possibly leads to a deteriorating state of the second. A choice must be made between the two (trade-off).
Counter-acting	-2	The pursuit of one objective counteracts another objective.
Constraining	-1	The pursuit of one objective sets a condition or a constraint on the achievement of another objective.
Consistent	0	There is no significant interaction between two objectives.
Enabling	+1	The pursuit of one objective enables the achievement of another objective.
Reinforcing	+2	One objective directly creates conditions that lead to the achievement of another objective.
Indivisible	+3	One objective is inextricably linked to the achievement of another objective.

Source: Nilsson et al. 2016a; Nilsson et al. 2016b

Most policies for water, land, energy, food and climate are coherent

At EU level and in all national and regional cases, more synergies than conflicts were found between policy objectives for the WLEFC sectors, based on an analysis of policy documents. Policy coherence between sectors is most evident if objectives for one sector are mainstreamed in policies for another sector or when objectives of one sector are closely related to objectives of another sector, for example in the climate and energy sectors. However, policy coherence in policy documents is not a guarantee for coherence in practice. Stakeholders mentioned conflicting interests during implementation, for example competing claims on water and land, negative effects on water, land and ecosystems of expanding agriculture, biomass production and developing hydropower, failure to implement environmental and landscape objectives.

Coherence issues concentrate around a limited number of 'nodes' within the nexus

The following policy coherence issues related to the nexus, as observed at an EU level, were also encountered on national and regional levels.

1. *Synergy (coherence scores +1, +2, +3).* The positive effects caused by good practices in water and land management: restoration of soils, prevention of soil erosion and reforestation as well as restoration of natural courses of rivers and infiltration capacity of soils are nature-based solutions to combat flooding and drought, are synergistic with climate change mitigation and adaptation and support agriculture. These synergies were confirmed by the transboundary case Czech Republic-Slovakia-Germany, and the regional cases Andalusia and South-West England.
2. *Synergy (coherence scores +1, +2, +3).* The positive effects of increasing energy and water efficiency, resource efficiency in the agro-food chain, and reduction in the use of water and energy. These are fundamental measures that serve all sectors within the nexus and are synergistic with climate change mitigation and adaptation. These synergies were mentioned by the cases Greece, Latvia, Andalusia and Sardinia.
3. *Ambiguity (coherence scores -2, -1, or +1, +2).* Internal conflicts that may exist in agriculture policy between economic and environmental objectives with trade-offs on water, land, energy and climate objectives. These conflicts were confirmed by the cases in Latvia, Andalusia, South-West England, and the transboundary case Czech Republic-Slovakia-Germany. On the other hand, agriculture has the potential to deliver environmental public services and to positively interact with water, land, nature, energy and climate.
4. *Ambiguity (coherence scores -2, -1 or +1, +2).* Water supply and management of flooding and drought may have positive effects within the nexus. However, increases in the water supply may increase energy demand and cause rebound effects, as was mentioned in the cases in Andalusia, Sardinia and Greece. Nature-based solutions, such as soil restoration, reforestation, creating marshes and patches of natural areas to restore local hydrology, have more synergy with land management and climate change mitigation than do pure technical solutions, such as canals, artificial reservoirs and pumps, as described by the Czech Republic and and Slovakia.
5. *Conflict (coherence scores -3, -2).* Competition for scarce water and land, confirmed by the the Netherlands, and the transboundary cases Czech Republic-Slovakia-Germany and the Upper-Rhine basin in Germany and France.
6. *Conflict (coherence scores -3, -2, -1, +1).* Negative trade-off with the production of first-generation biofuel crops, stimulated by European and national renewable energy policy. Large-scale monoculture changes the agricultural landscape, regional hydrology and local climate, as mentioned by the transboundary case Czech Republic-Slovakia-Germany. Hydropower has negative effects on ecological water quality and land availability. On the other hand, a water reservoir for hydropower also serves as a water buffer in case of drought.

2.4 Overall findings

A broad range of policy fields, within as well as outside the nexus, are influencing the nexus between water, land, energy, food and climate (WLEFC). Between policies within the nexus, coherence predominates vertically (between administrative levels) and horizontally (between policy areas at the same administrative level). In all ten cases that were investigated, European policies for WLEFC have been incorporated in national policies.

More synergies than conflicts exist between European, national and regional policy objectives for water, land, energy, food and climate as described in policy documents. There are numerous positively interacting policy objectives, providing opportunities for synergy. Some policy objectives serve the whole nexus, for example resource and energy efficiency and good practices in land and water management. However, some policy objectives conflict with most other objectives. Progress in

achieving these objectives comes at the expense of others. For example, the objectives 'Increase biofuel production', 'Increase hydro-energy production', 'Improve competitiveness of the agricultural sector' and 'Support the development and uptake of safe CCS technology' have the risk to conflict with most other EU policy objectives in the WLEFC nexus. These conflicts are only partly addressed in the current and proposed EU policies.

Problems because of incoherence start to manifest themselves when specific objectives and measures are articulated and implemented in practice. For example, economic interests in agricultural policy and renewable energy may get priority above environmental interests. Also, the implementation methods for a policy may conflict with other interests, as is the case with large scale monoculture of bioenergy crops or technical instead of nature-based solutions for combatting floods and droughts.

Several factors hinder implementation of European policies for water, land, energy, food and climate in the Member States (MSs), for example horizontal incoherence of EU policies causing conflicts in implementation, or unequal progress of policies and implementation between MSs. This may result in insufficient measures taken at lower scale in some MSs and more ambitious goals than the European in other MSs. In the latter case, the MS gets no support by the EU for ambitious national policy. Also, incoherence in regulations between scales was reported, as well as the dominance of energy policy and economic interest over environmental policy.

Implementation of the UNFCCC Paris agreement on climate change gets more attention from European national governments than the multi-sectoral Sustainable Development Goals. This unilateral focus may cause unwanted trade-offs. A nexus approach that gives equal attention to all nexus components, could be the answer.

3 Regulatory gaps, ambiguities, inconsistencies

Key messages:

- Conflicts in the agriculture policy between economic and environmental interests cause implementation problems between water, land, energy, food and climate (WLEFC);
- Biofuel causes conflicts with food production and sustainable forestry;
- A lack of priority to sustainability issues often puts emphasize on the short term economy rather than sustainability as a whole. Soil quality is an example of an issue that is under pressure but receives minor priority. Also agricultural measures from the EU Common Agricultural Policy, i.e. the Environmental Quality Objectives (EQO) and Good Agriculture and Environmental Conditions (GAEC), are in two cases reported to receive minor priority and insufficient regulative support in the MS implementation;
- There are conflicting interests between water use and land-use coming from a strong competition for scarce water resources and land-use;
- Low awareness of domain- and sector-crossing mind-sets, knowledge & coordination causes problems during the implementation.

3.1 Introduction

In this Chapter we look closer at the regulation at work. Regulation refers to the laws and other rules prescribed by authorities to regulate conduct, and it is also the act of regulating or the state of being regulated. By that we cover the implementation as well. The regulatory quality will be affected by the actual support, the priorities made, capacity, finance and the effect of unresolved issues. complex interdependencies meet competition for scarce attention and means. Regulatory differences between and within regions and countries add to the challenges. In effect, regulatory gaps, ambiguity and inconsistencies are then likely to occur. Regulatory gaps are seen when certain areas or issues are not covered by regulation. Inconsistencies are featured by two or more regulations interfering with each other. Ambiguity is when policies are open for interpretation and are facing multiple interpretations. More in general, ambiguity leads to a lack of clarity or consistency in reality, causality, or intentionality (March, 1994). We should stress that there is no specific nexus regulatory framework made to deal with the crossroads between water, land, energy, food and climate. No ambiguity would then be hard to imagine. Here we examine how the regulatory gaps, ambiguities and inconsistencies appear from the case studies. We have used the rich information from the international and European policy study in Munaretto et al (2017) and the national, transboundary and regional case studies in Munaretto et al (2018). Of particular interest is how the interests of stakeholders from different sectors in the WLEFC nexus are engaged and how they deal with the gaps, ambiguities and inconsistencies which can hamper policy practice. Regulatory gaps can be reasons for policy incoherence and are mentioned in Chapter 2 but Chapter 3 contains more details on these regulatory gaps than Chapter 2.

Our investigation, based on our own expert assessment in this project team identified the following seven types of or sources for regulatory gaps, ambiguities and inconsistencies from the cases. First of all, we call inconsistent objectives and implementation conflicting regulations. We also observed that there are different views of how to look at and assess policy, and that these views represents different 'groups', leading to who favours certain sector interests above others. We call this ambiguous discourses. In addition we see gaps and inconsistencies as a result of priorities made. Not all regulation receive the same amount of attention and some might then be given more attention and resources than others. There is also ambiguity resulting from rather coherent objectives that turns out to be much less clear and coherent during the implementation stage. Here we label this category

delegated ambiguity, although it is not (necessarily) intentionally delegated. We also have a category gaps of absent rules or no enforcement, which occurs when regulation is present or not implemented or just exists 'on paper'. Finally we distinguish a category of ambiguity by diffuse responsibilities, which is the case when it is not clear who is in charge of the policy implementation in question. We use these categories or types of ambiguity for the conclusions from the cases:

- Conflicting regulations (inconsistent objectives and implementation)
- Ambiguous discourses (competing forces)
- Gaps and inconsistencies due to a lack of priority (skewed focus)
- Delegated ambiguity (unclear implementation)
- Low awareness of 'Nexus-needs' (neglected sector-crossing solutions)
- Gaps by absent enforcement (no real implementation)
- Ambiguity by diffuse responsibilities (nobody in charge)

In section 3.13 we look at the overall findings from the case studies.

3.2 International cases

Munaretto et al. (2017) identified and reviewed the policies at international and European scale that are relevant to the water, land, energy, food, climate nexus (WLEFC - nexus). The case emphasizes that besides the policies directly aiming at these five nexus domains, other policies are also relevant, especially in the context of strategies for a resource efficient and low - carbon economy in Europe. These are referred to as policies in the domains of economy, investment, R&D and innovation, ecosystems and environment, EU regions, development, risk & vulnerability and trade. In addition Munaretto et al (2017), say that other policies may also be relevant, depending on the issues at stake, e.g. policies for economic sectors that have a key role in the SIM4NEXUS cases.
At international (global) scale, two key policy documents are leading for the WLEFC - nexus:

- the UN 2030 Agenda for Sustainable Development;
- the UN Framework Convention on Climate Change (and related Kyoto Protocol and Paris Agreement).

Around these plans numerous objectives have been formulated and many instruments exist to achieve them, Munaretto et al (2017) conclude, and often they are soft means, but there are also economic instruments that parties can use to achieve these goals such as emission trading, Joint Implementation and Clean Development Mechanisms in the context of the UNFCCC. In the food and climate sector, investment in developing countries is an important instrument.

In addition, European policies concerning the WLEFC - nexus are established by directives, regulations, decisions, road maps, plans and programmes (Munaretto et al, 2017). Although Munaretto et al (2017) conclude that there is more synergy than conflict among European policy objectives that are relevant for the WLEFC - nexus, the focus in this Chapter is on the regulatory challenges that follow with problematic issues. In particular, Munaretto et al (2017) found also policy objectives that are in conflict with most other EU policy objectives in the WLEFC-nexus.
These are *Increase of biofuel production*, *Increase hydro - energy production*, *Improve competitiveness of agricultural sector* and *Support the development and uptake of safe CCS technology*. A conclusion is that progress in achieving these objectives come at the expenses of other objectives in the nexus. As such this is a regulatory inconsistency that leads to inefficient implementation. Two EU policy objectives were assessed in more detail by Munaretto et al (2017). These are: *Increase of biofuel production* and *Ensure sufficient supply of good quality water for people's needs, the economy and environment*. Munaretto et al (2017) conclude:

- Negative effects of hydropower on aquatic ecosystems, water quality and water quantity are not addressed in EU policies for renewable energy.
- EU policies for biofuels are generally coherent with international policies, except for the food security and affordable food prices goals in the context of poverty reduction. The effects of biofuel production on these goals are weakly addressed in EU policies. Prices of agricultural products are addressed in the CAP from the viewpoint of farm income not the consumer. The EC will monitor the effects on food prices, but no concrete actions on unwanted effects are foreseen.
- The objective 'Fully consider water and ecosystem footprints of alternative climate change mitigation measures' (UNEP, 2012) is not referred to in EU/international energy/climate policies.

In light of our regulatory focus, we observe that Europe is currently focusing much on energy and climate. Issues as land-use for renewables, biofuel production, the renewable-mix, reduction of carbon emissions and uptake of safe CCS technology are then all relevant, but progress in achieving these objectives has however the unfortunate tendency of coming at the expenses of other objectives in the nexus. The biofuel production is then inconsistent and conflicting with food security and affordable food prices goals in the context of poverty reduction. There is thus a trade-off between central issues in the global Sustainable Development Goals (SDGs), for example SDG2 Zero Hunger and SDG13 Climate Action.

In the EU policies, the weakly addressed effects of biofuel production (Munaretto et al. 2017) might be a result of low Nexus-awareness in combination with a lack of priority, where energy and climate interests prevail. According to the EU policies for renewable energy, the EC will monitor effects of biofuel production on food prices and security, but Munaretto et al (2017) conclude that no concrete actions are being proposed in case of unwanted effects. Biofuel might also be inconsistent with matters of water quality. For this we have the European common agricultural policy (CAP). Inconsistencies with water quantity is addressed in the EU renewable energy policy. But biofuel production is thus dependent on an unambiguous and forceful water management and the willingness of actors in the supply chain to reduce impacts on water resources (Munaretto et al 2017). The gaps in the EU-regulation of hydropower on aquatic ecosystems, water quality and water quantity might also come from a low priority in the EU policies for renewable energy.

The conclusion here is that the international cases see first and foremost synergies between the WLEFC goals but that regulatory gaps and inconsistencies are found in biofuel and food production/security. We also see regulatory gaps between hydropower, water and ecosystem regulations, which are not being addressed by the EU renewable energy regulation. The next step here is to look closer at the implementation of the WLEFC nexus policies from the case studies at national and regional scales.

3.3 Andalusia

Andalusia is a case covering how agricultural and environmental policies can be integrated to address pressures on land and water whilst promoting their sustainable use and economic development. Andalusia is the most populous Spanish region and the second largest region, with eight provinces and 778 municipalities. The region has its own government and parliament, whose regulations are aligned with both EU and national policies. The main challenges in Andalusia are over-allocation of water resources, increasing competition for water among sectors, growing energy dependence in the agricultural sector, rising greenhouse gas (GHG) emissions, soil erosion and environmental degradation.

Inconsistency between the energy and agriculture policy

In the agricultural sector, high energy costs represent a big challenge for irrigated agriculture. The implementation of irrigation modernization plans to save water promoted the change from surface irrigation to pressurized systems, which are more water efficient but also more energy demanding. Energy then turned into an essential resource for irrigated agriculture, with a major increase in energy consumption.

Subsequently, the energy market liberalisation in 2008 brought about higher (unsubsidized) energy prices for irrigators. At the same time, the Spanish renewable energy sector suffered from three major problems: 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,

This regulation puts forth the elimination of economic incentives for new power generation facilities based on cogeneration, renewable energy sources and waste. In addition, it introduced a tax for self - consumption of photovoltaic installations for the electricity. 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.

The law has not only discouraged investment in renewable energy generation but also reduced output from existing renewable facilities, thereby limiting the reduction of CO2 emissions. These national energy policies are in conflict with the Andalusia Energy Strategy 2020, which sets the ambitious renewable energy goal of achieving 25% of total energy consumption from renewable sources and 5% self - consumption of electricity from renewable sources.

Ambiguous relationships between sustainable agriculture and resource use efficiency

There is ambiguity among the immense number of laws, specific rules and other types of regulations affecting the WLEFC-nexus. Generally, the case authors reports that 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. Achieving good ecological status of all water bodies as stated by the Water Framework Directive contrasts with the objective of consolidation and improvement of existing irrigation systems under the Andalusian Rural Development Plan. Ambiguous relationships are pronounced in the objective of closer coordination of urban and land use policies and instruments, and improving the sustainable competitiveness of the Andalusian agricultural and agro-industrial sector.

In sum, the mechanisms for a more integrated policy are currently not sufficiently removing the regulatory ambiguities, gaps and inconsistencies. There are regulatory conflicts between agriculture and resource use efficiency and a lack of priority for renewable energy. The effects on all nexus domains largely depend on how well environmental, agricultural, energy and land policies are implemented. This evidences the need to formulate changes in accordance to a nexus perspective involving all affected stakeholders to better cope with inevitable trade-offs.

3.4 Azerbaijan

Azerbaijan is a case concerning the shift from an oil based economy to a more sustainable pattern based on renewables and implications for agriculture and water management. It is about a transition to a low

carbon economy while minimizing the stresses on the energy, water, climate, land use and food. Azerbaijan is a transition economy which aspires to open up to a more market oriented pattern. But it depends heavily on oil and gas abstraction, which covers more than 90% of the export. Oil and gas fields are spread all over with many external effects. Agriculture covers 57% of the land, 40% of the employment and it is water-intensive, accounting for more than 70% of the fresh water withdrawal. But there is no system of wastewater treatment and ¾ of the water comes from upstream sources abroad. Forests cover 12% of the land with illegal logging as a problem. Azerbaijan is also vulnerable to climate change with much and expanding arid land prone to floods. For clear and more integrated policies the government plays a significant role, greater than for example in the EU. However, there is ambiguity by diffuse governance relationships as all sectors have a high number of institutions involved, with unclear relationships between the institutions and domains.

Inconsistencies in the regulation of energy and climate

The case study shows an conflicting inconsistency between the regulation of energy and climate. These are seen to have a great potential for synergies as the climate sector aim to curb greenhouse gas emissions and 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. But as the economy grows and the energy demand rises, the use of oil and gas increases, the decarbonization targets might become infeasible. This would then be inconsistent with the Strategy on Use of Alternative and Renewable Energy Sources and the economic Strategic Road Map aiming at sustainable energy system; determining key directions for the production of electricity and thermal energy from renewables; increase the energy efficiency; the quality of electricity transmission and distribution, create legal framework conditions for the usage and areas of RES (Renewable Energy Systems). The (increasing) use of oil of gas will also be inconsistent with the Climate 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. We see here signs of ambiguous discourses and conflicting regulations.

Inconsistencies between agriculture, water, land-use and energy

Also agriculture, water, land-use and energy carries inconsistencies. A growing agricultural (food and non-food) production requires higher levels of water use. Government programs for developing the agriculture sector and the food security, developing market infrastructure, promoting the growth of cotton, tobacco and barley production increases the demand, which in turn is restricted by increased water tariffs and the expansion of meter installations. At the same time, investments in irrigation infrastructure could boost agriculture output. The impact of agriculture on water resources triggers a link with the energy sector as higher volumes of irrigated water require larger amounts of energy. The implementation of more efficient practices could be helpful but the water withdrawal would still be large. The agriculture and water regulations represent a challenge as they are inconsistent with each other: agriculture uses much water to grow as a sector and the water regulation is meant to reduce this usage.

In sum we see here a national state with a strong involvement in the policy development but also a state where oil and gas dominates the priorities (ambiguous discourses and a lack of environmental priorities). In addition there are great challenges concerning water, energy, agriculture and land-use (low Nexus-awareness and ambiguity by diffuse responsibilities). In the case study it is recommend to

open up the economy and allow private actors to be more engaged, The case study author suggests that the country could potentially make certain sectors such as irrigation infrastructure or renewable energy less regulated and more open to private investments.

3.5 Greece

Greece is rich on flora and fauna. Agriculture and tourism, the prevailing economic sectors, put pressures on water and energy resources as well as on land-use. About 85% of the available water resources are used in the agricultural sector. Due to the fiscal crisis the GDP has declined and much focus is now on reforms for a better economy and a better alignment to EU-policy. The Greek population is expected to face an important decline during the next years while, employment and national GDP will start improving as the economic crisis starts receding. The Greek case does however show gaps, ambiguities and inconsistencies regarding the policy implementation on the Nexus domains. These inconsistencies arising at a practical level are mainly caused by ambiguous discourses between economic and more sustainable development, with a lack of common goals and interests.

Energy management: pressure on renewables

The achievements of 20% reduction of GHG emissions in relation to the respective 1990 emissions levels and the 20% penetration of RES in the gross final energy consumption is under pressure due to the share of lignite (brown coal) in the internal electricity market. Despite the fact that national climate and energy policies promote the development and use of RES, energy production still depends on the exploitation of lignite. This is due to the availability of lignite stocks in Greece and the subsequent need for ensuring energy sufficiency in the national level. Also, 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 (heat content), the issue is under discussion in order to reach a compromise.

Regulatory gaps leads conflicts in land-use: no spatial planning

The absence of land use regulations is linked to the relative policy gaps between spatial planning and the distribution of economic activities. As a consequence, there is not a land use policy framework regulating the development and spatial distribution of the several economic activities such as tourism, industry, RES. The National Cadastre will however set the base for solving such problems. There are also land use conflicts between livestock and agriculture. 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.

Ambiguities and inconsistencies between water , agriculture and land-use

The effective implementation of water policies is sometimes hampered by ambiguity and conflicts that concern spatial and temporal water allocation for covering water needs in several regions in Greece. Farmers, PPC, municipalities and the Ministry of Environment and Energy are all involved in these conflicts. Also the impacts of pesticides on water and soil quality plays an important role. Efforts of 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, versus water allocation (irrigation), domestic use, energy production and environmental matters. We see this here as a delegated ambiguity, with struggles in the implementation stage.

There is also inconsistency between policies that subsidize water - intensive crops (e.g. cotton) and policies related to the sustainable management of water resources that promote crop restructuring to reduce additional pressure on water resources. Another example is the 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. They call for a 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.

In sum, the main factors that lead to regulatory gaps, ambiguities and inconsistencies are rooted in a lack of common goals and interests (ambiguous discourses; lack of priorities), several conflicting interests, goals, future perspectives and discrepancies concerning the expected profits.

3.6 Latvia

Latvia case study is focusing on the enlargement of the energy self-supply, by widening the use of renewable energy sources and identify trade-offs and possible solutions towards low carbon economy, considering interlinkages with 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 CO2) emissions as well as maintaining or even increasing CO2 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. 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 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. Latvia has the second highest share of RES in the energy consumption in the EU. The case does not report any strong conflicts on the objectives. But in practice, conflicts can arise depending on implementation pathways and approaches selected.

Ambiguity in energy, water, agriculture

The growing of energy crops and fast-growing trees for the 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 increases water pollution through the leakages of fertilisers (biogens) and pesticides, herbicides applied. This causes in practice conflicts between the energy and water objectives, which also is the case in energy production in hydropower plants, which helps to reach targets for the use of RES, but has a negative impact on water quality and water ecosystems. 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. Also, the 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.

Unsustainable forest management (e.g. clear-cuts) to obtain biomass for energy production is also a way to achieve the RES target, but may have negative impact on forest ecosystems. This suggests a situation with a lack of priority for ecosystems. 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. 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 CO2 sequestration targets. Efforts to support high added value forestry though wood processing and furniture products could have been supportive as alternative income but had not had much effect due to the tax policy, limited credit resources, a small local market. Innovation support mechanisms are insufficient to compete with international market prices (e.g., for raw and secondary

processed material). The mandatory procurement of energy produced from renewable energy sources and cogeneration is also causing challenges as the regulatory framework has not implied stability, transparency and clearly defined conditions for all players involved. Problematic is the insufficient cost-benefit estimation, the weak management (issuing of permits), enforcement procedure (control over installation operation and the amount of energy production). There is ambiguity due to diffuse responsibilities and a low Nexus-awareness.

Lack of harmonisation of measures between sectors

The development of River Basin Management Plans and Rural Support Program causes problems as for example the harmonization of measures between agriculture and water sectors requests closer coordination between the responsible authorities. Currently there is better cooperation between experts and implementers than between policy makers. The attitude should change on the national level towards a more environmental policy and also shift among the producing sectors. For now, development programs in sectors are focused on sector specific issues with a lack of an integrated approach between sectors. Also a high load of bureaucratic procedures is reported to have its effects on the ability to harmonize sectors. Also here we observe ambiguity due to diffuse responsibilities and a low Nexus-awareness.

In sum, the forest sector is one of the key cornerstones in the national economy and has a high export capacity but economy dominates the resource management practices (e.g., water, forest, agricultural land), which is also considered important but weak. Competing forces (ambiguous discourses), a lack of priority in favour of sustainability and a low Nexus awareness causes challenging conditions for a Nexus mind-set. Sector bound perspectives and short term thinking of development are also essential. Market conditions leads to low added value production instead of high value-added production, despite efforts to focus on the latter, with long-term development perspective. Despite the availability of financial instruments in support of innovations and business in Latvia, the response from SMEs is reserved due to rather a high load of bureaucratic procedures and corresponding high efforts to prepare for the use of support instruments.

3.7 Netherlands

Netherlands has built a case around the provision of a comprehensive understanding of the role of biomass in a low-carbon and resource-efficient economy and the coherence of the relevant policies. Biomass is a Nexus issue as it is affected by other policies such as waste, emissions, agriculture and the environment. Although the sustainability of some biomass processes and products is questioned, there are currently discussions of whether or not there are enough other options to exclude biomass as a renewable energy source. The main problem addressed in this case 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 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. There are competing forces with ambiguous discourses. There is a strong pressure on land that is scarce and expensive, and agriculture, energy, water, nature, climate are strongly interconnected. 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.

Biomass: an ambiguous sector in need for more clarity

The complexity of biomass as a 'sector', the many administrative rules, regulations, a lack of clarity on the usage of biomass and unclear sustainability criteria for biomass and uncertainty for longer term investments makes biomass an ambiguous sector with a pronounced negative image.
One of the problems is that the biomass 'sector', is hardly a unified sector at all. It is diverse and it is not well organized and this puts restrictions to the ability for businesses to find each other in mutual beneficially activities. Stakeholders refer to the rules and regulation system, for instance for permits, time-consuming and costly. An 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 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 aware of the regulatory barriers and have tried to tackle many of them. 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.

Energy, agriculture, nature and biomass ambiguity leads to conflicting regulation
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. The energy-biomass ambiguity is challenged by the fact that the energy policy makes plans for biomass as a source of energy while the government also want 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 not ambiguous 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 much more ambiguous 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, which hampers the clarity and is further damaging to the image of the sector.

No level playing field leads to gaps, uncertainty and less investments
The work on trade rules as import tariffs and trade barriers in (mainly) the European context is considered a source of ambiguity for the biomass business. In particular, there are now import tariffs for bio-ethanol but not for fossil. This hampers the clarity, and it is viewed to be further damaging to the image of the sector. A part of the work on a level playing field concerns the registry REACH for bio-based components. Such a registration system for tens of thousands components could be useful but it is now seen by businesses as a time consuming and expensive system. But all components in the EU must be registered, and no change is to be expected. At the same time, the self-organizing capacity of biomass companies is low, thus their ability to front initiatives is limited, adding to the sense of sub-optimal usage of many opportunities. The ambiguity often remains unchallenged due to a lack of tradition in collaboration.

Knowledge development does not support a long term clarity
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. Farmers or nature organizations do not see themselves biomass producers. Knowledge development could support the work for more clarity with more research and innovation for biomass production, but also on better links between policy domains. However, the private sector does not have a very long-term perspective, and investments for such a long term are not

interesting for them. EU and national research could be useful for this end but funds for innovation have decreased, stakeholders report, especially for bio-based projects. As a result, big projects are not supported and this leads to smaller, fragmented projects. Ambiguity in who is responsible for initiatives and finance plays a role here. A robust and continuous long-term policy regarding research and innovation would provide certainty for investors but this is not yet reality. Critics also argue that climate now receives more attention than a broader resource efficiency approach, which might hamper the broader biobased policy.

In sum, the biomass sector faces ambiguities due to a problematic image and uncertainties concerning the usage as resource. In particular, the use as energy resource contradicts with higher end usage. In terms of sustainability there is quite some delegated ambiguity, but also diffuse responsibilities following the uncertain usage of biomass.

3.8 Sardinia

Sardinia is a case covering the links between energy, food, agriculture and water. The relevance of food and agriculture and tourism reflect the strong role that these sectors have in the economic structure of the region. But also land, forestry and climate regulation play a role. Sardinia is part of Italy as one of 5 autonomous regions with a special statute and a considerable degree of legislative and financial autonomy. While the Italian State has exclusive powers on some issues (Security, Foreign Affairs etc.) all Regions retain legislative power over a large number of issues, some of them trespassing the legislative competence of the national State, as for example the national energy distribution, the enhancement of cultural and environmental assets. The Regional administration has its own 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 the Structural Funds (ERDF, ESF, CF, EAFRD, EMFF). The high number of small firms, the low productivity and the low level of internationalization are the main hindrances for the Sardinian economic system.

Ambiguous support for agricultural expansion

Although the stakeholders had difficulties in providing examples of ambiguities, synergies or conflicts between policies, the highest number of conflicts occur between, food-water, tourism-water. food-water, in which the objective of expanding agricultural production was the objective with the highest score on ambiguous interactions. Expansion of agriculture would increase the demand for water that is already a scarce resource. But 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. Although no strong conflicts among objectives have been identified, in practice regulatory conflicts often arise because of ambiguities in measures and lack of coordination among sectors. For example, the case study reports 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.

Problematic are the lack of measures for many sectors and a lack of coordination and planning for the management of incentives (gaps by absent enforcement). Growing energy crops (maize), for instance, 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 but there are little incentives and management to organize the supply chain. And experts in the water sector 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 also reduce water prices and potentially promote increase in irrigated area or inefficient irrigation systems.

Regulatory gap in the land use policy for energy production

Partly due to a lack of regulation of land use for energy production, Sardinia faced in the past a nearly uncontrolled installation of solar and Eolic energy plants promoted by incentives for RES production. Citizens then asked to halt the use of agricultural land for these purposes and also the installation in high natural and cultural landscapes. The result was that regulation of land use for energy production was put in place, setting limits to the use of these land types. A landscape plan provided more clarity in how to achieve a more efficient use of agriculture land resources.

A less successful regulation concerns the 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. Factors causing trouble is an insufficient cost-benefit estimation and lack of funds and an insufficient organization of the biomass value chain (

In sum, no strong conflicts among objectives have been identified, but in practice conflicts often arise because of ambiguities in measures and lack of coordination among sectors. There is a rather low Nexus-awareness, a lack of priorities for sustainable solutions, there is quite some delegated ambiguity (unclear implementation), gaps by absent enforcement in land-use).. Despite a well-structured environmental impact assessment, weak management, sectorial bound perspectives and short term thinking of development has led to regulatory challenges. A lack of regulation of land use for energy production, for instance, led in the past to a nearly uncontrolled installation of solar and Eolic energy plants promoted by incentives for RES production. These problems are now under control. More problematic is the presence of forest biomass and fire control.

3.9 South-West England

South-West England is a unique case due to the Brexit process, which leads to policy revisions across all nexus sectors. The case is about how the governance of energy, water, 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. Regulatory gaps, ambiguities and inconsistencies are here found in some of the national policies which are only partly implemented at the regional level. Common reasons include difficulties in the coordination, also across jurisdictions.

Inconsistencies in the water policies

Although SWE complies with regulations, the cost of this provision is among the highest in the UK. Also, some difficulties are expected with the implementation of the National Strategy for Water and the Water Abstraction Plan 2017. Regulation to improve water quality in catchments enforced by the national Environment Agency can be at odds with local cost efficiencies with the water company South West Water in the middle, if there is limited dialogue. A disparity between how point discharge of wastewater and diffuse discharge from agriculture are regulated by the national regulator is also reported because the aggregated effect of numerous discharges is often greater than that from wastewater. The specific local conditions for the important sector agriculture can create disparities, as SWE is being more challenged than others to meet nationally required standards. Also mentioned is confusion over how the 2018 changes of the water quality regulations will be enforced.

Energy and climate: ambiguous and weak support for renewals

Also the National UK Energy Strategy meets legal obligations but here are issues of inertia in moving the energy system based on fossil fuels and nuclear to a more sustainable, flexible one. The Climate Change Act (2008) contains a legally binding carbon budgets with a cap on GHG emissions. But there has been

no progress in reducing agricultural GHG emissions over the past six years. Electricity emissions have reduced, but heat and transport remain stationary. In 2016, the government recognised that significant acceleration was required and the Energy Act (2013) contained action against older power plants. But despite opportunities for renewables through offshore and onshore wind and solar and new localised energy networks (LEMs), nuclear power poses hinders the transition to renewables. 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. Also drastic cuts to energy support mechanisms, as the Feed-in Tariffs scheme (FIT), had a detrimental effect on renewable energy businesses and community energy initiatives.

Inconsistencies and ambiguities in agriculture versus environment

There are problems related to agri-environment schemes and farming related regulation, and rules for farmers and land managers to prevent water pollution and flooding. The funding to farmers and land managers 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. Also, there has been a drop off from farmers and land-owners signing up for these subsidies because of Brexit. The regulation can also be difficult to implement because of a lack of coordination, through allocation of resources across the statutory bodies, and because of a lack of adequate funding for enforcement mechanisms. Similar reasons constrain the regulation to prevent water pollution and flooding, including a lack of coordination across relevant bodies to monitor pollution from farms, and a lack of coordination across jurisdictional boundaries between local authorities for flood prevention, suggesting conflicting regulations.

Ambiguous trade-offs in energy-agriculture

The UK Renewable Heat Incentive (RHI) provides a financial incentive for renewable heat amongst householders, communities and businesses. But 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. The short-term inducements of the financial incentives are 'skewing the picture' for the long-term impacts (conflicting regulations). An example is maize production to claim subsidy for bioenergy crops, which may generate energy but it requires water, land can be left bare and subject to soil erosion, and land is used that could otherwise grow food and livestock feed. The subsidies provided for feed-in tariffs for anaerobic digestion to promote renewable energy do then not take the efficiency of energy use into account, how this fits with agri-environmental schemes, and rent rises in the tenanted farm sector when they cannot compete for over-priced land. The South West region is relatively distant from other counties and waste that is generated in the regions needs taking care of in the region. This can be problematic in terms of meeting energy and waste targets (by 2025 no biodegradable waste should be sent to landfill. However, there is evidence that anaerobic digestion plants are under-used despite their efficacy for recycling food waste.

In sum, most ambiguities are found in agriculture objectives, followed by decarbonisation and renewable energy. Stakeholders reported 'almost a lack of policy' at regional and local levels and difficulties in influencing national policy. There are also different policy interpretations, with delegated ambiguity and regulatory conflicts likely to arise due to inconsistencies in how regulations are interpreted and enforced by regulators at the regional level. Ambiguities are linked to poor articulations of policies in the first place, but also 'siloed' thinking in policy making and failure to recognize cross-sectoral issues (low awareness). Some policies are also single issues that do not take others into account. There is a general concern about enforcement of policy at the regional level. Besides, policy implementation can be impeded by how the economic regulator (Ofwat), the environmental regulator (Environment Agency) and the water company (in this case SWW) work together (diffuse repsonsibilities). Common ground for working together is still lacking.

3.10 Sweden

Sweden has a case on the nexus-related policy space, focusing on priorities, goals and means concerning the nexus components land (in particular forest land), water, energy (mainly from forest biomass) and climate. Some 70% of Sweden is covered by forest which also accounts for 9-12% of the employment, turnover and added value. More than half of Sweden's electricity is generated from renewables as hydropower and forest biofuels. Climate change is expected to heavily affect water, forest ecosystems and their interlinkages. Forests depend on water, but they also have the potential to regulate water availability and quality. And both forest and water resources directly control the available potential to generate electricity from forest biofuels or hydropower.

Energy and climate policy objectives are well aligned due to new ambitious and tougher regulatory requirements. The agricultural sector is however the "black sheep" amongst all sectors, being the least aligned with other sectors with great challenges for balancing the market-oriented agricultural sector and a competitive food supply chain with more environmentally and climate friendly objectives. Particularly, there is a conflict between a market-oriented agriculture and the type of agriculture that would support high biodiversity.

Ambiguous implementation of Environmental Quality Objectives (EQOs)

There are difficulties concerning the regulation of the Environmental Quality Objectives. Aims for biodiversity in forest and agriculture as well as good surface water, groundwater and wetland quality are difficult to accomplish, while 'on paper' they are of equal importance. Most of the EQOs in Sweden are not being fulfilled, leading to e.g. more intensive production systems that do not support high biodiversity or lead to decreasing water quality. The main reason is that compared to energy, climate, forest production and economic development goals, environmental and particularly conservation-oriented goals have much lower priority in a practice where agricultural and forestry production dominate. Here we see ambiguous discourses, a lack of environmental priority and conflicting regulations. According to the Swedish Environmental Protection Agency (2011), when the production objective in forestry is in conflict with Environmental Quality Objectives, often the production objective is the most important one. Besides, a lack of resources for the EQOs work take its toll on the regulatory practice. In turn, implementing authorities face unclear responsibilities and a shortage of resources.

Ambiguities and inconsistencies between biofuels, forests, energy, water, climate and biodiversity

In general, the political agenda for climate change dominates over (and not always align with) other environmental problems. For example producing more biomass to support climate mitigation may hinder effective biodiversity conservation, as it requires more intensive forest management. The regulation is influenced by a lack of a holistic perspective by the decision makers, and a largely sectoral division of responsibilities with quite some conflicting sectoral objectives. The competition between forests, water and energy resources is strong and might be intensified by changing climate conditions. Knowledge gaps and considerable uncertainties on how environmental systems will impact are major challenges. In addition, large uncertainties remain in terms of the effect of future seasonal shifts in water availability on hydropower, which highlights the need for further research.

Sweden has also not fully implemented the Natura 2000 policies yet, with still an insufficient coverage of particular habitats in the Natura 2000 network and relatively many species without a favourable conservation status. Relatively low political priority is given to biodiversity conservation, compared to production-oriented goals, particularly in forestry. For instance certification standards (FSC, PFC) are not much directed towards conservation objectives, and the same goes for advice given by forestry authorities. There is ambiguity already built into the principle of "Freedom with responsibility" approach for forest owners, with much freedom and little formal legislation.

There is also insufficient coordination of regulatory activities in the water sector. Water authorities have no influence on forestry management or spatial planning of municipalities. Despite some collaboration between the sectors, it is insufficient for the implementation of all water goals. In essence, there are

conflicting interests, a lack of power/political mandate by Water Authorities to influence other actors and a lack of regulations supporting such influence. There is also no national (but some local) level policy/objective to implement climate adaptation measures, just climate mitigation. There is also here in general a lack of political priority and a lack of knowledge involved.

Inconsistencies and ongoing conflicts between housing and 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. Both population growth and the market forces drives this development, but due to a higher priority given to economic development compared to environmental objectives, the regulation shows signs of inconsistencies.

In sum, the case shows ambiguous discourses, a lack of environmental priority and conflicting regulations as most of the EQOs in Sweden are not being fulfilled, leading to e.g. more intensive production systems that do not support high biodiversity or lead to decreasing water quality. There are ambiguities and inconsistencies between biofuels, forests, energy, water, climate and biodiversity. For example biomass production for climate mitigation may hinder effective biodiversity conservation, with regulation influenced by a lack of a holistic perspective by the regulators and a largely sectoral division of responsibilities with quite some conflicting sectoral objectives.

3.11 Transboundary Case France-Germany Upper Rhine

Upper Rhine is a case on the links and synergies between energy policies and the transition to a low-carbon economy on the one side, and the management of natural resources (in particular water) and ecosystems on the other side, in the French region Grand Est and the German state Baden-Württemberg. The area is historically intertwined and cooperation beyond borders in the Upper Rhine institutions is viewed to be essential. This is also a case where the objectives are coherent on paper and practice contains regulatory inconsistencies, ambiguities and gaps. Language and culture did however not come up as a barrier. In this transboundary context, joint efforts to regulate Nexus challenges cooperation is viewed as a common strategy but at the same time also very difficult.

Inconsistency between the governance structure, collaboration and regulation
The difference between the French centralized and German decentralized governance structure is a source for regulatory challenges. The way regulation is applied is affected by a lack of cooperation. Recent reforms merged the former Alsace with two other regions to establish Grand Est, which might be a threat to existing cooperation with neighbour Germany. Not only do decision makers represent the interests of a wider area, but it may also limit the mandate of the former Alsace to develop transboundary work. Also issues such as fish being protected on one riverbank but caught at the other causes stress to cooperation. Besides, a shortage of staff, a high turnover and the finding of the right person in different governance structures is a threat on the transboundary work. In addition, the difficulty to obtain financial resources for transboundary projects and research is a problem, while 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 neighbouring 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 institutions such as the Upper-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. Also lack of knowledge and information sharing of regional plans

developed by the neighbouring state obstructs transboundary consistency. Furthermore, nature conservation problems arise when ambitions are not aligned, influencing the overall biodiversity of the region. Likewise, different nature conservation approaches were considered an issue and the result of dissimilar gained experiences. Another example reported 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.

Regulatory gaps by the priority setting

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 stakeholders, leading to an insufficient focus and a lack of integration into other policy domains. Moreover, cross-disciplinary research may help reduce regulatory inconsistencies, ambiguity and gaps between domains based on scientific knowledge, this type of research may be less suitable for funding, publications in journals and requires shared understanding from researchers. Another issue is that it is also considered not-done to introduce a potentially conflicting issue into the decision making process if there already is one present. This might easily be a source for regulatory gaps in practice as it tends to exclude issues that could be important to the functioning of regulations. Crossing policy domains is limited by mind-sets not used to this, especially by government representatives. Finally, economic interests too often prevail above environmental interest.

Policies may be clear on paper, but this does not guide reality. At the implementation level impacted actors try to fit their own interests by navigating rules. The wood industry, for example, is very powerful and well-structured in the Alsace region. This leads to overexploitation of the forest. 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. The hierarchy of prevent, reduce, compensate is surpassed in the negotiation processes of defining what instrument applies. Moreover, diffused responsibility may lead to a lack of responsibility of the whole integrated strategy. Despite the clear goals of preventing wetlands, alluvial forest or pastures losses and land take, land-consuming projects often manage to find their ways into implementation. Formally, the French law does possess the tool to prevent a project where an actual compensation is proven impossible, though it is hardly used.

Finally, a lack 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 occur due to incoherent time planning of policy renewal and implementation, insufficient State control of compensation measures, and private individuals that are not complying with rules and regulations purposefully or because the complexity is too high. Most constraining interactions occur as a consequence of spatial development, aligning agricultural production with market demands and increasing renewable energy capacity.

Agriculture inconsistency: the Ecophyto plan

This plan aimed at decreasing pesticides use by a factor of 2. Such chemicals are mostly used by the agriculture sector but 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 increased by 22% instead of the 50% reduction objective. 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 promoting more efficient equipment for intensive farming for example). Attempt to fix the intensive production system backfired and increased even more the conflicts with other sectors.

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, … This issue is partially addressed in regulation but it do not however add up to a consistent, exhaustive regulation. It creates regulation loopholes but also prevent the topic to be properly addressed in political discussions. Sector-specific laws and directives left a regulation loophole for the soils.

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 a 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. Work on more integrated plans, coordinated by the International Rhine Commission but it takes time 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 and opted for the easier technical solution, addressing the effect rather than the cause.

In sum, the transboundary governance institutions in the Upper Rhine regions are tools or frameworks to enhance the regulatory quality and by that manage trade-offs and exploit potential synergies across the border. However, the cooperation is constrained by the presence of differences in the legal systems; a complex decision-making structure which makes it hard to find the right person within various layers and within a region; a high turnover disables the building of trusted networks; a lack of time and human resources to invest in transboundary relationships and address issues; with rules for funding that prevents successful projects to expand across borders while budgets are not spent; a lack of knowledge, information exchange and low awareness on how to fully exploit the synergies. Besides, conflicts often remain unsolved or are left unaddressed. As a result, the regulatory frame is not used to take into account Nexus relations. Many regulations can be bypassed or adapted to fit other purposes than closing regulatory gaps, ambiguities and inconsistencies. Some regulations then are just not implemented. In addition, a centralization of the French governance structure limits Alsace in its independence to operate and represent the transboundary interests by a more centralized Grand Est level.

3.12 Transboundary Case Germany-Czech Republic-Slovakia

3.12.1 German part

The German part covers the German federal states Mecklenburg-Western Pomerania, Saxony Anhalt, Brandenburg, Thuringia, and Saxony constituting the German Democratic Republic (GDR) and the City of Berlin, which has been divided 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.

Central Nexus domains are water, land, and energy with major conflict lines related to climate change, food, water and environmental consequences. Central issues are renewable energy and the link to a stable electricity supply as lignite mining; but also food production versus biomass generation.

Contested and inconsistent regulations in the land use, agriculture and renewable energy policy

The land needed to produce solar and wind energy is most of the time acquired in agricultural areas and to the disadvantage of farmers. The loss of agriculture areas leads to a lack of acceptance for the policy. Wind energy plants also produce noise for nearby living people. It is also a risk factor for birds. Energy sector is in general a sensitive issue as corporations can be forced to tax their produced power two times, if they add power temporally into the (internal) network. The double taxation causes a sense of being punished for doing good. In addition, the EEG apportionment (Erneuerbare Energien Gesetz) has proven to be problematic, a failure even, the case concludes. This a German feed-in payment that producers of renewable power receive per kilowatt-hour (KWh) as a (successful) tool to integrate renewable power into the market. It is, with some exceptions, paid for by all electricity consumers but most energy intensive corporations are exempt from the apportionment to avoid additional costs for the industry, and this leads to a sense of an unjust distribution of costs. Also the energy efficiency of solar energy is a highly discussed topic due to a high demand for land since the efficiency of energy conversion is still quite low. The installation of solar energy plants as ample solar parks is a contested issue. Installation on buildings is more compatible with land use, food and environment objectives. But also the continuation of the lignite mining is contested since it goes directly against the energy, land use and climate objectives. It is in the case seen as an obstruction of the policies regarding energy, land use and climate. The use of emission rights are also brought forward as an issue where there is policy on paper but in practice they are seen as too cheap to actually have any effect on corporations.

Inconsistencies in agriculture, energy, water and land usage for biofuel

The promotion of biofuels can be considered questionable regarding the achievement of secured food production and water usage. Areas formerly used to produce food is needed for the cultivation of plants intended for biofuels. These inconsistencies between biofuels, agriculture and water are not really included in the decision making, leaving negative consequences to continue. Environmental minded stakeholders also argue that too much deadwood in forests is used for biomass utilization, despite forest protection regulation. Decision makers are having difficulties in finding a compromise between forest protection and renewable energies. Protective regulations for trees were reduced in 2004 in e.g. Berlin, which goes directly against the efforts regarding the protection of forests.

Regulation issues in general: inconsistency between general intentions and practice

Regulation also have a more generic effect on the Nexus. The case study reports that the many laws, with too many exceptions causes unnecessary hindrances. The same goes for hindrances caused by the implementing rules for instance in the case of subsidies for the agriculture. Their often changing and complicated rules for getting subsidies and the changing process of organizing the subsidies make it hard for farmers and authorities to cope with the adjustments to the changes. Of great importance is also the combination of a complex regulation with a lack of control and enforcement. Such a state of affairs comes with high costs regarding the trust and acceptance of the regulation.

In sum, regulatory gaps, ambiguities and inconsistencies reduce support, trust, acceptance and compliance, which is even enhanced by the complex regulations with a lack of control and enforcement. Regulation might even be a victim of negligence, if the needs and objectives of other sectors are not appropriately considered. There is also a lack of willingness of policy makers to fully commit to a regulation, sometimes out of concern for the economy. The interests of the economy and big corporations are seen as being held in higher regard than the achievement of e.g. climate policy goals. This leads to a significant amount of exceptions (EEG apportionment) and inadequate policy support.

3.12.2 Czech part

The Czech part focuses on spatial water retention in the landscape, and the link to agriculture, environment and climate. Despite the space that is offered in the EU-regulation for tailor-made solutions, the Czech Republic prefers the unified and general EU model. The implementation of policies remains the same for all levels national – regional – local, without any significant amendments.

Two competing discourses leads to competition and ambiguous solutions

Of great importance for the regulatory practice are the different discourses and attitudes of the Ministry of Agriculture and the Ministry of Environment. Agriculture is in charge of the water policy and prefers a technological approach to water, i.e. measures targeted on adaptation of riverbeds and streambeds, the deepening of waterways, flood protective barriers, new water reservoirs from small ones to big dams, irrigation systems; with a preference for the concrete lobby, as one stakeholder puts it. The Ministry of Environment, on the other hand, prefers natural water retention measures with renaturation of riverbeds, natural flooding, respecting natural floodplains, etc.

Landscape, water, agriculture and environment: inaction and voluntary measures

The two discourses work in practice differently. Where one seeks improvement of drainage conditions of the landscape based on a quick drainage to prevent floods and built new water reservoirs to increase water retention, the other focus on improvement in soil quality and measures to promote natural retention of water in the landscape and soil. Despite threats of crop failure and loss of groundwater from near-surface aquifers, there has been no regulation of the groundwater in the last 30 years. There is also no interest in any actively change landscape structure by new landscape features.

Implementation of greening measures is mandatory for all farmers that receive EU CAP subsidies, but despite a few exceptions (like grassing and other non-productive measures) the conditions are set so that the effect is close to zero. Greening measures used do not contribute to the increasing of soil quality and improving water regime. Nothing has changed since the adoption of this measure in 2015 except for some non-production measures. Some of the good agricultural and environmental conditions (GEAC) and agri-environmental measures are not implemented or not implemented in a strict way. The cause is voluntary implementation of GAEC standards into national legislation. They are mentioned in a general way in the Act on soil land protection. Due to the not very strict conditions of these measures there has been no effect on improving the agricultural landscape. Few farmers adopt measures due to heavy bureaucracy and a low awareness on benefits for water and soil quality. Also policy makes have no focus on the needs for complete changes in agriculture soil management, as reducing the size of the soil blocks areas, which is an important measure in terms of spatial retention of water in the landscape.

Regulatory gaps in water

The Water Framework Directive is the most significant and most comprehensive and complex legislation on water, covering the entire area of the environment. Regulation 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. This should be about more than applying new technical standards, but also 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. The only document with the potential to take into consideration most of the water objectives, is the National management plan of Labe catchment. The territory of the Czech Republic belongs to three international river basin districts where water protection interests are covered by an international treaty signed by the Czech Republic, the Federal Republic of Germany and the EU through the International Commission for the protection of the Labe. But the management plans are not built the principle of water as public interest requiring complex measures that needs cross-sectoral communication and legislative support on agriculture, water, land. The water retention quality

regulation are disrupted by the policies supporting biomass production for renewable resources. The management plan is a complex document but is poorly supported, as well as disrupted by higher level policies. Big farmers (about 80 % farms area are above 2000 ha) and too big arable fields are threatened by erosion and suffer from insufficient 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 and environmental protection. Such a complex landscape approach is missing in the Czech policy.

Pressure on soil

Soil functions are 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, but the sanctions are near to zero. Many soil issues have been underway since 1991, but have been underestimated over the long term. Most attention is however paid to the construction of roads instead of hydrological and ecological measures. There is missing legislation for soil erosion.

Renewable energy and CAP: regulation without incentives

The commitment to renewable energy sources has led to a steep increase in biofuel production, mainly maize and rape. But a liberal GAEC, cross-compliance, statutory management requirements 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 a size-based subsidy system, which helps preserve the legacy of the past regime of large soil blocks. Similarly, questions about the quality of agricultural land, with no strict 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. Although the Czech Republic has adopted the European Landscape Convention, its implementation into national legislation is only partial.

In sum, in the Czech Republic, there are commissions to deal with climate change, landscape and water management. 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 into implementation, lacking 1) specific 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. If things work it is because of the enthusiasm of the involved people. However, water retention needs the interest and willingness for major changes from the top political structures for the realization of the needed complex measures and inter-sectoral communication.

3.12.3 Slovak part

The Slovak part focuses on challenges concerning the achievement of integrated links between water, energy, agriculture, food production and climate. The Slovak republic has for 25 years now been in a transformation from a regionally developed and food self-sufficient country with rich traditions and a developed agriculture, with a processing industry and a vital regional development, to a food dependent country with low levels of processing of local food resources, poor regions and a depopulated countryside.

Regulatory inconsistencies in the energy, biofuel, agriculture and land-use

Increasing biofuel production is achieved by expanding the production of 1st generation biofuel crops(maize, rape). Up to 90% of arable land is currently used for cereals and oil production. These crops are planted on large field blocks, conflicting with the objective of a heterogeneous landscape structure, subsidized by a state budget that directly supports big companies, farming mostly on leased land, which is against the objective of supporting land ownership. There conflicting regulations between biofuel and almost all regulations for water, land/soil, and food production. For agriculture, the situation is ambiguous with energy crops produced for renewable resources versus good agricultural and environmental conditions (GAEC) and climate objectives. Biofuel production also conflicts with objectives for the water regime and quality of the soil. Ecological and environment oriented objectives for food and agriculture are not clearly defined. Current land management has distorted the sowing procedures, - crop rotation, diversity of crops - , with negative effects on water, climate and soil quality.

In sum, there are many regulatory challenges, but the economic interests prevail over the ecosystem services. There are regulatory conflicts in landscape drainage with a lack of water in the landscape, local people sense a loss of identification and responsibility for landscape management, and the motivation tools for landscape management are inefficient. Much can be derived back to the forced collectivization of agriculture. 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. But it is not a solution against erosion and increasing the retention ability of agricultural land. Regulation does not improve soil quality or increase farmers' responsibility for implementing measures. Financially demanding regulations must have support in the governmental budget it does not have today. Also a lack of anchoring of policy in a society-wide support is problematic, as are departmental barriers and unguarded competencies. Integration of natural and technical measures is necessary.
The fundamental strategic role of water calls for better responsibilities in an inter-ministerial setting, based on a societal perspective.

3.13 Overall findings

These following overall findings derive from the cases. The list is not meant to be a complete or exhaustive one because the cases have had different approaches and focus.

Table 13.1: Regulatory gaps, ambiguities, inconsistencies

Description	Examples found
Conflicting (inconsistent) regulations: between different policy sectors	Andalusia; Azerbaijan; Greece; Latvia; Netherlands; Sardinia; South-West England; Sweden; Upper Rhine; Germany; Czech Republic; Slovakia
Ambiguous discourses: Two or more dominant and competing discourses, source for inaction, or regulatory gaps due to a lack of common interests.	Andalusia; Greece; Latvia; Czech Republic; Netherlands; Sweden; Germany; Czech Republic; Slovakia
Gaps and inconsistencies due to a lack of priority: setting priorities; emphasize on certain elements, others are left out.	Andalusia; Azerbaijan; Greece; Netherlands; Sardinia; Sweden; Upper Rhine; Czech Republic; Germany; Slovakia
Delegated ambiguity: political and high-end administrative policy interests only clear at an abstract level, with unclear implementation.	Netherlands; Greece; Sardinia; South-West England
Low awareness of "Nexus-needs": no sector-crossing mind-sets, knowledge & coordination missing	Azerbaijan; Latvia; Sardinia; Upper Rhine, Germany, Czech Republic

Gaps by absent rules/enforcement	Sardinia; Upper Rhine; Germany; Czech Republic
Ambiguity by diffuse responsibilities: Nobody really responsible and the result is ambiguity and inaction.	Azerbaijan; Latvia; Sardinia; Upper Rhine

Conflicting (inconsistent) regulations: between different policy sectors

In Andalusia there is conflict between agriculture and resource use efficiency (energy/water), where the modernization of for instance irrigation and more production lead to more water and energy use. Azerbaijan faces conflicting regulations between energy and climate. due to a growing economy and energy demand where the oil and gas usage are in conflict with the government's plan for renewable energy. Greece has conflicts on the water policy that subsidies water for intensive crops and water policies reducing the pressure on water resources. This in turn results in conflicting policies in energy, climate and agriculture. In Latvia there are conflicts between energy (wood and hydro-power plants but also oil and gas), which helps achieving the objectives of renewable energy, but has a negative impact on water quality and water ecosystems, and forest ecosystems. Besides, energy crops/mono-cultures are conflicting with food production in agriculture. Logging (clear-cuts) also goes against environmental policies. The Netherlands faces conflicts between biomass as an energy source and higher-end usage, for example in the chemical or pharmaceutical industry. This is also in conflict with agriculture, which many argue should be about producing food and not waste. This is also the case with nature, where the policy for protection conflicts with nature (forests) for rest-streams (biomass). In Sardinia the expansion of agriculture demands much water which counteracts the policy to reduce water consumption. and the nature protection regulation. In South-West England is dealing with water conflicting water and agriculture policies due to disparities between how point discharge of wastewater and diffuse discharge from agriculture are regulated because the aggregated effect of numerous discharges is often greater than that from wastewater, and specific local conditions for agriculture can create conflicts with the generic water regulation. Also fossil energy use conflicts with renewables, bio-energy is inconsistent with agriculture and environmental regulations. The land-use is then subject to soil problems as erosion. Waste regulations are in conflict with renewable energy targets and also internally inconsistent because of the rule of local disposal only. In Sweden the market-oriented agriculture and forestry are inconsistent with environmental protection (biodiversity) and water quality. There are also ongoing conflicts between housing and biodiversity protection. The Upper Rhine has also inconsistencies similar to others by over-exploitation of forests and agricultural production versus nature protection. Germany is no exception either with inconsistencies in the regulations for land-use, biofuel for energy, agriculture for food, water and environment. Wind energy and land-use is one of the issues. For the Czech Republic inconsistences between landscape, soil, water, energy and environmental protection are reported to be present. For Slovakia we see inconsistencies in the regulation of energy, biofuel, agriculture and the specific inherited situation of a land-use built on large blocks of land that are reported to be incompatible with current needs. Much conflict derives from biofuel production.

Ambiguous discourses: Two or more dominant and competing discourses (ministries), source for inaction, or regulatory gaps due to a lack of common interests

Policy is not a 'neutral' activity. Of paramount importance for the regulatory practice are discourses that work against each other. A common and also the mother of all disparity is the one between economy and environment. These competing discourses fuel conflicts for example between agriculture, forestry and energy policies where struggles with environmental policies become manifest. In the case Andalusia this is reported by the reference to conflicts that 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. In Azerbaijan it is about fossil fuel and sustainability (and renewables). Greece reports on ambiguities between economic and more sustainability discourses, which is then seen in the energy vs climate debate and also has effects on agriculture and water. In Latvia these discourses are found in

forestry versus sustainability. In the Czech Republic techno vs nature). The Netherlands has in its case on biomass showed competing discourses between biomass for energy versus both a more resource efficient economy (high end usage of biomass) and also with land-use and agriculture/forestry and nature protection. Sweden reports on an intensive agriculture and forestry in disparity with environmental/nature protection. Germany also faces discursive struggles between economic development and environmental protection. Also the Czech Republic and Slovakia have similar situations between agriculture and environmental protection.
In short, the cases demonstrate the commonality of ambiguous discourses, which then also have effects on how policy is made and conducted.

Gaps and inconsistencies due to a lack of priority: setting priorities; emphasize on certain elements, others are left out
The lack of priority might follow the distribution of power within the MS but also the EU. In Andalusia promoting clean (renewable) energy is not enjoying too much priority. Azerbaijan is facing a similar state of affairs. In Greece agriculture production and tourism prevail above more sustainable policies. Latvia reports a lack of priority for ecosystems, in forestry for example. In the Netherlands critics argue that climate now receives more attention than a broader resource efficiency approach. In general, minor priority for sustainable solutions seems to play a role in various cases, for example in the land-use in Sardinia, agri-environmental measures in Sweden, soil management in Upper Rhine, and also in the commitment to sustainability in the Czech Republic, Germany and Slovakia.

Delegated ambiguity: political and high-end administrative policy interests only clear at an abstract level, with unclear implementation
A special case of ambiguity derives from policies that turn out to be unclear in the practical usage during the implementation. We see this in the Netherlands where the biomass usage in the business chain is far from clear. We also observe this from the Greece case with the water irrigation and use of for example pesticides in agriculture, in the biomass value chain in Sardinia, and the regulation for wastewater in South-West England. The point is that it hampers efficient implementation and it calls for questions concerning the presence of other types of ambiguity, as the setting of priority and the awareness involved.

Low awareness of "nexus-needs": no sector-crossing mindset, knowledge & coordination missing
In many cases there are low awareness of any need for sector-crossing knowledge and coordination. We see this for example in the cases from Azerbaijan; Latvia; Sardinia; Upper Rhine, Germany, Czech Republic. We do believe the awareness in all cases varies and that it is hard to point to a certain level of awareness. But the issue does deserve attention when it translates and affects policy achievements.

Gaps by absent rules/enforcement
Absent rules or rules that are not enforced will probably be rather common in many specific settings. We have observed here some examples of this situation. In Sardinia we see this in land-use, water and agricultural measures missing incentives. In Upper Rhine the French biodiversity law is not in use. Germany has enforcement issues in climate and environmental policies and the Czech Republic in management plans for water, agriculture, with no regulation for groundwater, but also agri-environmental measures that are not or hardly implemented. A more general challenge is the absence of soil protection policies where the MS do not want any EU-policy on soil either.

Ambiguity by diffuse responsibilities: Nobody really responsible and the result is ambiguity and inaction
For the implementation situations where nobody really is responsible for a certain policy part is observed in Azerbaijan, where there are many policy actors with regulatory authority. Also in for example Latvia with the issuing of permits for and enforcement of land management. We see it in the land-use enforcement in Sardinia and for the responsibility for the overall strategic plan in Upper

Rhine. This list is likely to grow if it is investigated more in detail. But our point here is that this should not be underestimated in the policy development.

We do add to this list that the immense amount of regulations and policy parts do play a role in the ambiguity of policy. Dealing with ambiguity is thus more than just making better priorities through more awareness and willingness.

4 Successful tailor-made solutions

Key messages

- The added value of a nexus approach stems from the exploitation of synergies between policies, avoidance of conflicts and trade-offs between policies because they were foreseen and addressed, and innovative solutions stimulated by broad cross-sectoral views and relational learning.
- As competences are differently divided between administrative levels for WLEFC sectors, and because trade-offs in the nexus cross scales as well as sectors, the governance of the WLEFC nexus is multi-sectoral and multi-scale.
- Successful nexus policymaking depends on political will, mindset, knowledge management and careful organisation of the process through the whole policy cycle.
- Fifteen critical elements for successful Nexus policies are identified, divided into *three main pillars* that partly overlap: Democratic Science, Participation and Support.
  - The *first pillar* relates to a democratic and broad science to establish a strong scientific knowledge basis about interconnections between natural resources, sectors and policies. Important is knowledge sharing and capacity building, open debates and shared understandings.
  - The *second pillar* proposes to maximise participation for boosting equality between sectors and sustainability of the policy. Legitimacy can be established through expanding existing networks and spread successful policies to a wider range of actors and sectors. Stakeholders need to be involved at all stages of policy processes and it is vital to create a sense of shared ownership with shared goals, benefits and costs.
  - The *third pillar* argues that constant monitoring and policy support are vital. Coherent implementation requires clarity of guidelines and measurable targets. The progression towards these targets needs to be monitored. All policy processes should take place at the appropriate scale of governance, vertical cohesion through different levels of governance to avoid conflicts and to facilitate capacity transfer down to the most local level. Support over the long term is important to nurture policies and implementation through the provision of finance and flexible management.

4.1 Introduction

The objective in this chapter is to identify tailor-made solutions and success factors for governing the Nexus, also for the European Commission. Material will be used here from Munaretto et al. (2017) who offers 'Windows of opportunities and improvements' for a nexus approach at European scale (chapter 7.4) and Munaretto et al. (2018) who describes factors hampering and fostering coherence, with much material on success and failure within both formal and informal arrangements across the case studies. Witmer et al. (2018) is devoted to success stories and criteria, with input on how the policy process and its governance affect the Nexus. They defined criteria to judge a policy in the water-land-energy-food-climate (WLEFC) nexus as successful for the output and impact of the policy as well as for the policy-making process. These criteria are: 1) Policy output: goals, implementation and instruments are defined in a transparent way, while addressing policy coherence, maximising synergies within and between sectoral policies and managing conflicts and trade-offs at bio-physical, socio-economic, and governance level. 2) Policy impact: the policy should be effective and efficient to reach the agreed goals and be sustainable. 3) Policy process: the process should be fair and transparent, and equally respect interests of stakeholders from different sectors in the WLEFC nexus.

The added value of a nexus approach stems from the exploitation of synergies between policies, avoidance of conflicts and trade-offs between policies because they were foreseen and addressed, and innovative solutions stimulated by broad cross-sectoral views and relational learning.

4.2 Successful nexus policy depends on multiple factors and is tailor-made

The case studies show many examples of national and regional tailor-made solutions that are successful but not necessarily common practice yet. Success in a nexus policy process depends on multiple factors. Factors that are successful in one setting might not have the same effect in another where the culture of interaction might be different. The context and timing are decisive for success. Two regional examples can illustrate this. One example concerns the case South-West England, the other the case Sardinia.

4.2.1 South-West England: resilient drinking water supply

The UK regulator for water OFWAT recently cited South West Water as a good example of resilience, integration, interdependencies and efficiency (OFWAT, 2019). Collaboration with the University of Exeter, Plymouth Marine Laboratory and Plymouth University on leak detection and their performance and planning has meant that they are considered on the "fast track" by OFWAT, the UK water regulator. Being categorised as 'fast track' by Ofwat means that the company will receive early draft determinations of their price, service and incentive package for 2020-25, a financial benefit and a boost to their reputation Specifically, the role of South West Water in the SIM4NEXUS project has drawn praise:

'South West Water also provides high quality evidence of collaboration with stakeholders to develop efficient options and integrated systems around resilience. One example is its collaboration within the multi-stakeholder SIM4NEXUS research project to improve its understanding of the inter-relationships and interdependencies of water, energy and land management in the South West of England.'
OFWAT (2019: 62)

In this fragment, several success factors are mentioned: stakeholder involvement, interdependency between stakeholders, integration of interests, integrated knowledge and understanding from scientific research and stakeholders of interrelationships and interdependencies. Targets are reached efficiently and on 'fast track'.

4.2.2 Sardinia: water allocation based on knowledge and stakeholder engagement

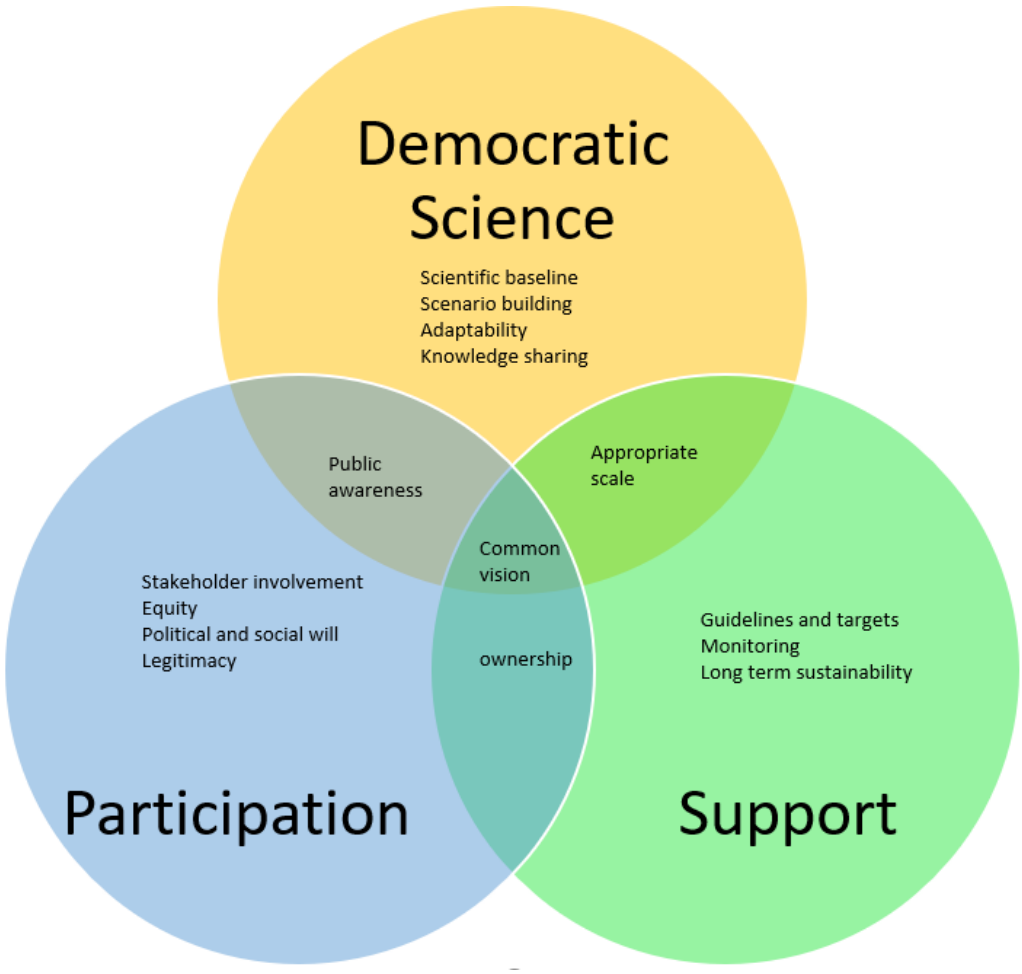
The Sardinian case study has contributed to the Sardinian Regional Strategy for Adaptation to Climate Change (SRACC). The case study was able to provide models and data on the interactions of water, land, food, energy and climate sectors. The SRACC was thereby able to produce new knowledge on the hydrogeological structure and risks for the territory, the agricultural and forestry sectors and the inland water sector. It showed the implications of water governance for multiple sectors, such as water, agriculture, land-use, tourism. As a result of the work, it has been possible to develop new networks of stakeholder engagement and interaction.

The following success factors are mentioned in this fragment: a strong knowledge base of interactions in the nexus, risks and implications of water management for multiple actors, with stakeholder involvement in new networks.

4.3 Fifteen success factors in three overlapping pillars

Witmer et al. (2018) drew up a list of success factors for a nexus governance process. They also defined criteria to judge the policy output and impact of such a nexus policy process 'successful'. The success factors were derived from Svensson (2018) who explored theoretical literature about good governance and made an inventory of success criteria and conditions, focussing on interdisciplinary, 'system-thinking' and cross-sectoral processes. She tested these criteria and conditions from theoretical literature against the findings in practice of eight finished and evaluated cases that were judged as 'successful' by the authors. Based on these two sources, theoretical literature and the eight cases, a Framework for successful nexus governance was designed and presented to the ten national, regional and transboundary cases of SIM4NEXUS. The cases checked if they could confirm the success factors mentioned in the framework, completed it and added examples of success and failures from practice. In this section, the list of success factors made by Witmer et al., (2018) is clustered in fifteen categories and three overlapping pillars, Democratic Science, Participation and Support (Figure 4.1). Per category, three examples are given from the SIM4NEXUS cases to illustrate how the success factor can work in practice.

Figure 4.1: Factors for successful Nexus policies



The first pillar relates to a *democratic and broad science*. It is necessary to establish a strong scientific basis of interconnections between natural resources, sectors and policies. This should be achieved through knowledge sharing and capacity building which opens up debates and can lead to shared understandings and languages. This is true for the status quo and for scenarios which consider uncertain futures. Knowledge and planning for uncertainty can make adaptive policy possible.

The second pillar proposes that all policy processes need to *maximise participation* which can boost equality between sectors and sustainability of the policy. Legitimacy can be established though expanding existing networks and successful policies to a wider range of actors and sectors. Stakeholders need to be involved at all stages of policy processes and it is vital to create a sense of shared ownership with shared goals, benefits and costs. This can both create and be facilitated by political will to affect change and public awareness of the issues.

The third pillar suggests that constant *monitoring and policy support* was found to be vital. Coherent implementation can only occur if there is clarity or guidelines and measurable targets are identified. The progression towards these targets needs to be monitored. All policy processes should take place at the appropriate scale of governance. Moreover, there must be vertical cohesion through the differing levels of governance to avoid conflicts and to facilitate capacity transfer down to the most local level. Support over the long term is important to nurture policies through the provision of finance and flexible management.

Here we present the 15 success criteria with examples.

1. A strong scientific baseline is the ideal start

Developing a strong scientific baseline should be given sufficient time, as a thorough understanding of the interconnections between resources and sectors is crucial. Moreover, no improvements can be measured without setting the baseline.

- In Sweden, forestry authorities are able to apply for external funding to increase the knowledge base in order to consolidate knowledge from a range of sectors related to water.
- In Greece, the Ministry of Environment and Energy, the Hellenic Public Power Corporation and research institutes collaborated to exchange knowledge and expertise.
- In France and Germany, the wine culture institute considers the interaction of agriculture and climate over the long term.

2. Scenario building can increase awareness and prepare for uncertainties

A nexus approach deals with many uncertainties, and scenario building has been shown to be an efficient way to increase the awareness of issues and prepare stakeholders for uncertainties, making the project more resilient.

- In Greece, the design of regional policies for climate change adaptation consider a range of scenarios to facilitate long term governance.
- In France-Germany complexity is included in policy planning. This is manifested by going beyond the consideration of environmental factors to also factor in social factors such as mobility, health, cities and food autonomy and how these drivers interact with the environment.

- The European Commission has recently released a report on policy foundations to realise a "Sustainable Europe" by 2030. This could be achieved through three different scenarios for implementing the Sustainable Development Goals. The costs and benefits of three scenarios are considered: an overarching guiding EU SDG strategy, mainstreaming of SDGs into EU policies and focus on external action.

3. Plan for adaptability and allow for objectives and targets to be revised to keep them relevant

Adaptability needs to be acknowledged already in the planning phase to prepare stakeholders and players that change may happen along the way. Revision of targets or methods to incorporate change will most likely be necessary, because governing a nexus involves many uncertainties.

- In the France-Germany cross border case, the Upper Rhine Conference transboundary governance organisation is able to account for uncertainty and complexity by considering themes which are important to the municipalities; cities, soils, food, autonomy, health, mobility and the circular economy.

- The Sustainable Development Goals are a framework which states can interpret as they see fit. This means states can focus on their own priorities and adapt if and when contexts change. This is supported by tracking and monitoring at global, regional and national levels.

- In South West England, monitoring and evidence of the impacts of catchment sensitive farming enables the targeting of specific policy areas. Foci can be adapted to the local context and circumstances to maximise synergies and reduce trade-offs.

4. Involve stakeholders in every aspect of the project

For a nexus approach, involving stakeholders from all relevant sectors is crucial. Involving local communities can be an efficient way to get information about local policies, cultures and knowledge, and avoid conflicts. Involvement can also increase ownership.

- In Latvia, a Regional Living Lab was created to bring together a range of stakeholders to produce a shared plan for the production and use of renewable energy within transport for the Zemgale region.

- In Andalusia, an inter-ministerial committee brings together ministries for Agriculture, Environment, Employment, Enterprise and Trade. In addition, NGOS and the private sector were consulted in the creation of the climate change law. This enabled the production of cross-cutting policy to address climate change.

- The Netherlands has a long history of stakeholder consultation, predating the concept of the Nexus. Previous conflict between the private sector and government over regulation as a barrier to innovation resulted in the creation of the "Acceleration Team" which addresses the concerns of business. This has streamlined processing times and improved subsidy scheme for the Stimulation of Sustainable Energy Production (SDE+).

5. Dynamic knowledge sharing and capacity building are important

The exchange of knowledge is important for the innovation of the project, the equity of participation and the achievement of goals. As knowledge may be contested, it is important that parties are open to different interpretations and framings of knowledge. Specific for a nexus, involving many sectors means that learning about new methods, languages and jargons will be necessary. It is also important to raise awareness about issues in different sectors that might not be known by stakeholders in other sectors.

- In Greece cross sectoral policies related to climate change adaptation were bolstered by knowledge sharing between the state, academia and a research institute. This built trust and the common language and definitions across sectors vital for successful collaboration.

- In Latvia, the Latvian Fund for Nature has cooperated with the Forestry Consulting Services Ltd to provide free seminars on environmentally friendly forest and land management to different stakeholders to encourage promotion of natural resources alongside profit.

- The process through which the sustainable development goals were conceived was one of the largest exchanges of knowledge ever conducted. It took three years and involved states, international organisations and non-governmental organisations. Consultations occurred at global, regional and national levels and even online. The process developed and refined the goals, but also built trust between actors.

6. A fair distribution of costs and benefits needs to be achieved, and equal opportunity to participate in the project for stakeholders

If the opportunity to participate for stakeholders in all sectors and the outcome of the project are considered fair, implementation of the project may be reached with higher acceptance.

- In Germany, it was found that policy success was bolstered if different parties and sectors have something to gain from adhering to regulations.

- In the Netherlands, by including a range of actors, the Dutch government was able to create shared ownership of the costs and benefits of actions, building stimulus for innovation.

- In Greece, when parties have similar levels of power and have somewhat aligned interests and interdependency, cooperation has been successful. This has been shown by the way in which ministries and electricity companies can work together with broadly shared goals.

7. Ownership increases engagement and sustainability of project

Creating ownership of the project can increase the likelihood of it being sustained in the future. A high staff turnover should be avoided to minimise the loss of information, legitimacy and emotional connection with the project.

- In the Netherlands, the government has been successful in fostering joint ownership. The private sector and NGOs were stimulated to lead in “Top Sector” policy and in the Climate Tables

- In South West England, catchment sensitive farming works on a cross-sectoral basis, including water, land and agriculture and food. Stakeholders include the public, the private sector, NGOs and farmers, who it is often challenging to engage in such processes. It is supported by Defra, the Environment Agency and Natural England. It is a long running programme funded by the government which has brought stability.

In Andalusia, the EIP-AGRI (European Innovation Partnership for Agricultural productivity and Sustainability) project has benefited from a range of stakeholders including famers, the private sector, non-governmental organisations, researchers and the government each taking ownership in the policy. The recent ‘Law 8/2018 of measures against climate change and for the transition to a new energy model in Andalusia’ is evidence of the success of how these groups work together.

8. Political and social willingness to change facilitate the implementation of project

The political and social willingness to change is important since it can help to push the change forward. An unaccepted status quo can make stakeholders more receptive for proposed changes.

- The Sustainable Development Goals had as their genesis the realisation that current modes of economic practice and environmental policies were unsustainable. Their codification represents the political and social will that without significant change we will inflict further damage on the environment and encroach upon planetary boundaries.

- In Greece, there is widespread recognition of the need to move towards renewable forms of energy production. This is shown by the growth in investment in photo-voltaic cells and their installation by households in addition to the establishment of wind parks.

- In Sweden, cross-sectoral cooperation has been institutionalised through the Regional development and cooperation in the environmental objectives system. This has combined with individual and institutional leadership and commitment.

9. Public Awareness increases acceptability and knowledge

By increasing public awareness, the need for change may be clarified and the proposed actions more likely to be accepted.

- In Sweden, the education system fosters a sense of both awareness of environmental issues and challenges, but also the sense that it is possible to confront them. Awareness of environmental issues within sectors has been bolstered through “Regional Development and Cooperation in Environmental Objectives System”.

- In Greece, farmers are now more likely to accept that pesticides are harmful and as a result organic farming is a growth sector.

- Germany-Czech Republic- Slovakia. In Germany, one of the reasons for increased resource efficiency is increased public awareness. For this reason, it is expected that increased education and awareness raising in rural areas of the Czech Republic and Slovakia could also bring positive results.

10. Common understanding and common vision need to be achieved

The effort to find common ground among stakeholders should not be rushed, as this vision will help steer the process. By the nature of a nexus, this will be extremely important as combining stakeholders from many sectors could mean divided ambitions that need to be merged. If a shared vision is reached, players will have higher acceptance towards short-term inconveniences for the benefit of the shared vision. Moreover, if a true understanding of each other’s interests is achieved, stakeholders from one sector may be more open to solutions which are beneficial for another sector.

- In Latvia, communication between institutions and organisation mean that opinions are presented and shared visions can evolve. This has led to collaborative arrangements in relation to use of resources and sustainable development in general.

- In Sardinia, the Regional Territorial Strategy combines all of the sectors of the Nexus. While it is unenforceable, it provides a strategic vision.

- Sweden has a tradition of deliberative and participative processes, a quality that enables the development of Nexus policy and the formalisation of cross-sectoral collaboration. This is supported by a education system which helps produce an environmentally aware population.

11. Legitimacy is essential

Legitimacy helps to gain support for the project. Recognised authority to implement change is important as empty promises quickly deplete trust. Building on already existing frameworks and establishments can help the project to gain legitimacy.

- In the Netherlands the collaborative nature of the policy making has been crucial in creating legitimacy. Specifically, by building on past experiences and successes of a climate agreement between the national government and other stakeholders by 2020, the "Climate Tables" which discuss measures to attain climate goals by 2030 were developed. In 2016, 180 organisations agreed on a National Agreement on the Circular Economy. This shared vision laid the groundwork for the subsequent Transition Agenda Circular Economy.

- In Košice, Slovakia initiatives are built upon the success of government programmes of landscape restoration which started in 2011.

- In the Upper Rhine area, shared experiences under the Upper Rhine Conference has created expertise, knowledge and trust vital for working on cross-sectoral issues.

12. Clear guidelines and measurable targets to avoid incoherent implementation

Clear guidelines will avoid misunderstanding and without measurable targets, monitoring is problematic. This becomes especially important when many sectors with different backgrounds and understandings are working towards a common goal.

- In Sweden the national government provides clear annual directions on key activities, targets and budgets allocation to different activities. It clearly states which goals need to be achieved and required reporting.

- There are 19 Sustainable Development Goals and a total of 169 targets, the attainment of which are measured by 232 indicators. There is even a target which is explicitly related to policy coherence. However, the SDGs avoid the danger of being prescriptive. As it is a normative framework, there is room within the goals for context specific and adaptive policy making, it is possible for states to experiment and develop best practices.

- In the Netherlands, the Climate Tables produced a clear framework for how to achieve climate goals by 2030.

13. Monitoring is important for developing a shared understanding, building trust, adaptability of the project and enforcement

Monitoring the projects process is fundamental for its success. Without monitoring, no progress can be measured. Monitoring is also important to provide information for future planning, to raise awareness, to assure trust among stakeholders is upheld and for the enforcement of the project.

- In Greece there is close monitoring of regional policies for climate change adaptation, the use of photovoltaics, energy, agriculture and biodiversity and wetlands.

- The evaluation of the 2007-2013 Andalusia Rural Development programme demonstrated success in addressing water, soil, agriculture and climate and also brought employment and economic growth.

- In Latvia, the Central Statistical Bureau of Latvia monitors national statistics, while the Cross-Sectional Centre Republic of Latvia monitors the implementation of national development plans and sectoral policies. The University of Latvia is currently is currently developing a system model for environmental indicators at national, regional and local levels.

14. Scale of governance should match the problem scale

Subsidiarity is an important criterion to divide the decision and implementation power. Decision and implementation power should be awarded to the most local level possible, to assure that correct information is used, to create ownership and acceptance and to avoid conflicts with local or regional plans and regulations. Regional or national leadership should be used when local leadership does not have sufficient capacity. Leadership that is too distant from the issue may overlook problems, synergy options and trade-offs.

- In Sweden, vertical cohesion has had a catalysing effect. The overarching framework of the European Union climate targets have contributed to galvanising national political will and the vision to make Sweden a fossil fuel free country.

- The SDGs are global, as environmental challenges are global phenomena which do not respect borders and have implications for planetary boundaries. In this way, it can be seen that the SDGs are an improvement on the Millennium Development Goals which were only implemented by developing countries.

- In the Czech-Slovak case, it has been possible to align global and European climate and energy policies. This has meant that subsidies at the national level have been used to support the growth of bio-energy crops. Initially this brought large-scale monoculture of bio-energy crops with implications for land cover, the water cycle and local climate. These negative outcomes are being reversed at a range of related scales. At the European level this occurs through changes in subsidies to promote second generation biofuels over the first generation which are produced from food crops and new environmental regulation and investment. At regional and local levels it has been possible to reverse the process through communication with landowners and farmers about the benefits of restoring other crops.

15. Long-term support is necessary

Access to the right resources, such as finances and a long-term management plan that allows for flexibility, is crucial for the successful completion of the project.

- In the Netherlands, the Dutch government has been proactive in the last decade, planning biomass policy until 2030. It has involved the private sector and non-governmental organisations to create co-leadership and invested in the biomass economy. EU interregional/EFRO co-financing facilitated cooperation between stakeholders in the provinces of Noord-Brabant in the Netherlands and Antwerp in Belgium.

- In the Upper-Rhine area, the interregional fund can provide funding for cross-border cooperation but at present these funds are under exploited as stakeholders may not know they are eligible and the application processes are complicated.

- In Azerbaijan, international support and networks have been vital to form environmental policy. The German Development Bank cooperates with local joint stock companies to improve water resources. The Ministry of Energy and BP are collaborating to improve the operation of small hydroelectric power stations and to effectively utilize the hydro-electric potential of rivers. Funded by UNEP and the TACIS programme of the European Commission (Technical Assistance to the Commonwealth of Independent States), a 'National Biosafety' project was developed. Although most of these projects may not be as nexus-compliant as in the EU, the relational learning they bring can lead to more synergistic policy in the future.

4.4 Overall findings

4.4.1 The success factors

Success factors do not stand alone but are interrelated. Implementation of these success factors should be tailor-made, appropriate for the issues at stake and stakeholders involved. As the list of success factors is quite extensive, the question arises when nexus governance is 'good enough'. This must be explored by applying the fifteen success factors in practice.

We have not found cases where all the above mentioned success factors criteria are well accounted for. But we have found interesting examples where the interdependent relationships between sectors are part of the approach although they might not satisfy all sectors involved. We see that synergies are possible, rather perfect synergy is impossible, and striving to attain it could lead to the trap of the *double maximand* through which nobody, or no sector is satisfied. These findings justify the need for working closely together on policy to enhance synergies and minimise trade-offs. Here we offer a reflection of the examples described above, following the three pillars and the 15 criteria.

Democratic science

A strong scientific baseline is by Svensson (2018) seen as the ideal start for improving relationships between sectors. This should be given sufficient time, Svensson (2018) argues, as a thorough understanding of the interconnections between resources and sectors is crucial. In South-West England they engaged two universities and an expert laboratory to provide the science in close encounter with the regulator and other stakeholders. Sardinia and Greece had a similar approach which even enabled an expansion or improvement of the collaboration. Sweden enabled funding for forestry authorities to engage in sector-crossing knowledge.

Scenario building for increased awareness is applied in Greece, France-Germany and also in the European Commission. It might be a powerful way of dealing with uncertainties and an efficient way to increase the awareness and prepare stakeholders for uncertainties. But is does require a willingness of engaging in such a way of working. Such willingness may lead to a ***planning for adaptability allowing policy revisions*** and ***knowledge sharing and capacity building.*** This work starts with building an early acknowledgement for preparing stakeholders for change. The France-Germany Upper Rhine collaboration has an institutionalized way of doing such work across borders, although it is reported to be rather formal. Knowledge sharing is also a demanding task, because knowledge is contested and the parties involved must be open to different interpretations and framings of knowledge. Specific for a nexus, Svensson (2018) argues, involving many sectors requires learning about new methods and new ways of seeing problems and opportunities. It is also important to raise awareness about issues in different sectors that might not be known by stakeholders in other sectors.

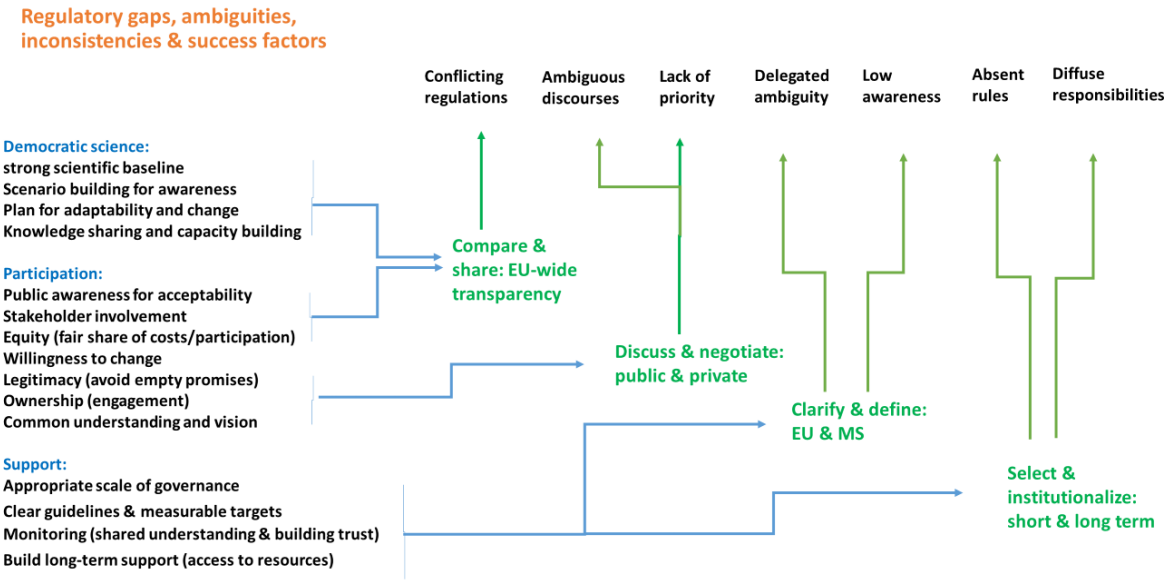
Participation

Participation points to *involve stakeholders in every stage of policy* and *participatory equity.* The Regional Lab in Latvia might be a good tool for such involvement. The Netherlands base much of its policy preparation on broad involvement, although this does not mean all stakeholders actually are involved, let alone satisfied. But it does fit the political culture of the country and such a fit in a particular setting might be a necessary condition for legitimacy. Svensson (2018) mentions the involvement of local communities as an efficient way to get information about local policies, cultures and knowledge, and avoid conflicts by increasing the sense of ownership. A fair distribution of costs and benefits needs to be achieved, with equal opportunity to participate in the project for stakeholders. We add to that the need to be somewhat selective in the choice of stakeholders. But who gets to decide that? An open participation would allow people and organizations to choose themselves but might also result in a skewed participation. Participation based on invitations might broaden the sector representation but will exclude some.
Creating a sense of *ownership* increases engagement and a way to increase the likelihood of it being sustained in the future. A high staff turnover should be avoided to minimise the loss of information, legitimacy and emotional connections. The Andalusia EIP-AGRI partnership is an interesting example as it has a multi-level and multi-actor binding between EU (through the EIP) and a range of governmental and non-governmental partners.

Support
Eventually, much is decided by the level of *political and social willingness* to change and to facilitate change of for instance the implementation. Such a willingness to change is important since it can help to push the change forward. The Swedish regional development has made progress on willingness by engaging in cross-sectoral collaboration combined with both individual and institutional leadership. In a broader sense, *public awareness* might increase the acceptability of change. The Latvian investments in communication has had effects on the level of *common understanding and vision*. Finding common ground among stakeholders should however not be rushed, Svensson (2018) argues. It takes time but it is also extremely important, because combining and committing stakeholders from many sectors is necessary in the nexus. Shared visions leads to a higher acceptance of maybe temporary inconveniences for the benefit of the future. At least stakeholders from one sector may be more open to solutions which are beneficial for another sector (Svensson, 2018). Support also depends on *legitimacy.* For governments recognised authority to implement change is important as empty promises quickly deplete trust. Building on already existing frameworks and establishments can help the project to gain legitimacy. The EU climate policy has for instance helped Sweden to national political will to engage in a fossil-free future. *Clear guidelines and measurable targets* to avoid incoherent implementation is usually important to avoid misunderstanding and conflicts. measurable targets, monitoring is problematic. This becomes especially important when many sectors with different backgrounds and understandings are working towards a common goal (Svensson, 2018). *Monitoring* is important for developing a shared understanding, building trust and create conditions for adaptability. Svensson (2018) sees it as a fundamental condition for success: Without monitoring, no progress can be measured. But also the *appropriate scale of governance* is of great importance to match the problem scale with solutions. Subsidiarity is an important criterion in Europe. Its principle of decision making and implementation power being awarded to the most local level possible, might enhance the sense of ownership and acceptance and to avoid conflicts. Regional or national leadership should be used when local leadership does not have sufficient capacity. Leadership that is too distant from the issue may overlook problems, synergy options and trade-offs (Svensson, 2018). Finally, *long-term support* is necessary and calls for access to the right resources, such as finances and a long-term management plan that allows for flexibility.

4.4.2 Success factors and regulatory challenges

In the figure below we combine the success factors with the regulatory challenges from Chapter 3. There could have been lines between all the possible combinations but here we emphasize some of the essential connections involved.



We argue here that there are many opportunities to improve policy and make it more coherent and achieve better results. As a stepping stone to the recommendations we identify an opportunity to explicitly compare and also share throughout the EU which conflicting regulations the EU and its MS are dealing. This is in particular a task that will involve science but then a democratic science with broad participation, also among citizens.
Another opportunity rely on the willingness of the involved to engage in a search for how the various discourses and the (lack of) priorities affects policy and then discuss and where necessary negotiate better solutions, with involvement of both public and private parties.
Then there is an opportunity in addressing both the delegated ambiguity and the low awareness in order to clarify and define solutions. Finally, we point to an opportunity to focus on the absence of regulations and the diffuse responsibilities involved in policy.

5 General conclusions and recommendations

5.1 Conclusions

The objective of this report is to identify improvements to the governing of the Nexus. For this purpose, we analysed the horizontal and vertical policy coherence between the Nexus domains water, land, energy, food and climate (WLEFC). Also, the regulatory gaps, ambiguities and inconsistencies in policies and policy processes, hampering the coherence, were investigated and we searched for successful national and regional tailor-made solutions applied in practice. We conclude the following:

1. Much attention to energy and climate but this comes with negative effects on water, land and food
In the EU and the MS much attention is currently paid to energy and climate, with potential negative impacts on water, land and food production. The objectives are rather coherent but in the implementation stage there are incoherencies due to unequal progress of policies and implementation between member states leading to different needs for support from EU policies; conflicts between socioeconomic and environmental interests; incoherence in regulations between scales; a sense of overregulation by many stakeholders due to the multitude of regulatory rules for the implementation.

2. More synergies than conflicts on objectives - synergy or conflicts depend largely on the way policies are implemented
Although there are more synergies than conflicts reported between European and national policy objectives for water, land, energy, food and climate, there are conflicts regarding biofuel production, hydro-energy production, agricultural competitiveness and the development and uptake of safe CCS technology. These conflicts are only partly addressed in the current and proposed EU policies. In addition, competing claims on scarce water and land are inherently conflicting. Synergies found in objectives as 'Resource and energy efficiency' and 'Good practices in land and water management including nature-based solutions' are beneficial for the whole nexus. For the objectives 'Improve the competitiveness of agriculture', 'Water supply' and 'Combatting droughts and floods', synergy or conflicts depend on the way policies are implemented.

3. Implementation vulnerable to conflicting interests rooted in a dominance of the short-term economy: often less priority to environmental issues and soil quality
In the implementation stage the SIM4NEXUS cases found many conflicts in the agriculture policy between economic and environmental interests. Biofuel is often in conflict with food production and sustainable forestry. We also report a strong competition for scarce water resources and land-use There are regulatory gaps and inconsistencies between water, land, energy, food and climate (WLEFC). A lack of priority to environmental issues often reflects that the sort-term economy prevails above sustainability. Soil quality is an example of an issue that is under pressure but receives minor priority. Also, agricultural measures from the EU Common Agricultural Policy, for example the Environmental Quality Objectives (EQO) and Good Agriculture and Environmental Conditions (GAEC), are often given minor priority and insufficient regulative support in the MS implementation.. A danger for the nexus coherence is low awareness of the interdependencies involved. There is a need for mind-sets that are able and willing to cross the borders of domains and sectors, with a focus on corresponding (joint) knowledge development and coordination.

4. Success factors identified build on more democratic science, participation and support

We identified fifteen critical elements for a successful nexus policy, which we divide into three main pillars; Democratic Science, Participation and Support.

- The first pillar relates to a more democratic science: An inter-disciplinary and broad (also citizen) science suited to facilitate and match the often contested knowledge being brought forward. A strong scientific basis should be used for enhanced understandings of the interconnections between natural resources, sector interests and policy needs. Investing in enduring knowledge sharing and capacity building might open up debates and feed new problem definitions and developing joint scenarios for an adaptive planning for the dealing with uncertainty.
- The second pillar is about participation: all policy processes need to maximise participation and boost equality between sectors and to increase sustainability of the policy. Legitimacy can be established through expanding existing networks and demonstrate the value of successful policies to a wider range of actors and sectors, for all stages of the policy processes. It is vital to create a sense of shared ownership concerning goals, benefits and costs.
- The third pillar regards support: building policy support calls for clarity on guidelines, practical solutions and measurable targets with the provision of (financial) resources. An enduring and reflexive monitoring can be a strong tool for progress if it is based on transparency, mutual reflexion and policy needs at the appropriate scale of governance.

5.2 Recommendations

Our recommendations are the following:

1. Compare and share insights on conflicting regulations and facilitate conflict resolutions and opportunities offered by synergy (joint benefits were possible)

It is important to continue the work on better coherence and less regulatory gaps, ambiguities and inconsistencies. The often economy-based interest conflicts between policies need to be identified, recognized, explicitly compared and also shared throughout the EU on which conflicting regulations the EU and its MS are dealing with. This is in particular a task that will involve science but then a democratic science with broad participation, also among citizens. The Common Agricultural Policy for instance contains environmental objectives that are coherent with objectives for water, land, energy and climate, whereas in practice powerful economic motives might prevent the achievement of the environmental objectives. All the major institutions should engage in this work, the European Commission, the European Parliament, the Member States, regions, non-governmental organizations, business community, knowledge organizations and citizens should engage in joint initiatives. Workshops and inter-service groups between DG-Agri, DG-Environment, DG-Climate, DG-Energy and DG-Grow for instance, are useful but is not enough to trigger improvement in the implementation stage. Possible windows of opportunity includes but is not limited to:

- 2020: CAP (ongoing)
- 2020: The adoption of a post-2020 global biodiversity framework (This new framework will be agreed at the Convention on Biological Diversity's Conference of the Parties in 2020
- 2020: Action Plan for Organic Production
- 2020: Regulation on the implementation of the 11th European Development Fund
- 2020: EU food and nutrition action plan
- 2020: Kyoto Protocol (Paris Agreement enters into force)
- 2022: IPCC Sixth Assessment Report 2020: 7th EU Action Programme for Environment

For these agenda's and others it is of vital importance to work on integrated plans based on a common vision of water, land, energy and climate. We underline for instance the importance of the work in the European Commission to propose a more flexible system, simplifying and modernising the way for instance the CAP works and the proposed policy shift from compliance and rules towards results and performance. But this work should include a firm focus on how to deal with regulatory gaps, ambiguities and inconsistencies as well as making policy work by engaging the success factors identified in SIM4NEXUS.

We also point to the importance of the work in MS on national strategic plans for agriculture, where the MS will set out how they intend to meet the EU-wide objectives using CAP instruments. We recognize the intention to respond to the specific needs of the farmers and also the rural communities in general.

We call for more joint agenda building work on opportunities to include a more integrated policy development where the EU and the MS facilitate

2. Celebrate the small wins & facilitate the spreading of success

More work is needed on making policy work. One way is to identify ways of ensuring that success stories are spread out and scaled up across Europe. It is vital to demonstrate how progress can be achieved with mutual gains. It is also important to show how valuable seemingly minor progress can be for a greater good. Networks developed through Horizon 2020 should be part of this but this work needs to be given higher priority. National and regional involvement in this work is vital. Also, a facilitating role of DG-RTD would be an asset, as research & innovation should be involved.

3. Regulatory renewal based on a positive framing

The work on regulatory renewal of the EU and MS should be continued based on the success factors grouped in the pillars of democratic science, participative engagement and appropriate support. All the sectors of water, land, energy, food and climate should be engaged in sector-crossing work with a broad foundation in society, based on sharing, joint awareness, recognized ownerships of problems and legitimate rule. This is a multi-level and multi-actor message to all the involved: the United Nations for its work on the SDGs and climate. But it is also a task for the EC and MS. The actual implementation is often facing difficulties with applying regulation and it is crucial to engage those who do this work. An often neglected issue of soil quality should be included in this work.

4. Nexus compliant EU policy making: enriching the policy assessment tools

European policies for WLEFC sectors already reckons with conflicts and trade-offs in other sectors. However, opportunities for synergies are less explored and there is no institutionalised procedure for a comprehensive nexus assessment of new policies. The results of such assessments could define the nexus scope of a policy-making process. New integrating themes can stimulate the support for a nexus approach. Such themes are for example circular and low-carbon economy related to resource efficiency and planetary boundaries, sustainable supply and consumption of healthy food related to public health, good management of land and water in relation to climate change adaptation and mitigation and sustainable cities. These themes cross EU DGs, national ministries and scales, and can be considered as integrating nodes of nexus approaches.

References

- Albrecht, T.R., A. Crootof and C.A. Scottt. 2018. The Water-Energy-Food Nexus: A systematic review of methods for nexus assessment. ENVIRONMENTAL RESEARCH LETTERS, VOL. **13** 043002. https://doi.org/10.1088/1748-9326/aaa9c6

- Brouwer, F., G. Avgerinopoulos, D. Fazekas, C. Laspidou, J.-F. Mercure, H. Pollitt, E.P. Ramos and M. Howells M. 2018. Energy modelling and the Nexus concept. Energy Strategy Reviews. DOI: 10.1016/j.esr.2017.10.005.

- Brouwer, F., L. Vamvakeridou-Lyroudia, E. Alexandri, I. Bremere, M. Griffey and V. Linderhof. 2018. The Nexus Concept Integrating Energy and Resource Efficiency for Policy Assessments: A Comparative Approach from Three Cases. SUSTAINABILITY 2018a, 10(12), 4860; https://doi.org/10.3390/su10124860

- Cairns, Rose and Krzywoszynska, Anna (2016) *Anatomy of a buzzword: the emergence of 'the water-energy-food nexus' in UK natural resource debates.* Environmental Science and Policy, 64. pp. 164-170. ISSN 1462-9011; http://dx.doi.org/10.1016/j.envsci.2016.07.007

- Chi Zhang, Xiaoxian Chen, Yu Li, Wei Ding, Guangtao Fu, Water-energy-food nexus: Concepts, questions and methodologies, Journal of Cleaner Production, Volume 195, 2018, Pages 625-639, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2018.05.194. (http://www.sciencedirect.com/science/article/pii/S0959652618315403)

- Hoff, H. (2011). Understanding the Nexus. Background Paper for the Bonn2011 Conference: The Water, Energy and Food Security Nexus. Stockholm Environment Institute, Stockholm, Sweden, https://bit.ly/2LTNJxW (accessed at 2 January 2019).

- Nilsson M., Griggs D., Visbeck M., Ringler C. (2016a). A draft framework for understanding SDG interactions. International Council for Science.

- Nilsson M., Griggs D., Visbeck M. (2016b). Map the interactions between Sustainable Development Goals. Nature 534: 320-322.

- March , J. G. (1994), A primer in decision making, New York Free Press.

- Munaretto, S. and M.C.H. Witmer (2017). SIM4NEXUS D2.1 Water-land-energy-food-climate nexus: policies and policy coherence at European and International scales. https://www.sim4nexus.eu/userfiles/Deliverables/WP2_Deliverable%202.1_15nov17_FINAL.pdf.

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

- Ofwat (2019), Trust in water PR19 initial assessment of plans: Summary of test area assessment, January 2019, https://www.ofwat.gov.uk/

- Svensson, S., 2018. Governance of the Water-Land-Energy-Food-Climate Nexus: an investigation for the conditions of success. Vrije Universiteit.

- UNEP (2012) Healthy waters for sustainable development. UNEP operational strategy for fresh water (2012-2016). UNON Publishing Services Section, Nairobi, Kenia.

- Witmer, M.C.H., S. Svensson, R. Oakes et al. (2018). SIM4NEXUS D2.3: Policy success stories in the water-land-energy-food-climate nexus.

- World Economic Forum water initiative (edited by Dominic Waughray) (2011). Water Security: the Water-Food-Energy-Climate Nexus. Island Press: Washington/Covelo/London. https://bit.ly/1Ra7s6A (accessed on 2 January 2019).

EU Policy documents

- Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy.
- EC_2012_Blueprint to safeguard EU water resources.3) EC_2015_Closing the loop an EU action plan for the circular economy.
- EC_2016_Action Plan on the Sendai Framework for Disaster Risk Reduction 2015 - 2030: A disaster risk informed approach for all EU policies.
- EU_2013_Decision No 1313/2013/EU of the European Parliament and of the Council of 17 December 2013 on a Union Civil Protection Mechanism.
- Directive 2007/60/EC of 23 October 2007 on the assessment and management of flood risks.
- EC_2007_COM: Addressing the challenge of water scarcity and droughts in the European Union (SEC(2007)/993; SEC(2007)/996).
- Directive 2009/28/EC 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/EC.
- A policy framework for climate and energy in the period from 2020 to 2030 [COM(2014) 15].
- DIRECTIVE (EU) 2018/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 on the promotion of the use of energy from renewable sources (recast).
- DIRECTIVE (EU) 2015/1513 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable source.
- Commission Communication of 7 December 2005 on A biomass action plan (COM(2005) 628).
- Report on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling (COM/2010/11).
- Energy 2020 A strategy for competitive, sustainable and secure energy [COM(2010) 639].
- Directive 2012/27/EU of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.
- Energy Efficiency Plan 2011.
- DIRECTIVE (EU) 2018/2002 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 amending Directive 2012/27/EU on energy efficiency.
- EC_2006_Thematic Strategy for Soil Protection.
- Commission Communication of 8 February 2006 'An EU Strategy for Biofuels' (COM(2006) 34 final).

- EC_2010_The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future.
- Regulation (EU) No 1307/2013 of 17 December 2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/200.
- Regulation (EU) No 1308/2013 of 17 December 2013 establishing a common organisation of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007.
- EC_2015_European Structural Investment Funds 2014 - 2020: official texts and commentaries.
- Grant SFS - 15 - 2014 proteins of the future in Horizon2020 programme for Safe food, healthy diets and sustainable consumption.
- A European Strategy for Low - Emission Mobility [COM(2016)501].
- Horizon 2020 - The Framework Programme for Research and Innovation - Communication from the Commission [COM(2011)0808].
- Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/200.
- REGULATION (EU) 2018/841 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, and amending Regulation (EU) No 525/2013 and Decision No 529/2013/EU. An 29) EU Strategy on Adaptation to Climate Change [COM (2013) 21].

All reports can be found on the SIM4NEXUS website (https://www.sim4nexus.eu/). The policy analysis of the case studies has been conducted by the case study partners, They differ in the level of detail and focus due to their own specific research focus and needs.
others.