SWEDISH CASE STUDY

Policy Analysis

AUTHORS: DR. CLAUDIA TEUTSCHBEIN, DR. MALGORZATA BLICHARSKA

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Contents

Executive Summary

This document gives an overview of the investigated nexus sectors and key research questions in the Swedish case study (Figure 1). It reports on the mapping of the nexus-related policy space in Sweden, mainly focusing on policy priorities, goals and means concerning the nexus components land (in particular forest land), water, energy (mainly from forest biomass) and climate. For each component, the socio-economic context is described using indicators, graphs and statistical data. The report further includes a sector-wise summary of stakeholder power and interest on decision-making, and highlights the key actors to be mobilized in the Swedish case study.

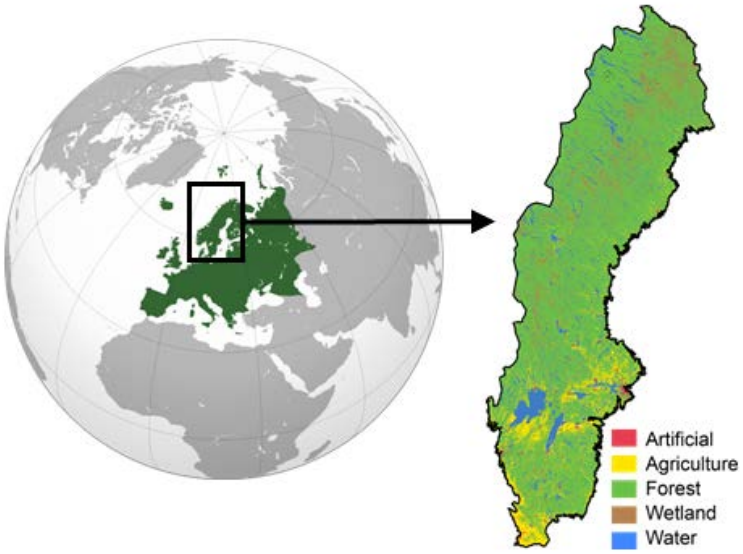

Figure 1: Sweden's geographic location and different landcover types.

1 Introduction

1.1 Case Study Description

Sweden is a country in northern Europe (Figure 1) bordered by Norway in the west, the North Sea in the southwest, the Baltic Sea in the east and Finland in the northeast. Sweden is well known for being a heavily forested country with uncounted lakes and rivers. It is perhaps not surprising that forestry and forest products are of great importance to the national economy. In addition, more than half of Sweden's electricity is generated from renewable sources such as hydropower and forest biofuels. However, changing climate conditions are expected to heavily affect both water resources, forest ecosystems and their interlinkages. Forests depend on water, but have, at the same time, the potential to regulate water availability and quality. On top of that, both forest and water resources directly control the available potential to generate electricity from forest biofuels or hydropower. These interactions of forest, water, climate change, and bioenergy (Figure 2) as an overarching issue promise to be of crucial importance in future years.

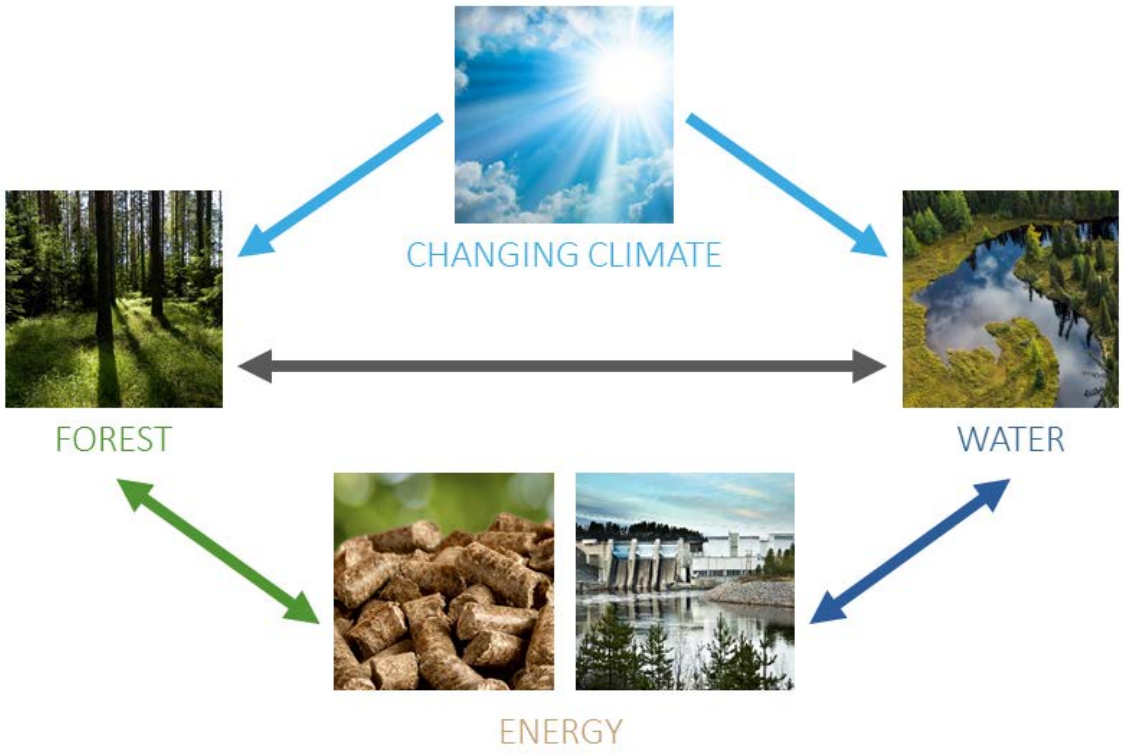

Figure 2: Overview of the forest-water-energy interconnections under changing climate conditions in the Swedish case study.

Sweden currently has two major initiatives of interest to these nexus sectors: (1) *The Generation Goal* and (2) *The Environmental Objectives* (Swedish Environmental Protection Agency, 2017).

The *generational goal* – the overall goal of Swedish environmental policy – defines the direction of the changes in society that need to occur within one generation if the country's environmental quality objectives are to be achieved. One of its targets is to increase the share of renewable energy and use energy efficiently with minimal impact on the environment. This goal is already achieved (Swedish Environmental Protection Agency, 2017), because Sweden managed to reach its goal of a 50 per cent renewable energy share several years ahead of the Swedish government's 2020 schedule, in 2012. Swedish bioenergy use has grown from 40 TWh/year in the 1970s to around 140 TWh in 2012 (Andersson, 2012). Bioenergy was the leading factor in Sweden's 9 percent decrease in greenhouse gases between 1990 and 2010, while gross national product increased by 50 percent. According to Andersson (2012), bioenergy's success also rests on the long-standing tradition of using natural forest resources while also protecting and developing them. Sweden's total forest stock has increased each year despite the rapid expansion in biomass use for energy.

The sixteen *environmental quality objectives* describe the state of the Swedish environment which environmental action is to result in. These objectives are to be met within one generation, i.e. by 2020 (2050 in the case of the climate objective). Objectives related to the forest and water sectors include:

- Reduced Climate Impacts (to be met by 2050)
- Flourishing Lakes and Streams (to be met by 2020)
- Good-Quality Groundwater (to be met by 2020)
- Sustainable Forests (to be met by 2020)

According to present forecasts (Swedish Environmental Protection Agency, 2017), these environmental objectives will not be met in time. In fact, the objectives of reducing climate impacts even shows a negative trend in the state of the environment, because greenhouse gas emissions are still rising. This clearly shows that the current environmental initiatives are not sufficient to achieve society's agreed environmental objectives for water and forests. For example, about three quarters of the largest river systems are affected by fragmentation from water regulation causing negative ecological consequences. In addition, the growing demand for bioenergy has led to an intensification of the forest industry through extensions of managed forest land, introduction of fast-growing tree species, increasing use of fertilization and increasing felling rates. The effects of such new management strategies for increased biomass production on forest species, soil resources and water quality at

landscape scales are, however, not well understood and not addressed adequately. In addition, Sweden is at the time of writing facing recurring problems of declining groundwater levels causing an increased risks for forest fires, drinking water shortages and low water levels. This has triggered a new debate on the forest cover - water yield relationship (i.e., on whether trees 'use' or 'supply' water), which is attracting increasing attention in Swedish media.

These issues will be addressed by the Swedish case study. Together with stakeholders, the question as to whether the goal of becoming a fossil-free nation interferes with some of the national environmental objectives will be discussed.

1.2 Nexus Sectors Investigated

1.2.1 Climate Sector

Temperature and precipitation are projected to increase more in high-latitude regions such as Sweden than in the rest of Europe (IPCC, 2014; Jacob et al., 2014). By the end of this century the annual average temperature is projected to be 2-6 °C higher than for the period 1961-1990, while the average annual precipitation is projected to increase by 10-40% (Sjökvist et al., 2015). Extreme short-term precipitation events (in particular short torrential showers) are projected to become more intensive (Sjökvist et al., 2015). Due to the fact that high-latitude ecosystems have adapted to low natural energy flows, they are relatively more sensitive to a given shift in climate, physical and biogeochemical conditions, which could intensify regional and seasonal environmental responses (Roots, 1989).

To enhance the preparedness and capacity to respond to such climate change impacts, the EU Adaptation Strategy (European Commission, 2013) aims to make Europe more climate resilient. The strategy stresses that many economic sectors, including forestry, are directly dependent on climatic conditions and are already facing the consequences of a changing climate. Challenges are related to both physical climate impacts and mutual dependencies across environmental systems, as well as to policy failures and knowledge gaps. Adaptation strategies are seen as the most effective instrument when assessing impacts, vulnerability and adaptation options and thus to face the projected impacts of climate change across sectors.

1.2.2 Landuse Sector (Forests)

Within the boreal region, Fennoscandia represents an extreme in terms of the degree and extent to which landscape dynamics are influenced by land management (Gauthier et al., 2015). For example, more than two thirds of Sweden are currently covered by forests, of which the majority is subject to forestry (SLU, 2015). The country has a long history of using its natural forest resources, while also protecting and developing them (Andersson, 2012). Total forest industry output was approximately 23 billion Euros in 2011 (Skogsstyrelsen, 2014), while the export value of forestry and the forest products industry was 13 billion Euros. The total number of employees in large-scale forestry has declined significantly in recent years, while, at the same time, the role of forest entrepreneurs (and their employees) has become increasingly important (Skogsstyrelsen, 2014).

Forests play an important role in terms of diverse and multifunctional benefits to people in Sweden. In addition to the economic output that is generated by the forestry sector, forests also deliver social and environmental functions. For instance, forests support biodiversity, provide opportunities for recreational activities ('freedom to roam', which is a general public right codified in law), allow for mushroom and berry picking, sequester atmospheric carbon, improve air quality, and regulate water quantity and quality.

Forestry in Sweden is currently regulated by the 1993 Forestry Act (The Swedish Parliament, 1993), which states that "the forest is a national resource", which "shall be managed in such a way as to provide a valuable yield and at the same time preserve biodiversity".

The forestry sector is subject to alterations in the light of developments in energy, governance and landuse systems, climate politics, and taking account of an increasing competition between economic, environmental and recreational functions (Sandström et al., 2011). The growing demand for bioenergy has led to an intensification of the forest industry (Helmisaari et al., 2014), in particular through extensions of managed forest land, introduction of fast-growing tree species and increasing use of fertilization (Rytter et al., 2013). In the future, more intense forestry practises require technological and logistical improvements to render an economically sustainable production and to reduce the negative effects on our environment (de Jong et al., 2014).

1.2.3Water Sector

1.2.3.1 Quantity: Hydrological Regimes

Swedish hydrological regimes (Figure 3) are generally characterized by rather low winter streamflow with a dominating snowmelt-driven spring flood peak (mainly in central and northern Sweden), followed by low summer flows and/or a somewhat lower precipitation-induced flood peak in the fall (mainly in southern Sweden). In a future climate, however, streamflow is projected to change to a more even regime with dominating large winter streamflow and no spring flood peak at all (Arheimer and Lindström, 2015; Donnelly et al., 2013; Teutschbein et al., 2011, 2015). Annual water availability in general is expected to increase as a result of increasing precipitation. There are, however, large seasonal variations: especially during summer months, water availability is likely to decline as a results of increasing evaporation rates in large parts of the country (Eklund et al., 2015). In southern Sweden, water shortages during summer increasingly affect the drinking water supply, both in terms of quality and quantity.

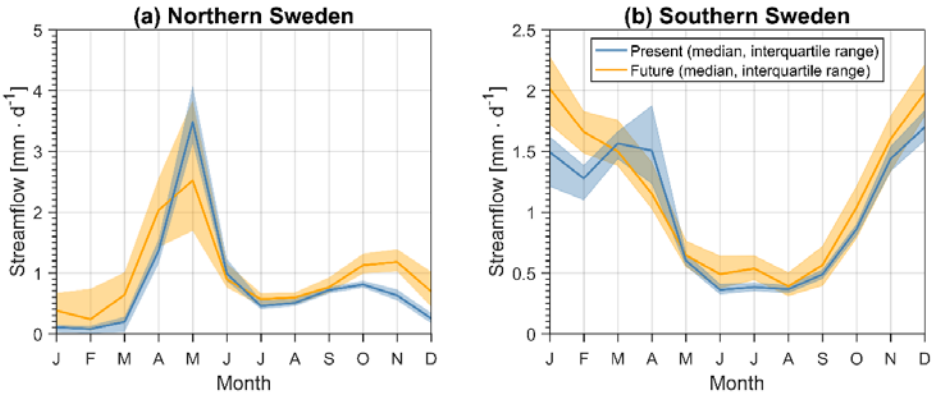

Figure 3: Projected changes in hydrologic regimes representative for (a) northern Sweden and (b) southern Sweden.

To achieve good quantitative status of surface water bodies including streams, the Water Framework Directive (European Parliament and Council of the European Communities, 2000) established a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater.

1.2.3.2 Extreme Events: Floods & Droughts

Hydrological extreme events, which are defined by the departure of surface and subsurface water supplies from average conditions at various points in time (WMO, 2006), can cause severe habitat damage, problems for agriculture, forestry, industry, building infrastructure, energy production and water supply (Swedish Commission on Climate and Vulnerability, 2007). In Sweden, past changes in

climate and land cover have had a major impact on streamflow patterns (Destouni et al., 2013). In a changing climate, shifts in meteorological conditions are expected to even further perturb regional hydrology, and thereby also the occurrence, frequency and duration of both floods and droughts. In fact, climate models project that extreme floods are expected to occur less often in northern inland Sweden and the northern coastal areas, while most the rest of the country is likely to suffer from more common extreme floods in a future climate (Eklund et al., 2015). Concurrently, more days with low river flows (i.e., hydrological droughts) are expected in southern and central Sweden.

Although Sweden has historically been a region abound with water, it is not exempt of droughts: the 2003 summer drought severely impacted the European continent, including Scandinavia (NVO, 2011). There was, however, large spatial variability in hydro-climatic patterns across the country, which indicates the complex interplay of meteorological and topographic features and the resulting hydrological impacts at the catchment scale. Events such as the European-wide 2003 drought could become more frequent in coming decades, and, thus, the early recognition of critical drought conditions is essential for drought risk management with large economic and social benefits. Yet, most available hydrological climate change impact studies concerning Sweden neglect hydrological droughts. To make matters even more concerning, interviews among Swedish municipalities and drinking water producers revealed that only 12% specifically considered potential effects of droughts on drinking water in their risk assessment (Norén et al., in preparation). Thus, there is now an urgent need to estimate water availability in a changing climate and a developing society.

Mitigating the effects of floods and droughts are addressed both in the Water Framework Directive (European Parliament and Council of the European Communities, 2000) and the Floods Directive (European Parliament and Council of the European Union, 2007).

1.2.3.3 Quality: Nutrient Loads

Multiple ongoing global changes have reshaped the pools and fluxes of biogeochemical elements in terrestrial and aquatic ecosystems. Of these, dramatic increases in the loading of bioreactive nitrogen (N) and phosphorus (P) to terrestrial ecosystems during the 20th century have drawn particular attention (Galloway et al., 2008) and are linked to multiple environmental problems, ranging from declines in species diversity to stratospheric ozone loss (Gruber and Galloway, 2008). Large quantities of anthropogenically mobilized N and P are also flushed from land to water (Seitzinger et al., 2005), contributing to freshwater and marine eutrophication (Bouwman et al., 2013; Conley et al., 2009), and connecting mounting water quality concerns to hydrological patterns that are themselves sensitive to

climate drivers (IPCC, 2014). Concurrent to these global changes, warming temperatures, longer growing seasons, and rising atmospheric CO_2 concentrations may lead to increased plant growth (Richardson et al., 2010), greater nutrient uptake and accumulation in terrestrial ecosystems (Luo et al., 2004), and reduced nutrient losses to surface waters in some cases (Lucas et al., 2016).

The Water Framework Directive (European Parliament and Council of the European Communities, 2000) aims at enhancing the status of aquatic ecosystems and reducing discharges/emissions/losses of priority substances. Surface water and groundwater bodies are further protected from pollution by the Nitrates Directive (Council of the European Communities, 1991b), the Urban Waste Water Directive (Council of the European Communities, 1991a) and the Groundwater Directive (European Parliament and Council of the European Union, 2006).

1.2.4 Energy Sector

Sweden's total energy supply in 2015 was 557 GWh. The most important energy sources (Figure 4) are nuclear fuel (33 %), crude oil and petroleum products (24%), biofuels (23%) and hydropower (12%). For the past decades, Sweden has invested heavily in alternative energy sources and is now in the front line of renewable energy use. The interaction between abundant natural resources, high oil prices, public concern for the environment, broad policy support, and strong incentives led to a transformation of Sweden's oil-dependent energy system (Andersson, 2012). Despite a large per capita energy consumption, Sweden's economy is today one of the least dependent on fossil fuels and has one of the lowest carbon emission rates. Thus, Sweden has set a model in terms of a resource-efficient and low-carbon economy that much of the world could emulate.

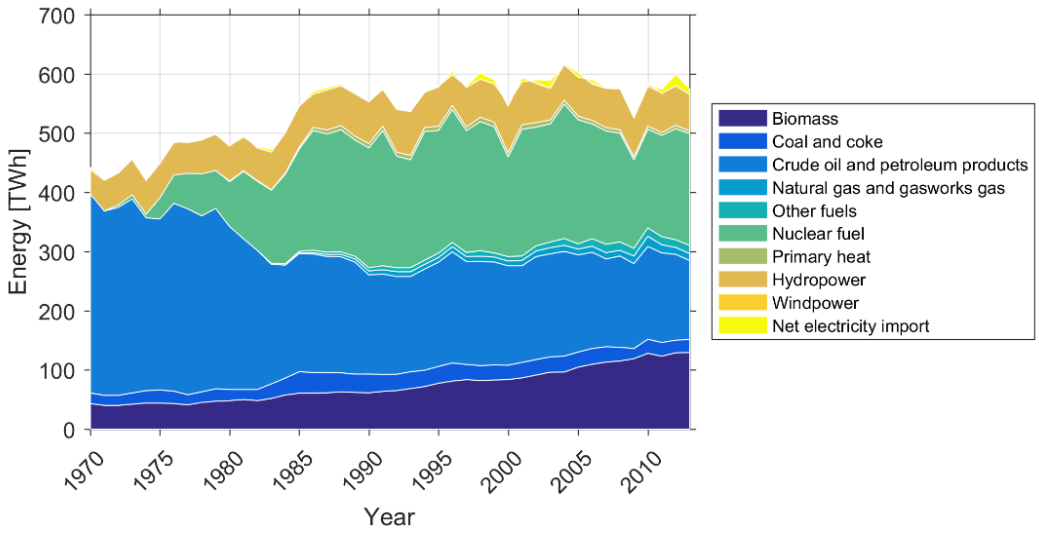

Figure 4: Total energy supply by energy commodity 1970-2013 based on data provided by Statistics Sweden.

The energy sector is targeted in the Europe 2020 strategy (European Commission, 2010) and the Swedish 2020 Climate and Energy Goals (The Swedish Parliament, 2006), which both set out targets for reducing greenhouse gas emissions, increasing shares of renewable energy and improving in energy efficiency (Table 1).

Table 1: Overview of European and Swedish climate and energy targets

	Sweden 2020	Europe 2020	Europe 2030
Reductions in Greenhouse Gas Emissions	40%	20%	40%
Share of Renewable Energy	50%	20%	27%
Improvements in Energy Efficiency	20%	20%	27%

1.2.4.1 Biofuels

Biofuels play a major role in industry, district heating, and to an increasing degree also in electricity production and transport (Figure 5). Biofuel is a collective term for several different types of fuels, including densified and undensified wood fuels, black liquor, biofuels from agriculture, combustible waster, bioethanol, biodiesel and biogas. The biofuel market in Sweden is presently growing at a rate of 3 TWh per year, which equals $1.5x10^6$ m3 of wood (de Jong et al., 2014). At present, the two leading biofuel sources are undensified wood (41%) and black liquor (33%), followed by densified wood (8%) and municipal waste-bio (7%). The increasing use of biofuels for electricity and heat production has caused a rising demand for wood fuels (Energimyndigheten, 2016), which has been satisfied through increased extraction of forest biofuels (de Jong et al., 2014). The market is expected to grow further in the near future (Energimyndigheten, 2013) and the supply of forest biomass for energy could potentially increase by 70% (Andersson, 2012).

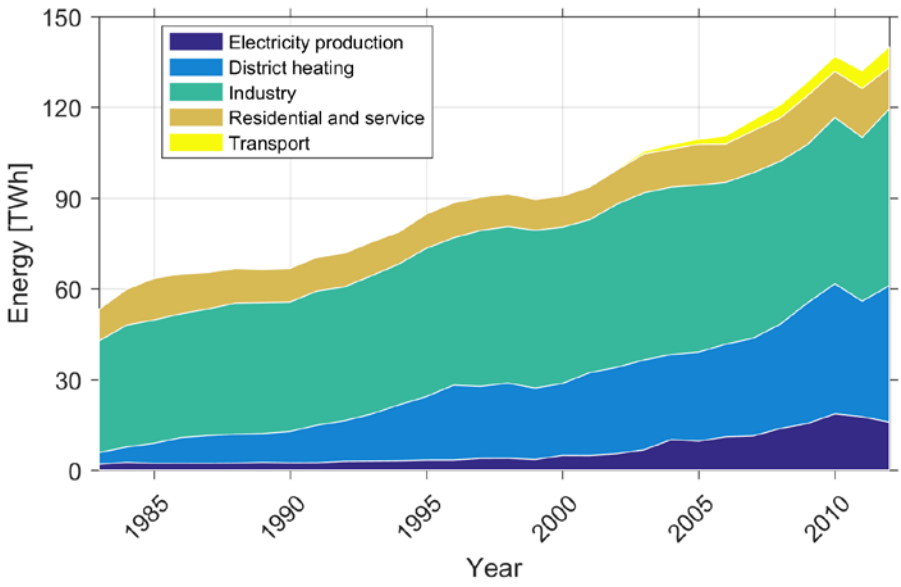

Figure 5: Use of biofuels, waste and peat by sector 1983–2012

1.2.4.2 Hydropower

Sweden is the largest hydropower producer in the EU and the tenth biggest in the world, generating on average 67 TWh of electricity per year. Most hydropower is produced in northern Sweden. The annual hydropower output varies depending on seasonal precipitation: during the past 15 years, hydroelectric output varied from 53 TWh in 2003 (European summer drought) to 79 TWh in 2000 (particularly wet year). Swedish hydropower provides a valuable source of renewable energy and is able to balance the national electricity grid (Rudberg, 2013). However, about three quarters of the largest river systems are affected by fragmentation from water regulation (Rudberg, 2013), causing negative ecological consequences. Swedish law prohibits hydropower constructions in four of the biggest streams and a number of smaller rivers, and, thus, limits further expansion of hydropower.

1.3 Key Research Questions

1.3.1 Landuse Sector (Forests)

In the future, the extended growing season that arises from warmer temperatures, in particular in the North, means that some areas will become increasingly available and attractive to forestry. This warming might also imply a shift in vegetation types and a shortening of the presently rather long rotation periods of typical boreal forests. Consequently, one of the key questions is whether the extraction of forest biomass can be further increased in the future without negative consequences for other forest functions and for water availability/quality. Typical forestry practices have an impact on soil, water, climate and biodiversity (de Jong et al., 2014) and, thus, a main challenge is to manage trade-offs between economic, environmental and recreational functions (Sandström et al., 2011).

1.3.2 Water Sector

In southern Sweden, water shortages during summer increasingly affect the drinking water supply, both in terms of quality and quantity. Increasing temperatures, shifts in seasonality and more streamflow (especially during winter) are likely to cause higher nutrient loads in Swedish boreal streams (Teutschbein et al., 2017). In addition, a continued intensification of the forest industry (Helmisaari et al., 2014), in particular extensions of managed forest land and increasing use of fertilization (Rytter et al., 2013), may increase the risk of nutrients leaching from watersheds (Sponseller et al., 2016). Consequently, key research questions in the water sector relate to how future climate change, streamflow shifts and changing forestry practices might affect (drinking) water availability and quality.

1.3.3 Energy Sector

As the market for biofuels further grows, the question arises as to whether the supply of forest biomass for energy can further be increased. The competition between forests, water and energy resources is further intensified by changing climate conditions. Knowledge gaps and considerable uncertainties on how environmental systems will change and on their impacts are major challenges. In addition, large uncertainties remain in terms of the effect of future seasonal shifts in water availability (e.g., more streamflow during winter, but expected longer drought period during summer) on hydropower, which highlights the need for further research.

2 Socio-Economic Context

2.1 Landuse Sector (Forests)

Relevant socio-economic indicators in the forestry sector include:

- Standing tree volume in Swedish productive forests
- Tree dry weight biomass for growing stock
- Volume of hard dead wood
- Number of people employed in the forestry sector
- Value of forest sector production and export

In the past decades, ***standing tree volume*** (Figure 6a) and ***tree dry weight biomass for growing stock*** (Figure 6b) have increased, despite a rapidly increasing felling rate (SLU, 2016).

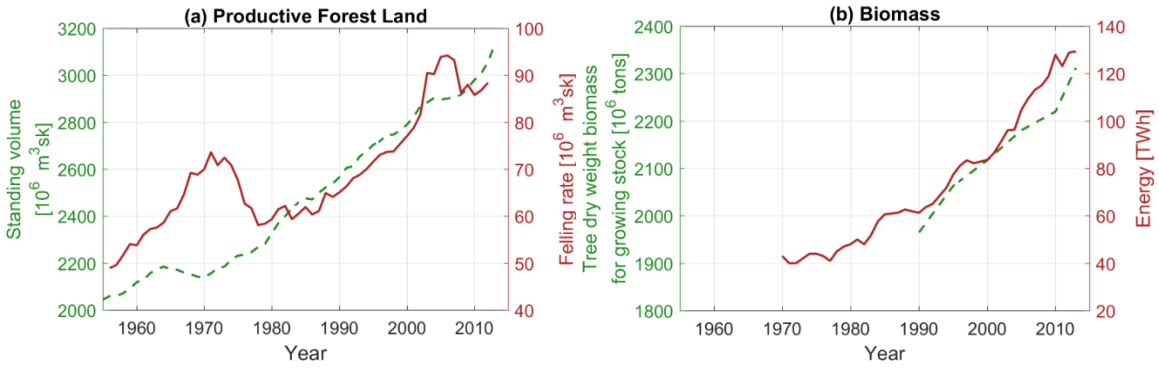

Figure 6: Swedish forest statistics including annual standing volume and felling rates for the productive forest land (a) and tree dry weight biomass for growing stock and energy produced by biomass (b) based on data provided by SLU (2016) and Energimyndigheten (2016).

The *volume of hard dead wood* per hectare on productive forest land has increased steadily since the late 1990's (Figure 7). It is considered as an indicator for the degree of environmental consideration in conjunction with felling.

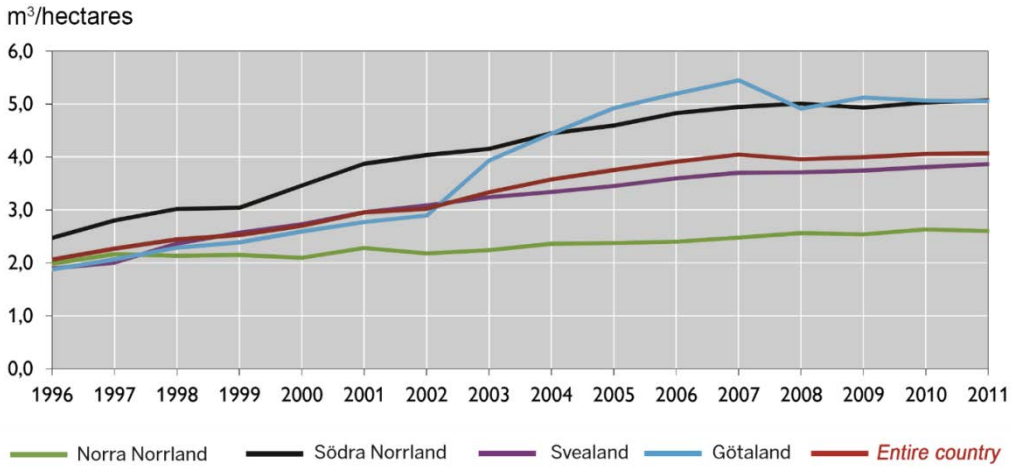

Figure 7: Volume of hard dead wood on productive forest land for different regions and the entire country based on a 5-year moving average. Figure modified from SLU (2015).

The *number of people employed in the forestry sector* has decreased considerably during the 1980's and 90's (Figure 8). Since 2000, the total number of employments in the sector have been stable at a level of roughly 15,000-16,000 annual work units.

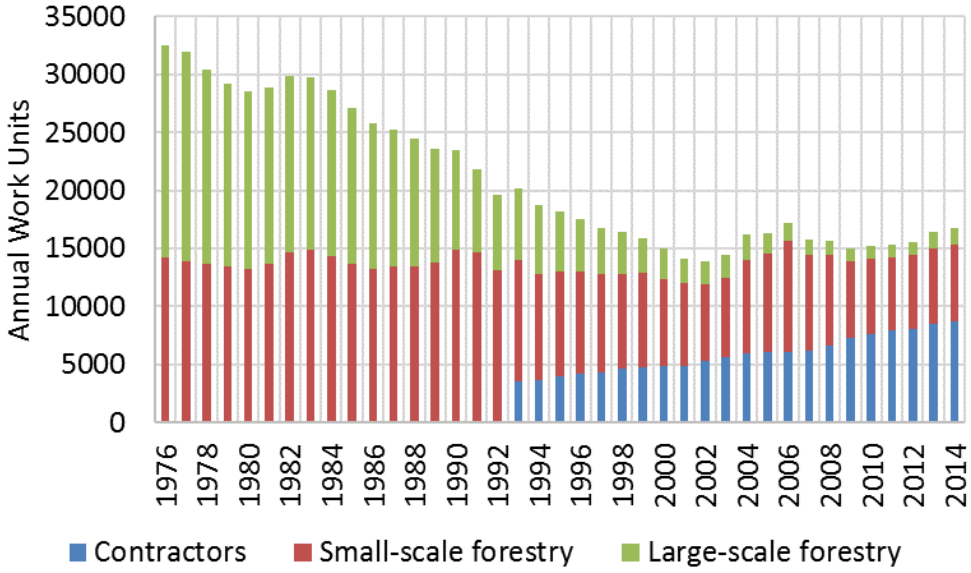

Figure 8: Swedish employment statistics in the forest industry for the period 1975-2015 shown in annual work units based on a 3-year moving average.

The *values of forest industry production and export* have increased over time since the year 2000 (Figure 9). The gross output (i.e., production value) has increased by roughly 22%, while export values have increased by 19%.

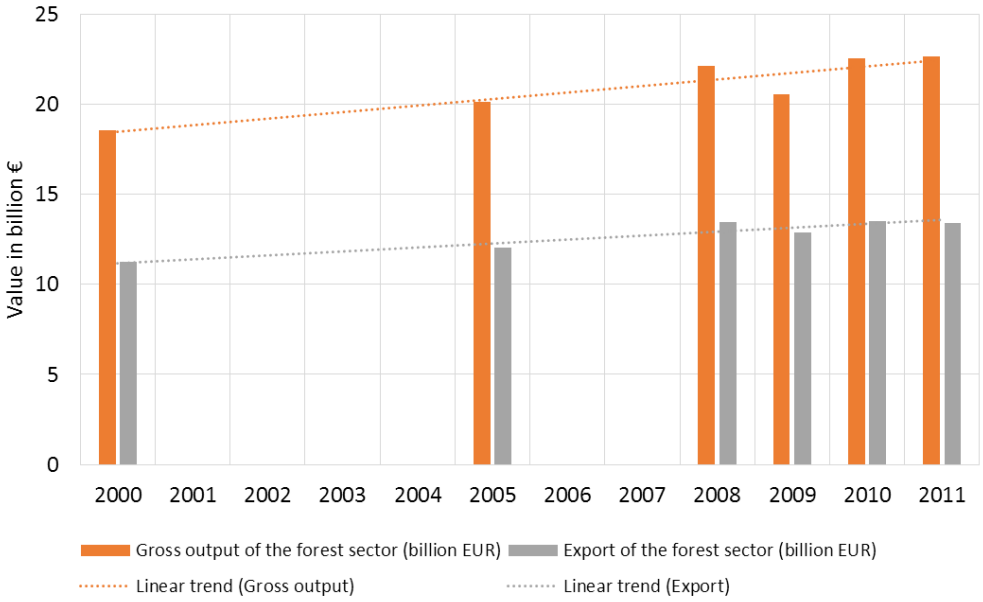

Figure 9: Comparison of gross output (orange) and export (gray) of the forest sector in billion Euros.

2.2 Water Sector

Relevant socio-economic indicators in the water sector include:

- Water use per sector
- Protected freshwater areas
- Water withdrawals
- Risk for floods (and droughts)

Water use per sector decreased slightly in the early 1990's and remained since then relatively constant over the past two decades (Figure 10). In the future, it might be possible that an increasing population leads to higher water use.

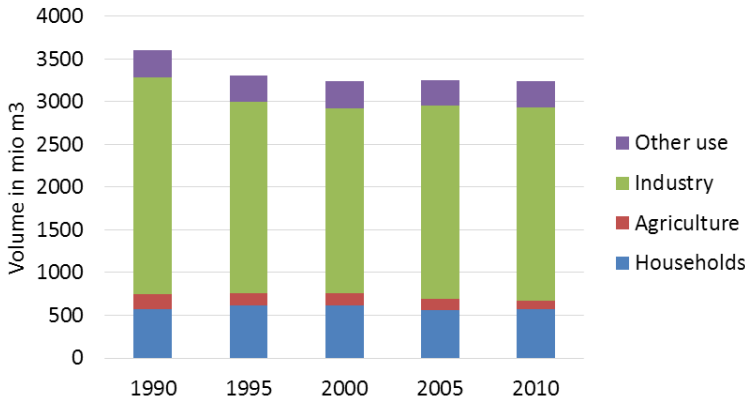

Figure 10: Water use per sector in Sweden 1990-2010

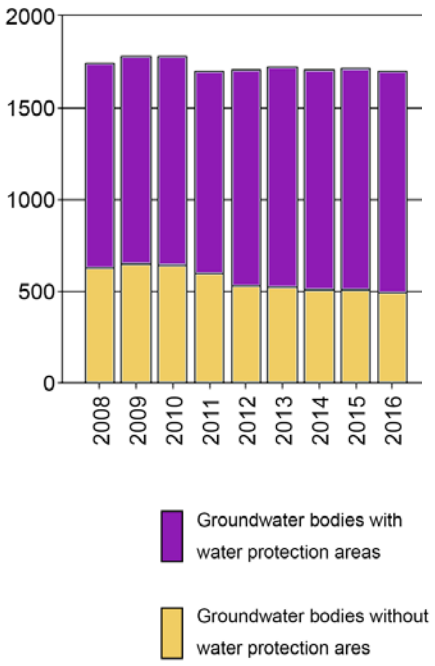

Figure 11: Comparison of the number of groundwater bodies with (purple) and without (orange) water protection areas. Figure modified from SLU (2015).

More than two thirds of municipal groundwater bodies have ***water protection areas*** (Figure 11). However, creating new water protection areas is a rather slow process and the total number of water protection areas has not increased in recent years.

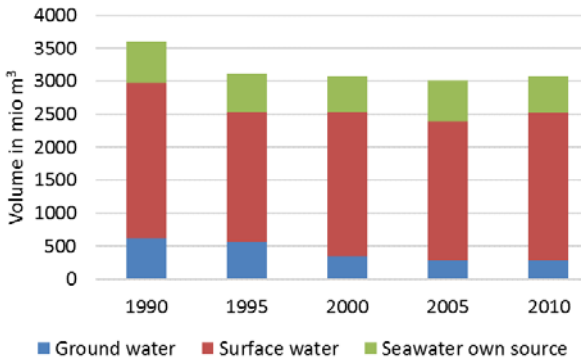

Figure 12: Water withdrawals by type of water in Sweden 1990-2010

Total water withdrawals declined somewhat in the early 1990's (mainly because of reduced surface water withdrawals) and remained relatively constant since then (Figure 12). Groundwater withdrawals declined continuously during the past 2 decades, while surface water withdrawals increased.

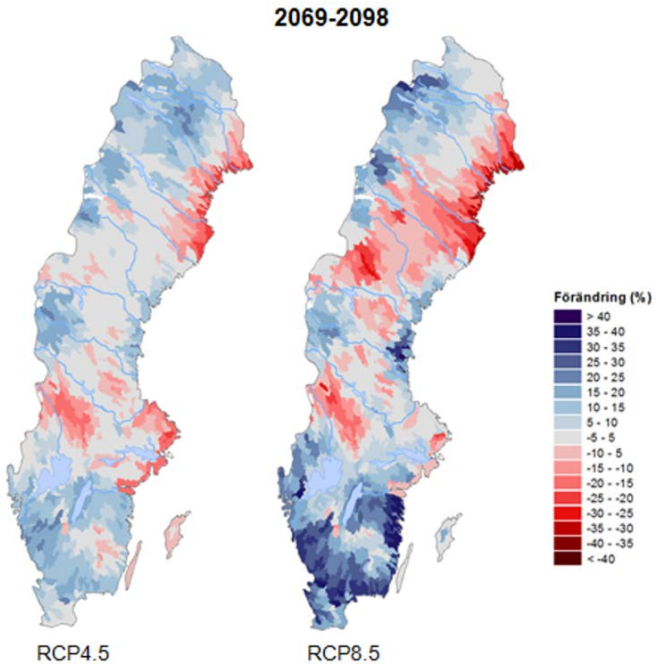

Figure 13: Projected future change in the magnitude of 100-year floods for the RCP4.5 (left) and the RCP8.5 (right) scenario. Figure obtained from https://www.smhi.se/kunskapsbanken/framtida-oversvamningar-vid-sjoar-och-vattendrag-1.28791.

The ***risk for flooding*** is projected to grow in many parts of the country (Figure 13). The magnitude of 100-year floods is expected to increase in the future especially in southern Sweden, where flooding occurs mostly as a consequence of heavy rain (during all seasons). In contrast, flooding in northern Sweden is mainly a consequence of snowmelt during spring. Since there will likely be less snow on the ground in the future, flooding in these northern regions is expected to decrease.

2.3 Energy Sector

Relevant socio-economic indicators in the energy sector include:

- Energy use
- Energy produced from solid biofuels
- Energy produced from hydropower

Total annual *energy use* per person in Sweden varied from 42 to 45 MWh during the 1990's and early 2000's, reaching its top in 2003 (Figure 14). Since then the energy use has been declining by ~17%.

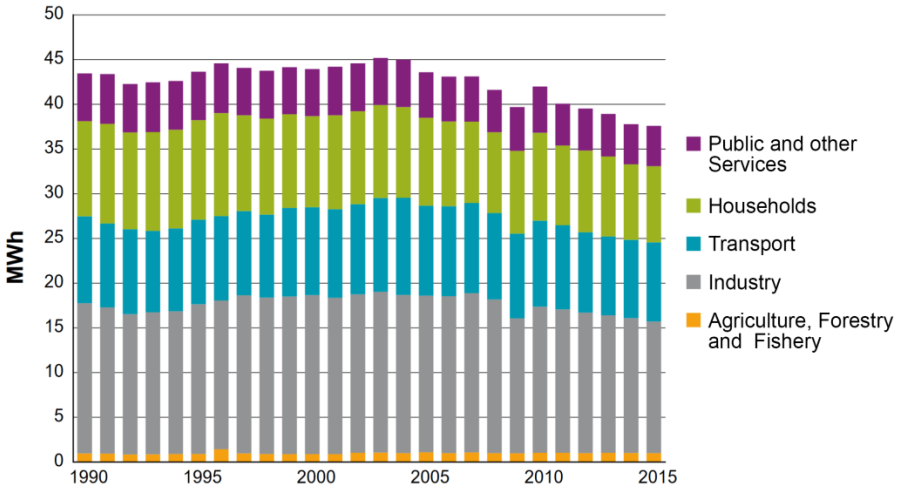

Figure 14: Sectorwise energy use per person in Sweden. Figure modified from the Swedish Environmental Protection Agency (2017).

The *energy produced from solid biofuels* (i.e., wood and black liquor) has increased by more than 200% since 1970, while the *energy produced from hydropower* does not show a marked trend (Figure 15).

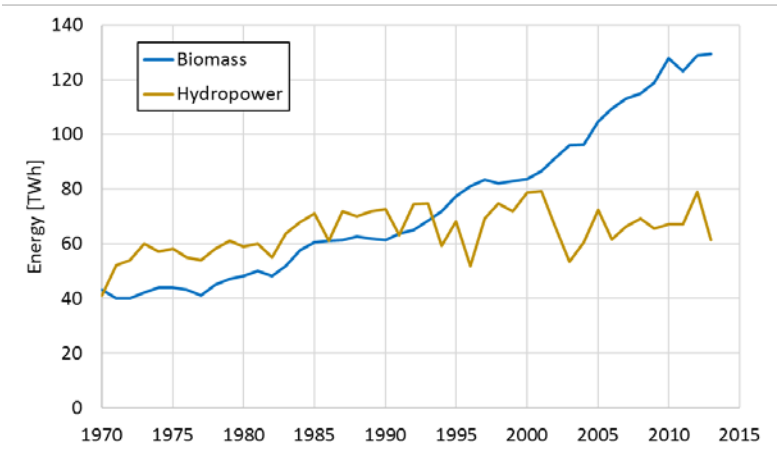

Figure 15: Energy produced form hydropower and biomass in Sweden 1970-2013

3 Mapping of Stakeholders

A list of organizations relevant for the sectors under consideration in the Swedish case study was created based on expert judgement. To identify the most relevant stakeholders and their influence in the policy process, they were clustered into actor groups (i.e., types of organizations) that have similar roles in the policy arrangement (Table 2): (1) businesses, (2) common interest associations, (3) local federations, (4) local governmental organizations, (5) regional governmental organizations, (6), national governmental organizations, (7) non-governmental organizations (NGOs), (8) research organizations and (9) trade associations.

Table 2: List of potential stakeholders grouped by the type of organization

ID	TYPE OF ORGANIZATION	ORGANIZATION
1	business	Bergvik Skog AB
2	business	Boxholms Skogar AB
3	business	E.ON vattenkraft
4	business	Fortum
5	business	Holmen Energi
6	business	Holmen Skog AB
7	business	Persson Invest Skog AB
8	business	Rebio
9	business	SCA Skog AB
10	business	SeKab
11	business	Skellefteå Kraft
12	business	Skogssällskapet förvaltning AB
13	business	Statkraft
14	business	Stockholm Vatten
15	business	Sveaskog AB
16	business	Uppsala University Foundations Management of Estates and Funds (Uppsala Akademiförvaltning)
17	business	Uppsala Vatten
18	business	Vattenfall
19	common-interest association	Agroforestry
20	local governmental organization	Sweden's 290 municipalities
21	local federation	Norrvatten
22	local federation	VA Syd
23	national governmental organization	Ministry of the Environment and Energy
24	national governmental organization	Swedish Environmental Protection Agency (Naturvårdsverket)
25	national governmental organization	The National Food Agency (Livsmedelsverket)
26	national governmental organization	The National Property Board of Sweden (Statens fastighetsverk)

ID	TYPE OF ORGANIZATION	ORGANIZATION
27	national governmental organization	The Swedish Agency for Marine and Water Management (Hav och Vatten)
28	national governmental organization	The Swedish Energy Agency (Energimyndigheten)
29	national governmental organization	The Swedish Forest Agency (Skogsstyrelsen)
30	national governmental organization	The Swedish Fortifications Agency (Fortifikationsverket)
31	national governmental organization	The Swedish Geological Survey (Sveriges Geologiska Undersökning)
32	NGO	Forest Stewardship Council (FSC)
33	NGO	Swedish Programme for the Endorsement of Forest Certification (PEFC)
34	NGO	Swedish Society for Nature Conservation
35	NGO	The Royal Swedish Academy of Agriculture and Forestry (Kunglig Skogs- och Lantbruksakademin)
36	NGO	The Swedish Forest Society Foundation (Skogssällskapet)
37	NGO	The Swedish Forestry Association (Föreningen Skogen)
38	regional governmental organization	Water authority Bothnian Bay (Vattenmyndigheten i Bottenvikens vattendistrikt)
39	regional governmental organization	Water authority Bothnian Sea (Vattenmyndigheten i Bottenhavets vattendistrikt)
40	regional governmental organization	Water authority Northern Baltic Sea (Vattenmyndigheten i Norra Östersjöns vattendistrikt)
41	regional governmental organization	Water authority Skagerack and Kattegat (Vattenmyndigheten i Västerhavets vattendistrikt)
42	regional governmental organization	Water authority Southern Baltic Sea (Vattenmyndigheten i Södra Östersjöns vattendistrikt)
43	research	Nordic Association for Hydrology (NHF)
44	research	Stockholm International Water Institute (SIWI)
45	research	Swedish Energy Research Centre (Energiforsk)
46	research	Swedish Hydrological Council (Svenska hydrologiska rådet)
47	research	The Forestry Research Institute of Sweden (Skogforsk)
48	trade association	Lantmännen Agroetanol
49	trade association	Mellanskog
50	trade association	Norrskog
51	trade association	Swedish Forest Industries Federation (Skogsindustrierna)
52	trade association	Swedish Hydropower Association (Svensk Vattenkraftförening)
53	trade association	Swedish Petroleum and Biofuel Institute (SPBI)
54	trade association	The Federation of Swedish Family Forest Owners (LRF Skogsägarna)
55	trade association	The Swedish Bioenergy Association (Svebio)
56	trade association	Water Regulation Enterprises (Vattenregleringsföretagen)

The stakeholder list (Table 2) contains eighteen ***businesses***, comprising a number of different hydropower, biofuel and forest-owing companies. One ***common interest association***, i.e., a group of individuals who voluntarily formed an organization to promote agroforestry, was identified. The list further includes two ***local federations*** formed by municipalities to manage local drinking water concerns, 290 municipalities belonging in the group of ***local governmental organizations***, five ***regional***

governmental organizations coordinating the work within the Swedish water districts, and nine *national governmental organizations* mainly consisting of Swedish government agencies that act independently to carry out policies. Furthermore, six *NGOs* dealing with forest issues and nature conservation, five *research organizations* in the forest, water and energy sectors, as well as nine *trade associations* were identified.

The division of resources between these actors naturally leads to differences in power and influence. As a starting point for looking at the relative position of the stakeholder and their power relations, actor groups were mapped to visualize their sizes, influence, roles and relationships (Figure 16). In addition, a power-interest grid per sector was generated (Figure 17) to visualize which stakeholders are key players that should preferably be fully engaged and which stakeholders only play a minor role.

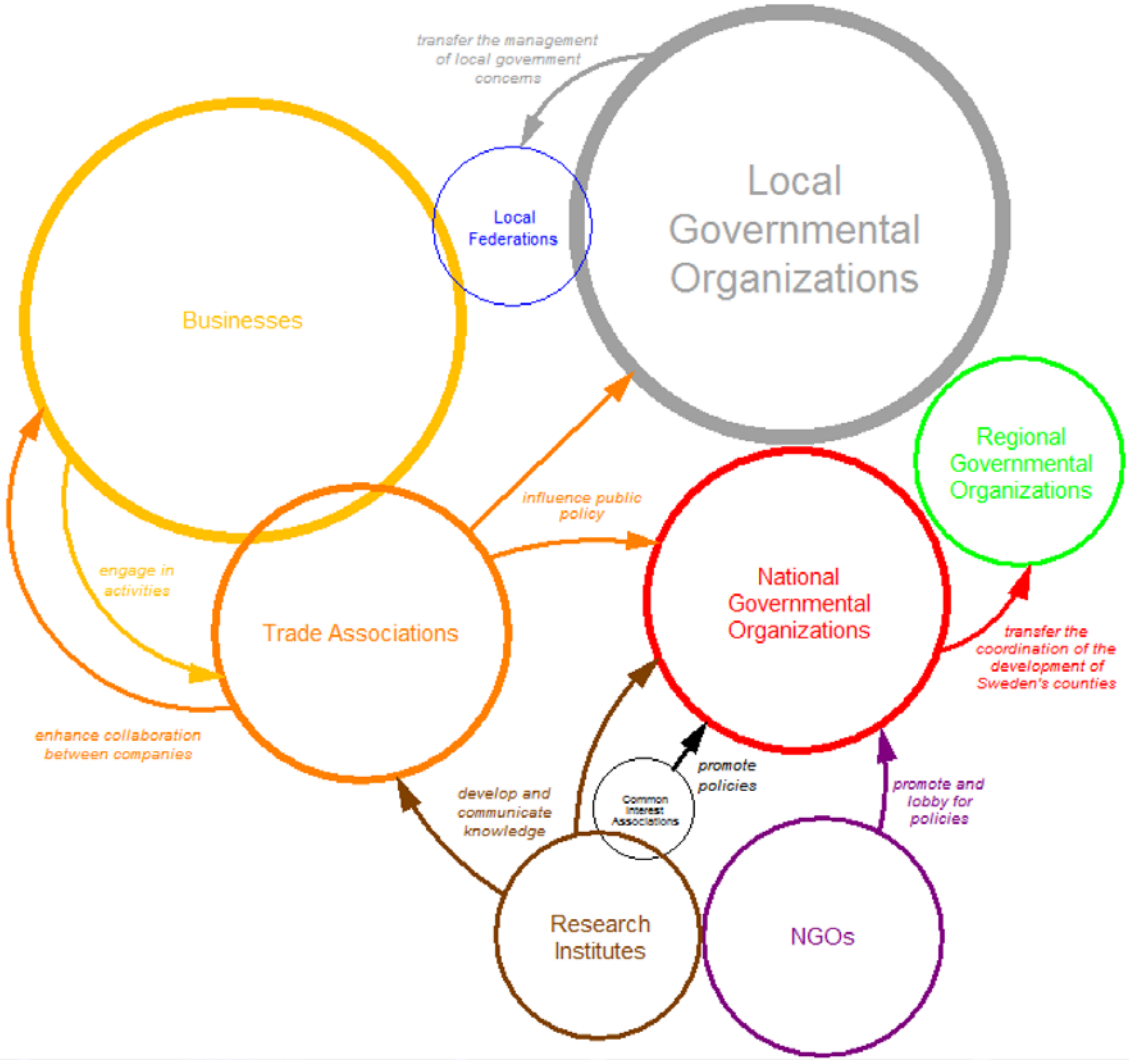

Figure 16: Map of relevant stakeholder groups and their relations. The size of the circles indicates the size of stakeholder groups, different colors represent different groups, the distance/overlap between circles indicates the relationship between the groups. Arrows indicate the main direction of the relationship.

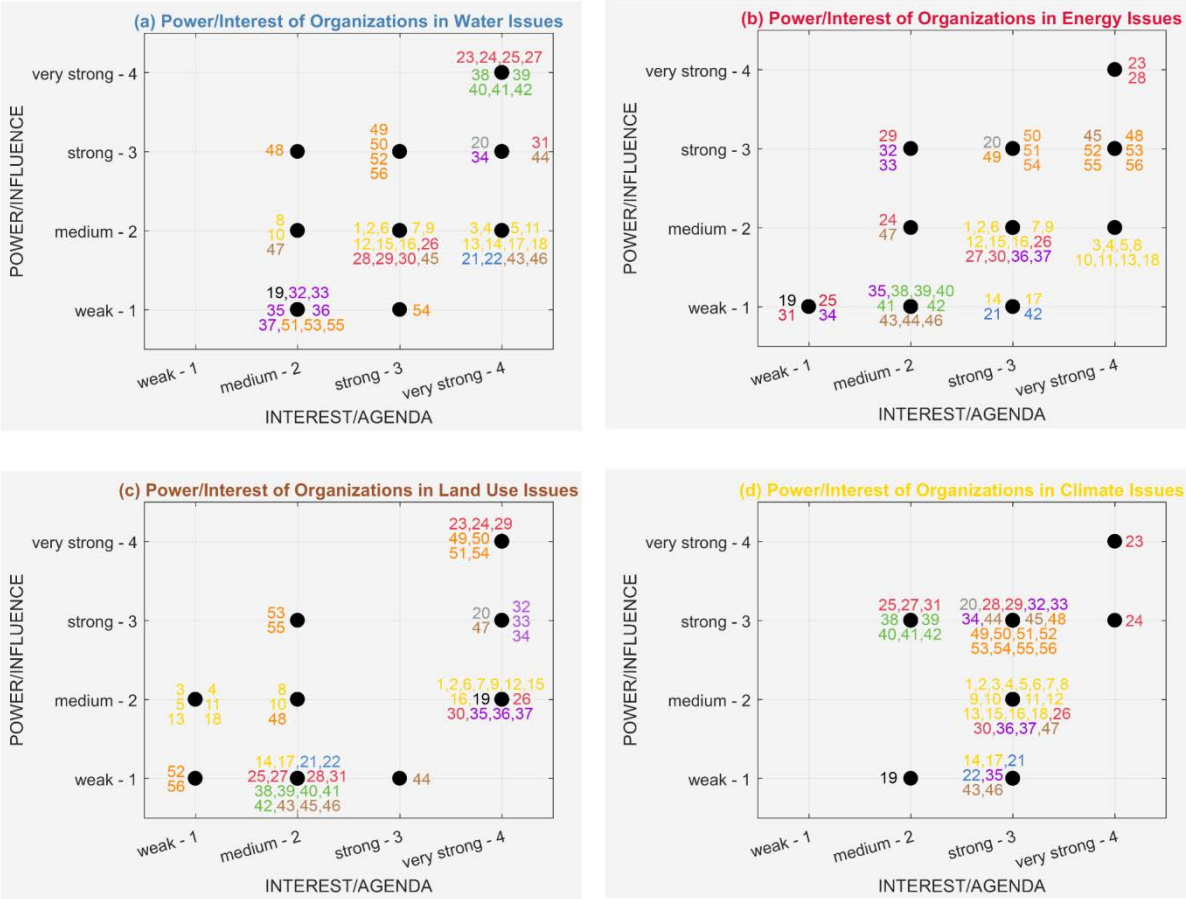

Figure 17: Power-interest grid of potential stakeholders in (a) the water sector, (b) the energy sector, (c) the land use sector, and (d) the climate sector.

Key stakeholders with high power (strong to very strong) and high interest (strong to very strong) were identified for each sector separately based on the power-interest grid (Figure 17). Ten stakeholders, which play a major role in more than two sectors, emerged (Table 3).

Table 3: Key stakeholders with high power and interest in more than 2 sectors (F = forest/land use, W = water, E = energy, C = climate)

ID	ORGANIZATION	F	W	E	C
Key actors in all 4 sectors					
20	Sweden's 290 municipalities	x	x	x	x
23	Ministry of the Environment and Energy	x	x	x	x
24	Swedish Environmental Protection Agency (Naturvårdsverket)	x	x	x	x
49	Mellanskog	x	x	x	x
50	Norrskog	x	x	x	x
Key actors in 3 sectors					
34	Swedish Society for Nature Conservation	x	x		x
51	Swedish Forest Industries Federation (Skogsindustrierna)	x		x	x
52	Swedish Hydropower Association (Svensk Vattenkraftförening)		x	x	x
54	The Federation of Swedish Family Forest Owners (LRF Skogsägarna)	x		x	x
56	Water Regulation Enterprises (Vattenregleringsföretagen)		x	x	x

4 Mapping of Policy Goals/Instruments

4.1 Key Policy Objectives and Instruments

The key policy objectives of the climate, water, forest and energy sector focus on long-term sustainable and efficient use/management of our natural resources (i.e., surface water, groundwater, forests, trees, etc.) and on mitigating climate change and its consequences. Key instruments include *administrative instruments* (e.g., regulations), *economic instruments* (including fees, flexible mechanisms, taxes and subsidies), *information* (e.g, education, consultation or guidance), *research & development*, and *voluntary actions* (such as certification or agreements).

4.2 Inventory of Policy Documents

The following subsections include inventories of relevant policy documents for each sectors under consideration (Table 4-Table 7) as well as horizontal policies (Table 8).

4.2.1 Documents in the Climate Sector

Table 4: Inventory of policy documents in the climate sector

Type of Document	Title of Document	Short Description	Life Span
Climate Policy	Act (SFS 2017:720) on Climate	This Act establishes that the Government's climate policy must be based on the climate goals and specifies how work is to be carried out.	2018-NA
	A Climate Policy Framework for Sweden (Gov. Bill 2016/17:146, passed in parliament 15 June, 2017)	This framework contains new climate goals, a Climate Act and plans for a climate policy council for the purpose of creating a clear and coherent climate policy.	2018-NA
	Ordinance (SFS 2015:517) on Aid to Local Climate Investments	Financial support may be granted under this Ordinance with the purpose of sustainable reduction of greenhouse gas emissions.	2015-NA
	Ordinance (SFS 2016:385) on Financial Support for Municipal Energy and Climate Advisors	Financial support may be granted under this Ordinance to support the coordination and development of municipal energy and climate advice.	2016-NA
Emission Policy	Act (SFS 2004:1199) on Emission Trading Ordinance (SFS 2004:1205) on Emissions Trading	These documents govern the conditions for trading the right to release greenhouse gases (emission allowances).	2005-NA

4.2.2 Documents in the Landuse Sector (Forests)

Table 5: Inventory of policy documents in the forest sector

Type of Document	Title of Document	Short Description	Life Span
Forestry Policy	Act (SFS 1979:429) on Forest Maintenance Ordinance (SFS 1993:1096) on Forest Maintenance	These documents state that the forest is a renewable resource that is to be managed sustainably to ensure not only a reliable yield of timber and the multiple use of forests, but also preserve biological diversity.	1980-NA
	Ordinance (SFS 2009:1393) with Instructions for the Swedish Forest Agency	Defines the role and tasks of the Swedish Forest Agency.	2010-NA
	Ordinance (SFS 2010:1879) on Support for Certain Measures in Forestry	Financial support may be granted under this Ordinance to support forestry actions resulting in the protection of natural environments and cultural heritage and for establishing/protecting broad-leaved deciduous forest.	2011-NA

4.2.3 Documents in the Water Sector

Table 6: Inventory of policy documents in the water sector

Type of Document	Title of Document	Short Description	Life Span
Fishing Policy	Act (SFS 1993:787) on Fisheries Ordinance (SFS 1994:1716) on Fishing, Aquaculture and Fisheries Ordinance (SFS 1998:1343) on the Support of Fish Conservation	These documents cover the right to fish as well as fishing activities in Sweden's territorial waters and exclusive economic zone. They regulate both fishing activities as such and subsequent activities until the landing of the fish and the fisherman's reporting of the catch.	1994-NA
Flood Risk Policy	Ordinance (SFS 2009:956) on Flood Risk	This Ordinance implements the Floods Directive 2007/60/EC and contains provisions to reduce the harmful consequences of floods.	2009-NA
Groundwater Policy	Act (SFS 1975:424) on the Duty to Report on the Exploration for Groundwater and Drilling of Wells	This Act requires whoever is engaged professionally in the drilling, digging or any other operation for the exploration of groundwater to report to the Swedish Geological Exploration Institute.	1975-NA

Type of Document	Title of Document	Short Description	Life Span
Water Operation Policy	Act (SFS 1998:812) Containing Special Provisions concerning Water Operations	This law contains parts of the old water law that could not be included in the Environmental Code, e.g., many rules for joint water facilities (i.e., water facilities with several partners).	1999-NA
Water Quality Policy	Ordinance (SFS 2004:660) on management of the quality of the aquatic environment	This Ordinance implements provisions of the Water Framework Directive 2000/60/EG and contains e.g. rules regarding the environmental quallity objectives for water bodies.	2004-NA
	Ordinance (2008:218) on Bathing Waters	This Ordinance implements Directive 2006/7/EC and provides rules for the identification, control and classification of surface bathing waters.	2008-NA
	Ordinance (SFS 2001:554) on Environmental Quality Standards for Fish and Bivalve Waters	This Ordinance implements the Freshwater Fish Directive (2006/44/EC) and contains environmental quality standards for fish and bivalve waters.	2001-NA
	Ordinance (SFS 1982:840) on Government Funding for Liming of Lakes and Rivers	Financial support may be granted under this Ordinance to support the liming of lakes and rivers with the goal to reduce acidifaction	1982-NA
Water Service Policy	Act (SFS 2006:412) on Public Water Services	The aim of this Act is to ensure household water supply and discharge in a coordinate manner so as to safeguard public health and the environment.	2007-NA

4.2.4 Documents in the Energy Sector

Table 7: Inventory of policy documents in the energy sector

Type of Document	Title of Document	Short Description	Life Span
Energy Policy	Act (SFS 1997:857) on Electricity	This Act provides regulations concerning power installations, trade and electrical safety.	1998-NA
	Act (1994:1776) on Tax on Energy Ordinance (2010:178) on Tax on Energy	These documents govern the carbon dioxide, the sulphur and the energy tax to increase environmental benefits.	1994-NA

Type of Document	Title of Document	Short Description	Life Span
	Act (SFS 2011:1200) Regarding Electricity Certificates Ordinance (SFS 2011:1480) on Electricity Certificates	These documents aim to promote the production of renewable electricity. The certificate system, is intended to help Sweden to achieve a more ecologically sustainable energy system and also to meet the EU target for the country's proportion of renewable energy production.	2012-2035
	Act (SFS 2010:601) on Guarantees of Origin for Electricity Ordinance (SFS 2010:853) on Guarantees of Origin for Electricity	These documents aim to ensure that the producer of electricity is entitled to receive guarantees of origins issued to show the origin of the produced product.	2010-NA
	Agreement by The Government, the Moderate Party, the Centre Party and the Christian Democrats on Swedish energy policy (link)	This agreement consists of a common road map for a controlled transition to an entirely renewable electricity system, with a target of 100 per cent renewable electricity production by 2040.	2016-NA
Renewable Energy Policy	Act (SFS 2010:598) on Sustainability Criteria for Biofuels and Bioliquids Ordinance (SFS 2011:1088) on Sustainability Criteria for Biofuels and Bioliquids	These documents implement certain provisions of the Renewable Energy Directive 2009/28/EC. They ensure that those biofuels and bioliquids that are used in Sweden fulfil a given set of sustainability criteria that cover the entire production chain of a biofuel or bioliquid, from feedstock production to end use.	2010-NA
	Ordinance (SFS 2003:564) on Grants for Measures Promoting Effective and Environmentally Sustainable Energy Supply	Financial project support for technology procurement may be granted under this Ordinance.	2004-NA
	Research and New Technology for the Future Energy System (Gov. Bill 2005/06:127)	This bill sets out guidelines for the continued long-term energy policy efforts in research, development, demonstration and commercialization in the energy field.	2006-NA

4.2.5 Documents of Horizontal Policies

Table 8: Inventory of horizontal policy documents that are relevant for several sectors

Type of Document	Title of Document	Short Description	Life Span
Agricultural Policy	A National Food Strategy for Sweden – more jobs and sustainable growth throughout the country (Gov. Bill 2016/17:104)	This Strategy is a platform that sets out the direction of Sweden's policy towards 2030, to create stability and ensure a long-term approach. Concrete measures are put forward in the Government's action plan stemming from areas identified in the strategy.	2017-2030
Biodiversity Policy	A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141)	This bill summarizes the overall strategy for biodiversity and ecosystem services, which includes milestone targets and initiatives that have been adopted.	2013-2020
	Ordinance (SFS 2007:845) on Species Protection	This Ordinance prohibits the trading, storage, and display of threatened species without special permission.	2007-NA
Cultural Heritage Policy	Act (SFS 1988:950) on Cultural Heritage Ordinance (SFS 1988:1188) on Cultural Heritage	These documents govern the cultural heritage protection and management with the aim to preserve and manage sites of historical, architectural or archaeological significance.	1989-NA
Environmental Policy	Environmental Code (SFS 1998:808)	This Code promotes sustainable development, which will assure a healthy and sound environment for present and future generations.	1998-NA
	Proposal for Consequential Legislation to the Environmental Code (Gov. Bill 1997/98:90)	This document proposes to adapt a number of existing environmental laws to the Environmental Code, (SFS 1998:808)	1998-NA
	Ordinance (SFS 1998:899) on Environmentally Hazardous Activities and the Protection of Public Health	This Ordinance concerns environmentally hazardous activities and provides for compulsory review of applications to conduct environmentally hazardous activities.	1999-NA
	Ordinance (SFS 1998:901) on Operator's Control	This document specifies regulations on the continuous examination, assessment and minimization of risks associated with the use of chemicals.	1999-NA
	Ordinance (SFS 1998:905) on Environmental Impact Statements	This Ordinance implements EU Directive 2001/42/EC and contains provisions on environmental impact	1999-NA

Type of Document	Title of Document	Short Description	Life Span
		statements and strategic environmental assessment reports.	
	Ordinance (SFS 1998:915) on Environmental Considerations in Agriculture	This Ordinance contains regulations regarding the handling of plant nutrients, nitrate-sensitive areas, and the storage of livestock manure.	1999-NA
	Ordinance (SFS 1998:1252) on the Protection of Natural Areas According to the Environmental Code	This ordinance contains provisions for the protection of natural areas, for game parks and for fencing in an area that is of interest for outdoor recreation.	1999-NA
	Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150), Chapter 12-13	This bill specifies the environmental quality objectives that are necessary to realize Sweden's environmental policy aims. Chapter 5 describes the objective "Reduce Climate Impact" and specifies interim targets. Chapters 12 and 13 describe the objectives "Flourishing Lakes and Streams" and "Good-Quality Groundwater". Chapter 16 describes the objective "Sustainable Forests" and specifies interim targets.	2005-NA
	Act (1995:1667) on Natural Gravel Tax	This document governs the natural gravel tax in order to increase the substitution of the natural gravel derived from glacifluvial deposits with other materials.	1996-NA
	Act (SFS 1984:410) on Taxation of Pesticides	This document governs the pesticides tax in order to reduce the use of pesticides for health and environmental reasons.	1985-NA
	Act (SFS 1990:613) on an Environmental Charge on Emissions of Nitrogen Oxides in Energy Production	This document governs the NOx emission tax in order to reduce soil acidification and water eutrophication.	
Food Policy	Act (SFS 2006:804) on Food	This Act aims at ensuring a high level of safety regarding health of human beings in relation with food.	2007-NA
Planning and Building Policy	Act (SFS 2010:900) on Planning and Building	These documents contain provisions on the planning of land and water areas,	2011-NA

Type of Document	Title of Document	Short Description	Life Span
	Ordinance (SFS 2011:338) on Planning and Building	and on construction. The purpose of the provisions is to promote societal progress with equal and proper living conditions and a clean and sustainable habitat, for people in today's society and for future generations.	
Road Policy	Act (SFS 1971:948) on Roads	This Act contains provisions governing the construction, viability, operation, safety, management and cancellation of public roads.	1972-NA
Rural Development Program	Ordinance (SFS 2015:406) on the Support for Rural Development Measures Ordinance (SFS 2015:407) of Locally Led Development	The Program is a tool for developing Sweden's rural areas. It contains support and compensation to achieve the objectives of the programme. Some of these target agricultural sectors in particular, although several types of support can be applied for by anyone living and working in rural areas.	2014-2020
Strategic Planning Policy	Ordinance (SFS 2007:825) with Instructions for the County Administrative Board	This document contains regulations about the County Administrative Board's responsibilities and tasks, the authoritys management and the consultation with other authorities.	2008-NA
Waste Policy	Ordinance (SFS 2001:512) on the Landfill of Waste Ordinance (SFS 2011:927) on Waste	These documents provide measures on waste and waste management, and apply to any business that deals in any capacity with non-hazardous and/or hazardous waste. The purpose is to prevent and reduce the negative effects of waste disposal on human health and the environment, especially in the area of surface water, groundwater, soil and air pollution, and the global environment.	2012-NA

4.3 Inventory of Objectives of Relevant Sectors

The subsections below include inventories of relevant policy objectives for each of the sectors under consideration: climate (Table 9), landuse/forests (Table 10), water (Table 11) and energy (Table 12).

4.3.1 Objectives in the Climate Sector

Table 9: Inventory of objectives in the climate sector

Overarching Objectives	Specific Objectives	Reference Documents
Ambitious, long-term and stable climate policy	Government's climate policy is to be based on the climate goals. The new climate act specifies how the work is to be carried out. The Government is to present a climate report every year in its Budget Bill. Every fourth year, the Government is to draw up a climate policy action plan which is to provide information on how the climate goals are to be achieved.	A Climate Policy Framework for Sweden (Gov. Bill 2016/17:146
Reduce Climate Impacts	Limit the rise in the global average temperature well below 2°C above pre-industrial levels. Pursue efforts to limit the rise to 1.5°C above pre-industrial levels.	A Climate Policy Framework for Sweden (Gov. Bill 2016/17:146
Emission reduction	By 2045, no net emissions of greenhouse gases into the atmosphere, thereafter negative emissions. By 2045, emissions from activities in Swedish territory at least 85% lower than in 1990 Increased uptake of carbon dioxide in forests and land, and investments in other countries. By 2030: emissions in Sweden outside of the EU ETS at least 63 per cent lower than emissions in 1990, and by 2040 at least 75 per cent lower. No more than 8 and 2 percentage points, respectively, of the emissions reductions may be realized through supplementary measures. By 2030: Emissions from domestic transport in the area of domestic aviation reduced by at least 70 per cent compared with 2010.	A Climate Policy Framework for Sweden (Gov. Bill 2016/17:146 Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150) , Chapter 5
Ensure climate action	Foster knowledge transfer and innovation. Promote resource efficiency and support the shift towards a low carbon and climate resilient economy in agriculture, food and forestry.	Ordinance (2015:406) on the Support for Rural Development Measures Ordinance (2015:407) of Locally Led Development

4.3.2 Objectives in the Landuse Sector (Forests)

Table 10: Inventory of objectives in the forest sector

Overarching Objectives	Specific Objectives	Reference Documents
Production goal: Ensure a reliable yield of timber	Reforest unproductive or idle forest land within three years. Use only reforestation methods that were found to produce satisfactory results within an acceptable time frame. Apply necessary rejuvenation measures to ensure regrowth of a forest of adequate density. Plowing may not be used as a soil/land preparation method.	Act (SFS 1979:429) on Forest Maintenance Ordinance (SFS 1993:1096) on Forest Maintenance
Environmental goal: Sustainable development and management of forest resources	The environment is protected against damage and detriment, whether caused by pollutants or other impacts. Valuable natural and cultural environments are protected and conserved. Biological biodiversity is preserved. The use of land, water and the physical environment in general is such as to secure a long-term good management in ecological, social, cultural and economic terms. Reuse and recycling, as well as other management of materials, raw materials and energy are encouraged with a view to establishing and maintaining natural cycles. Knowledge transfer and innovation in forestry and rural areas is fostered. Resource efficiency is promoted and the shift towards a low carbon and climate resilient economy in the forestry sector is supported.	Environmental Code, (SFS 1998:808), Chapter 1 Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150), Chapter 16 Ordinance (SFS 2010:1879) on Support for Certain Measures in Forestry A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141) Ordinance (SFS 2007:845) on Species Protection Act (SFS 1988:950) on Cultural Heritage Ordinance (SFS 1988:1188) on Cultural Heritage Ordinance (SFS 2015:406) on the Support for Rural Development Measures Ordinance (SFS 2015:407) of Locally Led Development

Overarching Objectives	Specific Objectives	Reference Documents
Achieve the forest policy goals decided on by the government	The Swedish Forest Agency shall be responsible for: ▪ supervising regulatory compliance ▪ creating inventories, following-up and evaluating how the forests are managed ▪ providing advice and information on how the forests should be managed ▪ working towards the achievement of the Environmental Objectives and the Generation Goal, and, if necessary, proposing measures for the development of environmental work ▪ coordinating follow-up, evaluation and reporting of the Environmental Objective "Living Forest" ▪ assisting in issues related to community planning for sustainable development and use of natural resources ▪ coordinating the implementation, development, follow-up and reporting of the goals of the Outdoor Recreation Policy	Ordinance (SFS 2009:1393) with Instructions for the Swedish Forest Agency

4.3.3 Objectives in the Water Sector

Table 11: Inventory of objectives in the water sector

Overarching Objectives	Specific Objectives	Reference Documents
Protect inland surface waters, transitional waters and coastal waters.	Maintain and improve the aquatic environment (essentially water quality) Prevent further deterioration of aquatic ecosystems and protect/enhance their status Promote sustainable water use based on long-term protection of available water resources Protect and improve the aquatic environment through specific measures for the progressive reduction of discharges, emissions and losses of priority hazardous substances Ensure the progressive reduction of pollution of groundwater and prevent its further pollution	Environmental Code, (1998:808) Chapter 5 Section 8 Swedish Ordinance (2004:660) on Management of the Quality of the Aquatic Environment Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy Environmental Quality Objectives – A Shared

Overarching Objectives	Specific Objectives	Reference Documents
	contribute to mitigating the effects of floods and droughts Provision of the sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use Achieving the objectives of relevant international agreements, including those which aim to prevent and eliminate pollution of the marine environment, by Community action under Article 16 Protect territorial and marine waters Ensure greater integration of qualitative and quantitative aspects of surface waters Establish common definitions of the status of water in terms of quality and, where relevant for the purpose of the environmental protection, quantity should be established; Achieve the objective of at least good water status for each river basin by defining and implementing the necessary measures within integrated programs of measures; Protect, enhance and restore all bodies of surface water with the aim of achieving good surface water status in 2015 Protect and enhance all artificial and heavily modified bodies of water with the aim of achieving good ecological potential and good surface water chemical status by 2015 Implement the necessary measures with the aim of progressively reducing pollution from priority substances	Responsibility (Gov. Bill 2004/05:150)
Ensure the sustainable management of natural resources.	Restore, preserve and enhance ecosystems related to agriculture and forestry, with a focus on: ▪ restoring, preserving and enhancing biodiversity	Ordinance (2015:406) on the Support for Rural Development Measures Ordinance (2015:407) of Locally Led Development

Overarching Objectives	Specific Objectives	Reference Documents
	▪ improving water management, including fertiliser and pesticide management	
Lakes and watercourses must be ecologically sustainable, of good quality and their variety of habitats must be preserved.	Development of environmental quality standards for water bodies and for fish/bivalve waters. Provide rules for the identification, control and classification of surface bathing waters. Reduce acidification. Support liming of lakes and rivers. Reduce pollution. Protect water areas with high natural value. Restoring disturbed fresh waters. Reinstate a sufficient number of ecologically sustainable and diverse habitats. Strengthen the financial and the legal frameworks for restoring rivers and streams.	Ordinance (SFS 2004:660) on management of the quality of the aquatic environment Ordinance (2008:218) on Bathing Waters Ordinance (SFS 2001:554) on Environmental Quality Standards for Fish and Bivalve Waters Ordinance (SFS 1982:840) on Government Funding for Liming of Lakes and Rivers A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141) Ordinance (SFS 2007:845) on Species Protection
Groundwater must provide a safe and sustainable supply of drinking water and contribute to viable habitats for flora and fauna in lakes and watercourses.	Secure good water quality by establishing measures on water quantity Ensure greater integration of qualitative and quantitative aspects of groundwater. Reduce the extraction of gravel from Eskers (natural gravel deposits). Implement the measures necessary to prevent or limit the input of pollutants into groundwater and to prevent the deterioration of the status of all bodies of groundwater; Protect, enhance and restore all bodies of groundwater, ensure a balance between abstraction and recharge of groundwater Implement the measures necessary to reverse any significant and sustained upward trend in the	Environmental Code, (1998:808) Chapter 5 Section 8 Swedish Ordinance (2004:660) on Management of the Quality of the Aquatic Environment Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy Act (SFS 1975:424) on the Duty to Report on the Exploration for Groundwater and Drilling of Wells

Overarching Objectives	Specific Objectives	Reference Documents
	concentration of any pollutant resulting from the impact of human activity in order progressively to reduce pollution of groundwater;	Act (1995:1667) on Natural Gravel Tax
Natural productive capacity, biological diversity, cultural heritage assets and the ecological and water-conserving function of the landscape must be preserved, at the same time as recreational assets are safeguarded.	Support people's opportunities to spend time in nature and enjoy outdoor recreational activities, with the right of public access being a foundation of outdoor recreation.	Act (SFS 1993:787) on Fisheries Ordinance (SFS 1994:1716) on Fishing, Aquaculture and Fisheries Ordinance (SFS 1998:1343) on the Support of Fish Conservation Act (SFS 1998:812) Containing Special Provisions concerning Water Operations Act (SFS 2006:412) on Public Water Services
Promote sustainable development to ensure a healthy and sound aquatic environment for present and future generations	The environment is protected against damage and detriment, whether caused by pollutants or other impacts. Valuable natural and cultural environments are protected and conserved. Biological biodiversity is preserved. The use of land, water and the physical environment in general is such as to secure a long-term good management in ecological, social, cultural and economic terms. Reuse and recycling, as well as other management of materials, raw materials and energy are encouraged with a view to establishing and maintaining natural cycles.	Environmental Code, (SFS 1998:808), Chapter 1

4.3.4 Objectives in the Energy Sector

Table 12: Inventory of objectives in the energy sector

Overarching Objectives	Specific Objectives	Reference Documents
Sustainable and environmentally friendly energy supply	Promotion of the production of renewable energy and thereby increase their share The target by 2040 is 100 per cent renewable electricity production. By 2045, Sweden is to have no net emissions of greenhouse gases into the atmosphere and should thereafter achieve negative emissions. Impose modern environmental requirements on hydropower Continue to protect the protected 'national rivers' in the north of Sweden and other waterways specified by law from development Reduce property tax on hydropower plants Extend the electricity certificate system and expand by 18 TWh of new electricity certificates until 2030.	Act (SFS 2010:601) on Guarantees of Origin for Electricity Ordinance (SFS 2010:853) on Guarantees of Origin for Electricity Act (SFS 2010:598) on Sustainability Criteria for Biofuels and Bioliquids Ordinance (SFS 2011:1088) on Sustainability Criteria for Biofuels and Bioliquids Act (SFS 2011:1200) Regarding Electricity Certificates Ordinance (SFS 2011:1480) on Electricity Certificates Agreement by The Government, the Moderate Party, the Centre Party and the Christian Democrats on Swedish energy policy
Efficient energy use with minimal impact on the environment	An energy-efficiency target for the period 2020 to 2030 will be produced and adopted no later than 2017. Adapt existing regulatory frameworks to new products and services in the areas of energy efficiency, energy storage and electricity sales Introduce a special energy efficiency program Investigate broadly the potential obstacles to enable services to develop with respect to active customers and energy efficiency	Act (1994:1776) on Tax on Energy Ordinance (2010:178) on Tax on Energy Agreement by The Government, the Moderate Party, the Centre Party and the Christian Democrats on Swedish energy policy

Competitive energy provision: Offer electricity at competitive prices and build a robust electricity network with high security.	Strengthen Nordic cooperation on network investments, develop the cooperation on NordPool, and contribute to completing the move towards a harmonized Nordic electricity retail market Nuclear power needs major investment if it is to meet upcoming safety requirements. Continue high production of hydropower Increase transmission capacity within Sweden	Agreement by The Government, the Moderate Party, the Centre Party and the Christian Democrats on Swedish energy policy

4.3.5 Objectives of other Horizontal Sectors

Table 13: Inventory of horizontal policy documents that are relevant for several sectors

Overarching Objectives	Specific Objectives	Reference Documents
Environmental goal: A varied agricultural landscape	Protect the value of the farmed landscape and agricultural land for biological production and food production. Preserve and strengthen biological diversity and cultural heritage assets.	A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141) Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)
A market-oriented agricultural sector and a competitive food supply chain	Increase overall food production while achieving the relevant national environmental objectives. The increase in production – of both conventional and organic food – should correspond to consumer demands. Generate growth and employment Increase the level of self-sufficiency. Reduce vulnerability in the food supply chain.	A National Food Strategy for Sweden – more jobs and sustainable growth throughout the country (Gov. Bill 2016/17:104)

Overarching Objectives	Specific Objectives	Reference Documents
Environmental goal: Rich Diversity of Plant and Animal Life	Preserve biological diversity for the benefit of present and future generations. Safeguard species habitats and ecosystems and their functions and processes. Provide people with access to a good natural and cultural environment rich in biological diversity, as a basis for health, quality of life and well-being.	A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141) Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)
Environmental goal: Zero Eutrophication	Nutrient levels in soil and water must not be such that they adversely affect human health, the conditions for biological diversity or the possibility of varied use of land and water.	Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)
Environmental goal: A Magnificent Mountain Landscape	Preserve the pristine character of the mountain environment in terms of biological diversity, recreational value, and natural and cultural assets. Activities in mountain areas must respect these values and assets, with a view to promoting sustainable development. Protect particularly valuable areas from encroachment and other disturbance.	Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)
Environmental goal: Natural Acidification Only	Limit the acidifying effects of deposition and land to values that can be tolerated by soil and water.	Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)

4.4 Inventory of instruments of Relevant Sectors

This section includes inventories of relevant policy instruments for each of the sectors under consideration below: climate (Table 14), landuse/forests (Table 15), water (Table 16) and energy (Table 17). Main instrument categories in this report are *administrative instruments* (e.g., regulations), *economic instruments* (including fees, flexible mechanisms, taxes and subsidies), *information* (e.g, education, consultation or guidance), *research & development*, and *voluntary actions* (such as certification or agreements).

4.4.1 Instruments in the Climate Sector

Table 14: Inventory of instruments in the climate sector

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Administrative (Regulation)	Land drainage provisions of the Environmental Code, which indirectly affect trends in carbon dioxide removal	Environmental Code, (SFS 1998:808), Chapter 11
	Site protection and nature conservation agreements, which indirectly affect trends in carbon dioxide removal	Environmental Code, (SFS 1998:808), Chapter 7-8
	Provisions on forest management in the Forestry Act, which indirectly affect trends in carbon dioxide removal	The Swedish Forestry Act (SFS 1993:1096)
	Provisions on the use of biofuels (in transport) and bioliquids (for electricity and heating)	Act (SFS 2010:598) on sustainability criteria for biofuels and bioliquids Ordinance (SFS 2011:1088) on sustainability criteria for biofuels and bioliquids
	Provisions concerning guarantees of origins to reduce greenhouse gas emissions and improve sustainability rating.	Act (SFS 2010:601) on Guarantees of Origin for Electricity Ordinance (SFS 2010:853) on Guarantees of Origin for Electricity
Economic (Flexible Mechanisms)	EU Emission Trading System (EU ETS) Joint Implementation (JI) Clean Development Mechanism (CDM)	Ordinance (SFS 2004:1205) on Emissions Trading
Economic (Subsidy)	Financial support to local climate investments with the goal to provide greatest possible climate benefit and reduce greenhouse gas emissions.	Ordinance (SFS 2015:517) on Aid to Local Climate Investments
	Financial support to municipalities for energy and climate consulting	Ordinance (SFS 2016:385) on Financial Support for Municipal Energy and Climate Advisors
Economic (Tax)	Energy tax Carbon tax Electricity consumption tax	The Swedish Energy Tax Act (1994:1776)

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Information	Information campaigns at local, regional and national levels	Sweden's Sixth National Communication on Climate Change (Swedish Ministry of the Environment, 2015)
Research & Development	Extensive research and innovation efforts.	A Climate Policy Framework for Sweden (Gov. Bill 2016/17:146
	Technology procurement: Support the development for more energy-efficient products/systems and an increased use of renewable energy.	Sweden's Sixth National Communication on Climate Change (Swedish Ministry of the Environment, 2015)
Voluntary Action (Certification)	Electricity Certification	Act (SFS 2011:1200) Regarding Electricity Certificates Ordinance (SFS 2011:1480) on Electricity Certificates

4.4.2 Instruments in the Landuse Sector (Forests)

Table 15: Inventory of instruments in the forest sector

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Administrative (Regulation)	Define minimum requirements as to how to manage the forest	Act (SFS 1979:429) on Forest Maintenance Ordinance (SFS 1993:1096) on Forest Maintenance
	Provisions concerning forestry activities that can potentially have a significant impact on the natural environment (including an obligation to make a notice of consultation)	Environmental Code, (SFS 1998:808), Chapter 12, Section 6
	Site protection and nature conservation agreements, which affect forest activities	Environmental Code (SFS 1998:808), Chapters 7-8 Ordinance (SFS 1998:1252) on the Protection of Natural Areas According to the Environmental Code
	Provisions concerning the management of the quality of the aquatic environment, which affects the management of forests	Ordinance (SFS 2004:660) on management of the quality of the aquatic environment
	Provisions on the protection and management of cultural heritage.	Act (SFS 1988:950) on Cultural Heritage Ordinance (SFS 1988:1188) on Cultural Heritage

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
	Provisions on the trading, storage, and display of threatened species without special permission.	Ordinance (SFS 2007:845) on Species Protection
Economic (Fee)	Environmental sanction charges can be charged directly by a supervisory authority when a violation against the Environmental Code (SFS 1998:808) is ascertained.	Environmental Code (SFS 1998:808), Chapters 29-30
Economic (Subsidy)	Financial support for environmental measures in forests	Ordinance (SFS 2015:406) on the Support for Rural Development Measures Ordinance (SFS 2015:407) of Locally Led Development
	Financial support for forestry actions resulting in ▪ the protection of natural environments and cultural heritage, and ▪ for establishing or protecting broad-leaved deciduous forest	Ordinance (SFS 2010:1879) on Support for Certain Measures in Forestry
Information	Provide advice and information on how the forests of the country should be managed	Ordinance (SFS 2009:1393) with Instructions for the Swedish Forest Agency A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141)
Research & Development	Extensive research and innovation efforts into biodiversity and ecosystem services.	A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141)
Voluntary Action (Certification)	Forest Certification through the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC)	Environmental Quality Objectives – A Shared Responsibility (Gov. Bill 2004/05:150)
Voluntary Action (Agreements)	Voluntary nature conservation agreements ('Naturvårdsavtal') between the government and a landowner to formally support long-term development and protection of areas with high natural values	Proposal for Consequential Legislation to the Environmental Code (Gov. Bill 1997/98:90)

4.4.3 Instruments in the Water Sector

Table 16: Inventory of instruments in the water sector

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Administrative (Regulation)	Provisions on flood risk assessments and management plans.	Ordinance (SFS 2009:956) on Flood Risk
	Provisions concerning the management of the quality of the aquatic environment.	Ordinance (SFS 2004:660) on management of the quality of the aquatic environment
	Site protection and nature conservation agreements, which affect forest activities	Environmental Code (SFS 1998:808), Chapters 7-8 Ordinance (SFS 1998:1252) on Protection of Natural Areas According to Environ. Code
	Definition of duties for municipal authorities to provide for coordinated water services. General directives for the planning and operation of water supply and discharge installations.	Act (SFS 2006:412) on Public Water Services
	Regulations regarding fishing activities	Act (SFS 1993:787) on Fisheries Ordinance (SFS 1994:1716) on Fishing, Aquaculture, Fisheries
	Water-related provisions governing the construction, viability, operation, safety, management and cancellation of public roads.	Act (SFS 1971:948) on Roads
	Provisions on the planning of land and water areas.	Act (SFS 2010:900) on Planning and Building Ordinance (SFS 2011:338) on Planning and Building
	Minimum requirements as to how to manage the forest, which can have substantial physical and hydrological impacts.	Act (SFS 1979:429) on Forest Maintenance Ordinance (SFS 1993:1096) on Forest Maintenance
	Provisions on the protection and management of cultural heritage.	Act (SFS 1988:950) on Cultural Heritage Ordinance (SFS 1988:1188) on Cultural Heritage
	Regulations on environmentally hazardous activities.	Environmental Code (SFS 1998:808) Ordinance (SFS 1998:899) on Environmentally Hazardous

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
		Activities and the Protection of Public Health
	Provisions on environmental impact statements and strategic environmental assessment reports.	Environmental Code (SFS 1998:808) Ordinance (SFS 1998:905) on Environmental Impact Statements
	Provisions on the continuous examination, assessment and minimization of risks associated with the use of chemicals.	Environmental Code (SFS 1998:808) Ordinance (SFS 1998:901) on Operator's Control
	Regulations concerning measures on waste and waste management.	Environmental Code (SFS 1998:808) Ordinance (SFS 2001:512) on the Landfill of Waste Ordinance (SFS 2011:927) on Waste
	Provisions on the identification, control and classification of surface bathing waters.	Ordinance (2008:218) on Bathing Waters
	Provisions regarding environmental quality standards for fish and bivalve waters.	Ordinance (SFS 2001:554) on Environmental Quality Standards for Fish and Bivalve Waters
	Provisions on the handling of plant nutrients.	Environmental Code (SFS 1998:808) Ordinance (SFS 1998:915) on Environmental Considerations in Agriculture
	Provisions on drinking water quality.	Act (SFS 2006:804) on Food
	Regulations regarding the reporting on drilling, digging or any other operation for the exploration of groundwater.	Act (SFSS 1975:424) on the Duty to Report on the Exploration for Groundwater and Drilling of Wells
	Provisions on the responsibilities and tasks of the County Administrative Boards, which are coordinating national authorities with supervisory responsibilities that work amongst others on issues concerning the environment and nature.	Ordinance (SFS 2007:825) with Instructions for the County Administrative Board

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Economic (Fee)	Annual fees to be paid by water operators as determined by the Land and Environment Court.	Act (SFS 1998:812) Containing Special Provisions concerning Water Operations
	Fees to be paid by property owners for the supply of drinking water and the removal of waste water.	Act (SFS 2006:412) on Public Water Services
	Water operators have to pay compensations to property owners in case of property damage.	Environmental Code (SFS 1998:808)
	Fees to be paid in case of water pollution caused by emissions from ships.	Act (SFS 1993:787) on Fishing
	Environmental sanction charges can be charged directly by a supervisory authority when a violation against the Environmental Code (SFS 1998:808) is ascertained.	Environmental Code (SFS 1998:808), Chapters 29-30
Economic (Subsidy)	Financial compensation for water operators in connection with the establishment of nature reserves.	Environmental Code (SFS 1998:808)
	Government Funding for municipalities to support liming of lakes and rivers to reduce acidification	Ordinance (SFS 1982:840) on Government Funding for Liming of Lakes and Rivers
	Financial support for fish conservation activities.	Ordinance (SFS 1998:1343) on the Support of Fish Conservation
	Financial support for forestry actions resulting in the protection of natural environments and cultural heritage.	Ordinance (SFS 2010:1879) on Support for Certain Measures in Forestry
	Financial support for investing in the improvement of the environment (e.g. reductions in leaching from farms or establishment/restoration of wetlands)	Ordinance (2015:406) on the Support for Rural Development Measures Ordinance (2015:407) of Locally Led Development
Economic (Tax)	Natural gravel tax, which indirectly reduces hydrological impacts.	Act (1995:1667) on Natural Gravel Tax
	Tax on pesticides to reduce the impact on water quality.	Act (SFS 1984:410) on Taxation of Pesticides
	Tax on NOx emissions, with the intent of reducing acidification and eutrophication.	Act (SFS 1990:613) on an Environmental Charge on Emissions of Nitrogen Oxides in Energy Production

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Information	Project "Focus on Nutrients" ('Greppa näringen'), which is the largest single undertaking in Sweden to reduce losses of nutrients to air and water from livestock and crop production. It offers free-of-charge advice to farmers.	http://www.greppa.nu/om-greppa/om-projektet/in-english.html
	Provide consultation, education and information material, e.g. ▪ Handbook for water planning ▪ Handbook on water protection areas ▪ General advice on nitrogen fertilization of forest land provided by the Swedish Forest Agency	A Swedish strategy for biodiversity and ecosystem services (Gov. Bill 2013/14:141)
Voluntary Action (Agreement)	Voluntary nature conservation agreements ("Naturvårdsavtal") between the government and a landowner to formally support long-term development and protection of areas with high natural values	Proposal for Consequential Legislation to the Environmental Code (Gov. Bill 1997/98:90)

4.4.4 Instruments in the Energy Sector

Table 17: Inventory of instruments in the energy sector

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
Administrative (Regulation)	Provisions concerning power installations, trade in electrical power in certain cases and electrical safety.	Act (SFS 1997:857) on Electricity
	Provisions on the use of biofuels (in transport) and bioliquids (for electricity and heating)	Act (SFS 2010:598) on Sustainability Criteria for Biofuels and Bioliquids Ordinance (SFS 2011:1088) on Sustainability Criteria for Biofuels and Bioliquids
	Provisions concerning guarantees of origins to reduce greenhouse gas emissions and improve sustainability rating.	Act (SFS 2010:601) on Guarantees of Origin for Electricity Ordinance (SFS 2010:853) on Guarantees of Origin for Electricity
	Provisions of the Environmental Code, which indirectly affect the use	Environmental Code, (SFS 1998:808)

General Instrument or Instrument Category	Specific Policy Instruments	Reference Documents
	of land and water areas for energy production.	
	Provisions of the Planning and Building Policy, which affect the use of land and water areas for energy production.	Act (SFS 2010:900) on Planning and Building Ordinance (SFS 2011:338) on Planning and Building
Economic (Flexible Mechanisms)	EU Emission Trading System (EU ETS)	Ordinance (SFS 2004:1205) on Emissions Trading
Economic (Subsidy)	Carbon tax relief for industry Energy tax exemption for fuels used in industrial activities in the manufacturing process.	Act (1994:1776) on Tax on Energy
	Financial support to promote the development of new technology and the use of more energy-efficient products and systems (technology procurement)	Ordinance (SFS 2003:564) on Grants for Measures Promoting Effective and Environmentally Sustainable Energy Supply
Economic (Tax)	▪ Energy tax ▪ Carbon tax ▪ Electricity consumption tax	Act (1994:1776) on Tax on Energy Ordinance (2010:178) on Tax on Energy
Information	Information initiatives, including ▪ Energy advice ▪ Energy labeling ▪ Energy declarations for buildings ▪ campaigns on energy use	'Policy Instruments for Reduced Environmental Impacts' (Swedish Energy Agency, 2007)
Research & Development	Extensive research and innovation efforts in the energy field.	Research and New Technology for the Future Energy System (Gov. Bill 2005/06:127)
Voluntary Action (Certification)	Electricity Certification	Act (SFS 2011:1200) Regarding Electricity Certificates Ordinance (SFS 2011:1480) on Electricity Certificates
	Energy Mapping (provides municipalities and utilities with a way to evaluate existing energy use in a community and plan to improve energy efficiency through the use of better building standards and alternative energy sources)	'Policy Instruments for Reduced Environmental Impacts' (Swedish Energy Agency, 2007)

5 Assessment of Policy Coherence

5.1 Assessment of Interactions between Nexus Critical Objectives

5.1.1 Description of Nexus Critical Objectives

From the inventory of objectives for each sector (section 4.3), 14 objectives (Table 18) were identified to be most critical for the nexus. These objectives are particularly interesting to investigate, because they are either

- highlighted in the Swedish Government's policy work and objectives (e.g. climate, energy and environmental objectives, see http://www.government.se/government-policy/), or
- widely mentioned in news and media (e.g. climate and energy goals), or
- controversial and often discussed in debates (e.g. forest production versus environmental goal), or
- objectives that are not only important for Sweden but can also affect a larger region including the Baltic Sea (e.g. water-related objectives)

Table 18: Overview of selected nexus-critical objectives

Sector	Goal ID	Goal
Climate	C1	Environmental goal: Reduce Climate Impacts
	C2	Emission Reduction Targets
Forest	F1	Production goal: Ensure a long-term sustained yield of timber
	F2	Environmental goal: Forests with high natural, cultural and recreational values
Water	W1	Environmental goal: Flourishing Lakes and Streams
	W2	Environmental goal: Good-Quality Groundwater
	W3	Environmental goal: Thriving Wetlands
	W4	Reduce the harmful consequences of floods
Energy	E1	Sustainable and environmentally friendly energy supply
	E2	Increase energy efficiency
Horizontal	H1	Environmental goal: A varied agricultural landscape
	H2	A market-oriented agricultural sector and a competitive food supply chain
	H3	Environmental goal: Zero Eutrophication
	H4	Environmental goal: Natural Acidification Only

5.1.2 Scoring Matrix of Interactions

The assessment of the interactions between the selected 14 objectives was based on the evaluation by three researchers, a literature review, results of a survey sent to stakeholders, and a Stakeholder Workshop 1 (see details in the section "Validation" below). The final scoring matrix is presented in Table 19.

Table 19: Scoring matrix of policy objectives on a scale from -3 (strong conflict) to +3 (strong synergy), where 0 indicates no interactions.

Affecting Sector \ Affected Sector	E1	E2	C1	C2	F1	F2	H1	H2	H3	H4	W1	W2	W3	W4
E1	NaN	2	1	1	2	1/-1	-1	-1	0	1/-1	-1	-1	-1	1
E2	3	NaN	2	3	0	0	0	1	0	0	0/-1	0	0	0
C1	2	2	NaN	3	1	1/-1	1	-1	1	0	1	1	1	1/-1
C2	2	2	3	NaN	1	0	-1	-1	0	1	1	1	1	1/-1
F1	2	0	1	1	NaN	-1	0	0	-1	-1	-1	-1	-1	-1
F2	-1	0	1/-1	0	-1	NaN	1	-1	2	2	2	1	2	1
H1	-1	0	0	-1	0	1	NaN	1/-1	1	0	1	0	0	1
H2	-1	1	-1	-1	0	-1	1/-1	NaN	1/-1	-1	-2	-1	-1	0
H3	0	0	0	0	-1	2	1	1/-1	NaN	0	2	2	2	0
H4	1/-1	0	0	1	-1	2	0	-1	0	NaN	2	2	2	0
W1	-1	0	1	1	-1	2	1	-2	2	2	NaN	2	2	2
W2	-1	0	1	1	-1	1	0	-2	2	2	2	NaN	2	1
W3	-1	0	1/-1	1/-1	-1	2	2	-1	2	2	2	2	NaN	1
W4	1	0	1	1	-1	1	1	0	0	0	2	1	1	NaN

Cancelling	-3
Counteracting	-2
Constraining	-1
Neutral	0
Enabling	1
Reinforcing	2
Indivisible	3
Multiple	1/-1

5.1.3 Justification of the Scoring

The scoring in the final scoring matrix (Table 19) is further clarified in Table 20.

Table 20: Justification of the scores assigned to interactions among objectives

Interaction			Score	Justification
				ENERGY
E1	>	E2	2	the goal of more renewable energy and reducing energy use will inevitably lead to new technology inventions that support a more efficient use of energy
E1	>	C1	1	the goal of more renewable energy and reducing energy use reduces GHG emissions and thereby supports the efforts to reduce the temperature rising
E1	>	C2	1	the goal of more renewable energy and reducing energy use reduces GHG emissions
E1	>	F1	2	more renewable energy leads to a larger interest in production of forest biomass as energy source
E1	>	F2	-1/+1	conflict: more renewable energy from forest biomass might lead to a more intensified forestry activities, which may reduce the biodiversity in forests synergy: if we interpret the goal directly (as it says the energy supply should be "sustainable" and "environmentally friendly") this means that there is a synergy with sustainable management of forests (supporting biodiversity)
E1	>	H1	-1	more renewable energy from fuel crops can lead to mono-cultures and less focus on protection of land and crops, which influences agricultural biodiversity negatively
E1	>	H2	-1	the goal of reducing energy is in conflict with an increased agricultural production, which requires energy for harvest, processing etc.; the goal of more renewable energy requires more land (e.g. for fuel crops) and limits therefore agricultural production and export
E1	>	H3	0	///
E1	>	H4	1/-1	synergy: reduced energy use reduces those substances/emissions that cause acidification conflict: more renewable energy from forest biomass causes more intensified harvest, which in turn causes acidification
E1	>	W1	-1	Hydropower dams affect the entire downstream ecosystem, including all surface water resources
E1	>	W2	-1	Hydropower dams affect the entire downstream ecosystem, which also impacts on groundwater recharge, groundwater quality and the habitats for animals and plants
E1	>	W3	-1	hydropower dams prevent the creation/protection of wetlands (wetlands support high concentrations of animals - including mammals, birds, fish, and invertebrates)
E1	>	W4	1	hydropower dams are able to store larger amounts of water, which is typically beneficial for flood protection
E2	>	E1	3	the goal of efficient energy use will lead to new technology inventions that help to reduce energy use
E2	>	C1	2	more efficient energy use reduces GHG emissions and thereby supports the efforts to reduce the temperature rising
E2	>	C2	3	more efficient energy use reduces GHG emissions
E2	>	F1	0	///
E2	>	F2	0	///
E2	>	H1	0	///
E2	>	H2	1	increasing energy efficiency in agricultural production can lead to a more ecological production in a sustainable manner, which can increase Sweden's competitiveness in agricultural sector
E2	>	H3	0	///
E2	>	H4	0	///
E2	>	W1	0/-1	conflict: short-term regulation of water flow in hydropower dams (for more efficient energy production) is negative for aquatic biodiversity neutral: in relation to other sources of energy
E2	>	W2	0	///
E2	>	W3	0	///
E2	>	W4	0	///

				CLIMATE
C1	>	E1	2	the aim of reducing the temperature increase facilitates the increase of renewable energy shares and the reduction of energy use
C1	>	E2	2	the aim of reducing the temperature increase supports new technologies to use energy more efficiently
C1	>	C2	3	the aim of reducing temperature rise is inextricably linked to reducing GHG emissions
C1	>	F1	1	reducing the temperature rise supports the forest production goal as growing forests sequestrate CO2
C1	>	F2	-1	the aim of reducing the temperature supports forest production goal (CO2 sequestration) which limits the potential for protecting existing forest
C1	>	H1	1	the aim of reducing the temperature increase is good for different crop types/species
C1	>	H2	-1	the aim of reducing the temperature increase is limiting implementation of a market-oriented and competitive agricultural sector goal that requires more energy use, leads to emissions etc.
C1	>	H3	1	Increased temperatures mean more rain, which causes higher surface run-off leading to more nutrients flow and potential eutrophication; that is why working to mitigate climate change is beneficial for the goal of reducing eutrophication
C1	>	H4	0	///
C1	>	W1	1	reducing the temperature rise below 2 degrees has a positive effect on evaporation and the available water resources (quantity and quality)
C1	>	W2	1	reducing the temperature rise below 2 degrees has a positive effect on evaporation and the available water resources (quantity and quality)
C1	>	W3	1	reducing the temperature rise below 2 degrees has a positive effect on evaporation and the available water resources (quantity and quality)
C1	>	W4	1/-1	synergy: as climate change increases risk for high-intensity rainfall and for subsequent flooding (especially during autumn in urban areas), mitigation of climate change counteracts these effects (and thus protect against flooding) conflict: in a warmer climate, there is lower risk of spring flooding caused by snowmelt; reducing the temperature rise does consequently not support the goal of reduced flooding risk (in Sweden)
C2	>	E1	2	the aim of reducing emissions enables the increase of renewable energy shares and the reduction of energy use
C2	>	E2	2	the aim of reducing emissions fosters new technologies to use energy more efficiently
C2	>	C1	3	the aim of reducing GHG emissions is inextricably linked to reducing temperature rise
C2	>	F1	1	the aim of reducing emissions fosters the forest production as forest biomass can be used as energy source with lower emissions (compared to fossil fuels)
C2	>	F2	0	///
C2	>	H1	-1	the aim of reducing emissions can cause a conflict between landuse for food production and fuel crops
C2	>	H2	-1	the aim of reducing emissions is limiting implementation of a market-oriented and competitive agricultural sector goal that requires more energy use, leads to emissions etc.
C2	>	H3	0	///
C2	>	H4	1	the aim of reducing emissions (especially sulfur dioxide) helps to reduce acidification
C2	>	W1	1	reducing emissions has a positive effect on temperature and evaporation and the available water resources (quantity and quality)
C2	>	W2	1	reducing emissions has a positive effect on temperature and evaporation and the available water resources (quantity and quality)
C2	>	W3	1	reducing emissions has a positive effect on temperature and evaporation and the available water resources (quantity and quality)
C2	>	W4	1/-1	synergy: as climate change increases risk for high-intensity rainfall and for subsequent flooding (especially during autumn in urban areas), decreased emissions counteract these effects (and thus protect against flooding) conflict: in a warmer climate, there is lower risk of spring flooding caused by snowmelt; reducing emissions does consequently not support the goal of reduced flooding risk (in Sweden)

				FOREST
F1	>	E1	2	using more forest biomass as energy source increases the share of renewable energy
F1	>	E2	0	///
F1	>	C1	1	more growth sequestrates more CO2; wood products are positive for the climate
F1	>	C2	1	using more forest biomass as energy source leads to fewer emissions
F1	>	F2	-1	forest production and forestry operations are in conflict with the protection of biodiversity and social values; older forest is needed for biodiversity but not for production
F1	>	H1	0	///
F1	>	H2	0	///
F1	>	H3	-1	an increased production/felling is based on felling operations and fertilizer (locally) that increase acidification
F1	>	H4	-1	an increased production/felling is based on felling operations and fertilizer (locally) that increase nutrients in water and soil
F1	>	W1	-1	an increased production/felling is based on felling operations and fertilizer (locally) that reduce surface water quality and aquatic biodiversity
F1	>	W2	-1	an increased production/felling is based on felling operations and fertilizer (locally) that reduce groundwater quality
F1	>	W3	-1	an increased production/felling is based on felling operations and fertilizer (locally) s that reduce the quality of wetlands
F1	>	W4	-1	forest clearing can increase the risk of flooding locally
F2	>	E1	-1	the protection of forest ecosystems and forest wetlands limits the forest production and the use of forest biomass as a renewable energy source
F2	>	E2	0	///
F2	>	C1	1/-1	synergy: protecting forest biodiversity creates conditions for environmental functions to mitigate climate change (e.g. forests or wetland creation/restoration) conflict: protecting existing forest limits the potential for forest growth which would sequestrate CO2
F2	>	C2	0	///
F2	>	F1	-1	protecting forest biodiversity limits the production of forests; older forest is needed for biodiversity but not for production
F2	>	H1	1	increased forest biodiversity can improve agricultural biodiversity through increasing heterogeneity of landscapes, providing connectivity, ecotone habitats and source of species
F2	>	H2	-1	increasing the forest biodiversity through ecological landscape planning might limit the potential to create a strong market-oriented agricultural sector and a competitive food supply chain
F2	>	H3	2	protecting forest biodiversity creates conditions for reducing nutrients in soil and water through a reduction in fertilizer and buffering of watercourses
F2	>	H4	2	protecting forest biodiversity creates conditions for reducing acidification through a reduction in fertilizer
F2	>	W1	2	more forest biodiversity also includes more biodiversity in forest aquatic systems (forest rivers, lakes, wetlands)
F2	>	W2	1	protecting forest biodiversity creates conditions for improving groundwater quality through less use of fertilizer and buffering of watercourses
F2	>	W3	2	protecting forest biodiversity creates conditions for improving wetland quality through less use of fertilizer and buffering of wetlands
F2	>	W4	1	more forest biodiversity through more structure and a more complex combination of species increases the capacity to retain water
				HORIZONTAL
H1	>	E1	-1	conserving biodiversity and natural values involves the protection of land and crop types, which could limit to some degree the potential increase of renewable energy from agricultural crops
H1	>	E2	0	///
H1	>	C1	0	///

H1	>	C2	-1	conserving biodiversity and natural values involves the protection of land and crop types, which could limit the production of renewable energy from agricultural crops and thereby limit the emission reduction goals
H1	>	F1	0	///
H1	>	F2	1	a varied agricultural landscape produces substrates that can be used instead of wood raw materials, so that more forests can be managed in a more natural way.
H1	>	H2	1/-1	synergy: protecting biodiversity and cultural values supports ecological production conflict: protecting biodiversity makes it impossible to intensify regular production and increase export
H1	>	H3	1	agricultural biodiversity can have beneficial effects on soil function and can increase soil nitrogen, which in turn can reduce the need for inorganic fertilizers leading to eutrophication
H1	>	H4	0	///
H1	>	W1	1	more agricultural biodiversity can contribute to a better connectivity of the landscape and thereby also improve aquatic biodiversity
H1	>	W2	0	///
H1	>	W3	0	///
H1	>	W4	1	more agricultural biodiversity through more structure and a more complex combination of species increases the capacity to retain water
H2	>	E1	-1	an increased agricultural production requires more energy for harvesting and processing, which complicates energy reduction
H2	>	E2	1	the desire to increase the competitiveness can lead to a more efficient energy use, which would save energy (and money) in the long run
H2	>	C1	-1	market-oriented and competitive are euphemisms for putting less emphasis on consequences. Due to the way agriculture operates, it has negative impacts on emissions, fossil fuel use, etc.
H2	>	C2	-1	market-oriented and competitive are euphemisms for putting less emphasis on consequences. Due to the way intensive agriculture operates, it has negative impacts on emissions, fossil fuel, etc.
H2	>	F1	0	///
H2	>	F2	-1	market-oriented and competitive are euphemisms for putting less emphasis on consequences and having less focus on the costly protection of biodiversity that require lower intensity of agriculture
H2	>	H1	1/-1	synergy: an increased ecological production supports the protection of biodiversity and cultural values conflict: an increase in production and export makes protecting biodiversity impossible
H2	>	H3	1/-1	synergy: an increased ecological production supports the reduction of fertilizer conflict: an increased intensive production implies more use of fertilizer which leads to more nutrients in water and soil
H2	>	H4	-1	an increased production leads to more use of fertilizer and can lead to less protected land areas for nutrient retention
H2	>	W1	-2	an increased production implies more use of fertilizer and less natural buffers which lead to deterioration of surface water quality and aquatic biodiversity
H2	>	W2	-1	an increased production implies more use of fertilizer and less natural buffers, which lead to deterioration of groundwater quality
H2	>	W3	-1	an increased production implies more use of fertilizer and less natural buffers, which lead to deterioration of wetland quality
H2	>	W4	0	///
H3	>	E1	0	///
H3	>	E2	0	///
H3	>	C1	0	///
H3	>	C2	0	///
H3	>	F1	-1	reducing nutrients in soil and water requires reduced use of fertilizer and using more environmentally friendly, less intensive harvesting techniques
H3	>	F2	2	reducing nutrients in soil and water creates conditions for better biodiversity in forests
H3	>	H1	1	reducing nutrients in soil and water creates conditions for better agricultural biodiversity
H3	>	H2	1/-1	synergy: reducing nutrients in soil and water supports ecological production and leads to a safer food production

				conflict: limiting the nutrients in soils and water limits the use of fertilizer and thereby the potential to increase intensive production
H3	>	H4	0	///
H3	>	W1	2	reducing nutrients in soil and water is inextricably linked to surface water quality, which contributes to the landscape ecological functioning and good conditions for plants and animals
H3	>	W2	2	reducing nutrients in soil and water is inextricably linked to groundwater quality
H3	>	W3	2	reducing nutrients in soil and water is inextricably linked to water quality, which affects the ecological status of wetlands and their biodiversity
H3	>	W4	0	///
H4	>	E1	1/-1	synergy: reducing acidification could lead to more efforts to reach a reduction in energy use conflict: reducing acidification implies adapting harvesting techniques, which could limit the potential for more renewable energy from forest biomass
H4	>	E2	0	///
H4	>	C1	0	///
H4	>	C2	1	reducing acidification could lead to more efforts to reduce emissions (especially sulphur dioxide emissions)
H4	>	F1	-1	reducing acidification constrains the harvesting techniques used and the use of fertilizer
H4	>	F2	2	reducing acidification creates conditions for better biodiversity in forests
H4	>	H1	0	///
H4	>	H2	-1	reducing acidification may lead to more areas set aside for conservation purposes, which affects productivity negatively
H4	>	H3	0	///
H4	>	W1	2	reducing acidification is inextricably linked to surface water quality, which contributes to the landscape ecological functioning and good conditions for plants and animals
H4	>	W2	2	reducing acidification is inextricably linked to groundwater quality
H4	>	W3	2	reducing acidification is inextricably linked to water quality, which affects the ecological status of wetlands and their biodiversity
H4	>	W4	0	///
				WATER
W1	>	E1	-1	protecting/maintaining aquatic biodiversity and the landscapes natural productive capacity constrains the intensification of forestry (biomass extraction and biofuel production) and the production of hydropower
W1	>	E2	0	///
W1	>	C1	1	protecting/maintaining aquatic biodiversity (e.g. through construction of wetlands or nature reserves) can serve as environmental functions to mitigate climate change
W1	>	C2	1	protecting/maintaining aquatic biodiversity (e.g. through construction of wetlands or nature reserves) can serve as environmental functions to mitigate climate change
W1	>	F1	-1	protecting/maintaining aquatic biodiversity and the landscapes natural productive capacity constrains the intensification of forestry
W1	>	F2	2	protecting/maintaining aquatic biodiversity (e.g. through construction of wetlands or nature reserves) reinforces forest biodiversity
W1	>	H1	1	protecting/maintaining aquatic biodiversity (e.g. through construction of wetlands or nature reserves) enables agricultural biodiversity through an increased connectivity
W1	>	H2	-2	protecting/maintaining aquatic biodiversity implies a reduction of pesticides, fertilizer etc. which counteracts with increased production and export
W1	>	H3	2	protecting/maintaining aquatic biodiversity implies a reduction of pesticides, fertilizer etc. which reduces nutrients in soil and water
W1	>	H4	2	protecting/maintaining aquatic biodiversity implies a reduction of pesticides, fertilizer etc. which reduces acidification
W1	>	W2	2	protecting/maintaining aquatic biodiversity and the landscapes natural productive capacity creates conditions for good groundwater quality
W1	>	W3	2	protecting/maintaining aquatic biodiversity helps to protect wetland functioning

W1	>	W4	2	protecting/maintaining aquatic biodiversity and the landscapes natural productive capacity creates conditions for natural flood protection
W2	>	E1	-1	protecting/maintaining groundwater quality constrains the intensification of forestry (biomass extraction and biofuel production) and the production of hydropower
W2	>	E2	0	///
W2	>	C1	1	protecting/maintaining groundwater quality (e.g. through construction of wetlands or nature reserves) can serve as environmental functions to mitigate climate change
W2	>	C2	1	protecting/maintaining groundwater quality (e.g. through construction of wetlands or nature reserves) can serve as environmental functions to mitigate climate change
W2	>	F1	-1	protecting/maintaining groundwater quality constrains the intensification of forestry
W2	>	F2	1	protecting/maintaining groundwater enables opportunities to increase forest biodiversity
W2	>	H1	0	///
W2	>	H2	-2	protecting/maintaining groundwater quality implies a reduction of pesticides, fertilizer etc. which counteracts with increased production and export
W2	>	H3	2	protecting/maintaining groundwater quality implies a reduction of pesticides, fertilizer etc. which reduces nutrients in soil and water
W2	>	H4	2	protecting/maintaining groundwater quality implies a reduction of pesticides, fertilizer etc. which reduces acidification
W2	>	W1	2	protecting/maintaining groundwater quality creates conditions for aquatic biodiversity and the landscapes natural productive capacity
W2	>	W3	2	protecting/maintaining groundwater quality helps to protect wetland functioning
W2	>	W4	1	protecting/maintaining groundwater quality creates conditions for natural flood protection
W3	>	E1	-1	protecting/maintaining wetlands constrains the intensification of forestry (biomass extraction and biofuel production) and the production of hydropower
W3	>	E2	0	///
W3	>	C1	1/-1	synergy: protecting/maintaining wetlands can serve as environmental functions to mitigate climate change conflict: wetlands (particularly not forested ones) can release methane gas and amplify climate impacts
W3	>	C2	1/-1	synergy: protecting/maintaining wetlands can serve as environmental functions to mitigate climate change conflict: wetlands (particularly not forested ones) can release methane gas
W3	>	F1	-1	protecting/maintaining wetlands constrains the intensification of forestry
W3	>	F2	2	protecting/maintaining wetlands reinforces opportunities to increase forest biodiversity
W3	>	H1	2	protecting/maintaining wetlands can help to capture nutrients from agriculture run-off before they enter water bodies enabling better conditions for agricultural biodiversity
W3	>	H2	-1	protecting/maintaining wetlands implies a reduction of pesticides, fertilizer etc. which counteracts with increased production and export
W3	>	H3	2	protecting/maintaining wetlands can help to capture nutrients from agriculture run-off before they enter water bodies
W3	>	H4	2	protecting/maintaining wetlands can help to capture nutrients from agriculture run-off before they enter water bodies, which reduced acidification
W3	>	W1	2	protecting/maintaining wetlands creates conditions for aquatic biodiversity and the landscapes natural productive capacity
W3	>	W2	2	protecting/maintaining wetlands creates conditions for good groundwater quality
W3	>	W4	1	protecting/maintaining wetlands creates conditions for natural flood protection, increasing landscape's buffering capacity
W4	>	E1	1	flood protection can foster hydropower dams as they are able to store larger amounts of water, which is typically beneficial for flood protection
W4	>	E2	0	///
W4	>	C1	1	reducing flood risk can be done by creating wetlands, hydropower dams and afforestation, which can both help to mitigate climate change and reduce emissions
W4	>	C2	1	reducing flood risk can be done by creating wetlands, hydropower dams and afforestation, which can both help to mitigate climate change and reduce emissions

W4	>	F1	-1	reducing flood risk can be done by creating wetlands and afforestation, which can limit forest production
W4	>	F2	1	reducing flood risk can be done by creating wetlands and afforestation, which both foster landscape connectivity and improve conditions for forest biodiversity
W4	>	H1	1	reducing flood risk can be done by creating wetlands and afforestation, which both foster landscape connectivity and improve conditions for agricultural biodiversity
W4	>	H2	0	///
W4	>	H3	0	///
W4	>	H4	0	///
W4	>	W1	2	reducing flood risk can be done by creating wetlands and afforestation, which both reinforce the protection of aquatic biodiversity and the landscapes natural productive capacity
W4	>	W2	1	reducing flood risk can be done by creating wetlands and afforestation, which both enable the protection of groundwater quality
W4	>	W3	1	reducing flood risk can be done by creating wetlands and afforestation, which both enable the protection of wetland quality

5.1.4 Overall Assessment

The results indicate that the energy policy objectives are well aligned with the climate objectives. This might be because Sweden is a leading actor in the design of a new regulatory framework for tougher requirements in the area of climate and energy. The climate and energy goals set by Sweden are more ambitious than those of the EU. Recently, several legislative acts have been negotiated such as the Climate Policy Framework for Sweden (Gov. Bill 2016/17:146, passed in parliament 15 June, 2017) and the new Climate Act, which entered into force in January 2018.

On the other hand, our scoring highlights that the agricultural sector is the “black sheep” amongst all sectors, which is least aligned with the policy objectives of other sectors. It remains a great challenge to create synergies between a market-oriented agricultural sector and a competitive food supply chain on one side, and more environmentally and climate friendly objectives on the other side. Particularly, there is a conflict between the idea of a competitive market-oriented agriculture and the type of agriculture that would support high biodiversity. However, it has been suggested at the stakeholder workshop that if Sweden better utilized its image of “environmentally friendly” food producer and built its market competitiveness on it, it would lead to better alignment of the agricultural goal with other goals.

Another striking result is the difficulty to implement the Environmental Quality Objectives. Objectives such as biodiversity in forest and agriculture as well as good surface water, groundwater and wetland quality seem to be difficult to accomplish, while both agricultural and forestry production dominate. This is reflected in the failure to implement most of the Swedish Environmental Objectives in the recent years. One of the main problems is the higher priority given to most of the production-oriented and economic development-oriented goals as compared to environmentally oriented goals, leading to e.g.

more intensive production systems that do not support high biodiversity or lead to decreasing water quality. In addition, highest priority is given to climate change goals, which are not always in line with other environmental objectives. For example producing more biomass to support climate mitigation may hinder effective biodiversity conservation, as it requires more intensive forest management.

In general, our scoring exercise shows that there seem to be more synergies than conflict between policies of different sectors. This is in line with the report published by the Swedish Environmental Protection Agency about synergies and conflicts between Swedish Environmental Quality Objectives and objectives of other sectors (Swedish Environmental Protection Agency, 2011). The report revealed that although there are some conflicts, particularly with regard to conservation-oriented versus production-oriented objectives, many synergies can be found, specifically between the Environmental Quality Objectives and forestry and energy sector.

5.1.5 Validation

Based on the inventory of objectives for each sector (see section 4.3), a pre-selection of nexus-relevant objectives was done collaboratively by three researchers with experience in forestry, biodiversity, energy, water and climate. We assured the quality of the assessment of the coherence between critical objectives by triangulation. First, three researchers independently scored the interactions between these selected 14 objectives, based on their expert knowledge and literature review. The resulting scoring matrixes were compared and all differences in the scoring were discussed and adjusted to a common scoring matrix. Second, an online survey was sent in February 2018 to 354 stakeholders with the goal to confirm the selected nexus-relevant objectives and to receive a scoring independently from the expert judgement. We received 101 responses to the survey from stakeholders representing different sectors, in most cases, authorities at different levels. Both the expert judgement and the survey results were then evaluated and merged. Finally, results of the scoring exercise from the first Stakeholder Workshop (18th of April 2018) were used to refine the scoring, resulting in the final scoring matrix (Table 19) together with justification of the scores (Table 20).

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

5.2.1 Description of Nexus Critical Instruments

The Nexus critical instruments have been selected based on the review of literature and policy documents, expertise of the authors of this report and indication by the stakeholders from different sectors provided on the first Stakeholder Workshop.

Table 21: Overview of selected nexus-critical instruments

Sector	Instr. ID	Instr. Type	Goal
Climate	Ca	Economic	Tax on fossil fuels
Forest	Fa	Administrative	Act (SFS 1979:429) on Forest Maintenance
	Fb	Voluntary	Forest Certification (FSC)
Water	Wa	Administrative	Water Framework Directive (2000/60/EC)
	Wb	Administrative	Ordinance (SFS 2009:956) on Flood Risk
	Wc	Voluntary	Agreement on Water Maintenance
Energy	Ea	Voluntary	Energy mapping
	Eb	Economic	Subsidies for solar panels and environmental cars
Horizontal	Ha	Economic	Ordinance (SFS 2015:406) on the Support for Rural Development Measures(i.e., financial support for environmental measures in forests and agriculture)
	Hb	Administrative	Environmental Code (SFS 1998:808)
	Hc	Voluntary	Food Certification (KRAV, EU ecolabel, SIGILL)

5.2.2 Scoring Matrix of Interactions

Table 22: Scoring matrix of policy instruments and objectives.

	E1	E2	C1	C2	F1	F2	H1	H2	H3	H4	W1	W2	W3	W4	Σ+	Σ-	Σ+/-
Ea	1	1	1	1	0	0	0	0	0	0	0	0	0	0	4	0	0
Eb	1	0	1	1	1	-1	-1	1	0	0	0	0	0	0	5	2	0
Ca	1	0	1	1	1	-1	-1	1	0	0	0	0	0	0	5	2	0
Fa	0	0	0	0	1	1	0	0	0	0	0	0	0	0	2	0	0
Fb	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
Ha	0	0	0	0	-1	1	1	-1	0	0	1	1	1	0	5	2	0
Hb	1	0	1	1	-1	1	1	-1	1	1	1	1	1	0	10	2	0
Hc	0	0	0	0	0	0	1	1/-1	0	0	0	0	0	0	1	0	1
Wa	0	0	0	0	0	0	0	0	0	0	1	1	1	1	4	0	0
Wb	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
Wc	0	0	0	0	0	1	1	0	0	0	1	1	1	0	5	0	0
Σ+	4	1	4	4	3	5	3	3	1	1	4	4	4	2			
Σ-	0	0	0	0	2	2	2	2	0	0	0	0	0	0			
Σ+/-	0	0	0	0	0	0	1	0	0	0	0	0	0	0			

Conflict	-1
Neutral	0
Synergy	1
Multiple	1/-1

5.2.3 Justification of the Scoring

Table 23: Justification of the scores assigned to interactions among instruments and objectives

Interaction			Score	Justification
				ENERGY
Ea	>	E1	1	energy mapping provides municipalities and utilities with a way to evaluate existing energy use in a community and plan to improve energy efficiency through the use of alternative energy sources
Ea	>	E2	1	energy mapping provides municipalities and utilities with a way to evaluate existing energy use in a community and plan to improve energy efficiency through the use of better building standards and alternative energy sources
Ea	>	C1	1	energy mapping helps to reduce energy use and increase renewable energies, which leads to reduced climate impacts
Ea	>	C2	1	energy mapping helps to reduce energy use and increase renewable energies, which leads to reduced emissions
Ea	>	F1	0	///
Ea	>	F2	0	///
Ea	>	H1	0	///
Ea	>	H2	0	///
Ea	>	H3	0	///
Ea	>	H4	0	///
Ea	>	W1	0	///
Ea	>	W2	0	///
Ea	>	W3	0	///
Ea	>	W4	0	///
Eb	>	E1	1	subsidies on renewable energies increase the share of renewable energy sources
Eb	>	E2	0	///
Eb	>	C1	1	subsidies on renewable energies increase the share of renewable energy sources which leads to reduced climate impacts
Eb	>	C2	1	subsidies on renewable energies increase the share of renewable energies which leads to reduced emissions
Eb	>	F1	1	subsidies on environmental cars increase the demand for fuel produced from forest biomass
Eb	>	F2	-1	subsidies on environmental cars increase the demand for fuel produced from forest biomass, which leads to less protection of forest biodiversity
Eb	>	H1	-1	subsidies on environmental cars increase the demand for fuel produced from fuel crops, which leads to less protection of agricultural biodiversity
Eb	>	H2	1	subsidies on environmental cars increase the demand for fuel produced from fuel crops
Eb	>	H3	0	///
Eb	>	H4	0	///
Eb	>	W1	0	///
Eb	>	W2	0	///
Eb	>	W3	0	///
Eb	>	W4	0	///
				CLIMATE
Ca	>	E1	1	taxes on fossil fuels increase the share of renewable energy
Ca	>	E2	0	///
Ca	>	C1	1	taxes on fossil fuels increase the share of renewable energy, which leads to reduced climate impacts
Ca	>	C2	1	taxes on fossil fuels increase the share of renewable energy, which leads to reduced emissions
Ca	>	F1	1	taxes on fossil fuels increase the share of renewable energy including forest biomass, which leads to reduced climate impacts
Ca	>	F2	-1	taxes on fossil fuels increase the share of renewable energy including forest biomass, which leads to less protection of forest biodiversity

Ca	>	H1	-1	taxes on fossil fuels increase the share of renewable energy including fuel crops, which leads to less protection of agricultural biodiversity
Ca	>	H2	1	taxes on fossil fuels increase the demand for fuel produced from fuel crops
Ca	>	H3	0	///
Ca	>	H4	0	///
Ca	>	W1	0	///
Ca	>	W2	0	///
Ca	>	W3	0	///
Ca	>	W4	0	///
				FOREST
Fa	>	E1	0	///
Fa	>	E2	0	///
Fa	>	C1	0	///
Fa	>	C2	0	///
Fa	>	F1	1	the Swedish forestry act specifies requirements as to how to manage forests in a sustainable way
Fa	>	F2	1	the Swedish forestry act specifies requirements as to how to protect natural and cultural forest values
Fa	>	H1	0	///
Fa	>	H2	0	///
Fa	>	H3	0	///
Fa	>	H4	0	///
Fa	>	W1	0	///
Fa	>	W2	0	///
Fa	>	W3	0	///
Fa	>	W4	0	///
Fb	>	E1	0	///
Fb	>	E2	0	///
Fb	>	C1	0	///
Fb	>	C2	0	///
Fb	>	F1	0	///
Fb	>	F2	1	forest certification standards contribute to maintaining forest biodiversity
Fb	>	H1	0	///
Fb	>	H2	0	///
Fb	>	H3	0	///
Fb	>	H4	0	///
Fb	>	W1	0	///
Fb	>	W2	0	///
Fb	>	W3	0	///
Fb	>	W4	0	///
				HORIZONTAL
Ha	>	E1	0	///
Ha	>	E2	0	///
Ha	>	C1	0	///
Ha	>	C2	0	///
Ha	>	F1	-1	Financial support for environmental measures in forests limits the potential for forest production
Ha	>	F2	1	Financial support for environmental measures in forests contributes to maintaining forest biodiversity

Ha	>	H1	1	Financial support for environmental measures in agriculture contributes to maintaining biodiversity
Ha	>	H2	-1	Financial support for environmental measures in agriculture limits the potential for agricultural production
Ha	>	H3	0	///
Ha	>	H4	0	///
Ha	>	W1	1	Financial support for environmental measures in forests and agriculture contributes to maintaining surface water quality
Ha	>	W2	1	Financial support for environmental measures in forests and agriculture contributes to maintaining groundwater quality
Ha	>	W3	1	Financial support for environmental measures in forests and agriculture contributes to maintaining wetland quality
Ha	>	W4	0	///
Hb	>	E1	1	The Environmental Code states that renewable energy sources should be used and it supports the reuse of energy
Hb	>	E2	0	///
Hb	>	C1	1	The Environmental Code states that renewable energy sources should be used, which leads to reduced climate impacts
Hb	>	C2	1	The Environmental Code states that renewable energy sources should be used, which leads to reduced emissions
Hb	>	F1	-1	The Environmental Code supports measures for maintaining forest biodiversity, which limits forest production potential
Hb	>	F2	1	The Environmental Code supports forest biodiversity
Hb	>	H1	1	The Environmental Code supports agricultural biodiversity
Hb	>	H2	-1	The Environmental Code supports biodiversity, which limits the potential for agricultural production
Hb	>	H3	1	The Environmental Code supports the protection of land and nature, which limits nutrients in soil and water
Hb	>	H4	1	The Environmental Code supports the protection of land and nature, which limits acidification
Hb	>	W1	1	The Environmental Code supports the protection of surface water quality and biodiversity
Hb	>	W2	1	The Environmental Code supports the protection of groundwater quality
Hb	>	W3	1	The Environmental Code supports the protection of wetlands
Hb	>	W4	0	///
Hc	>	E1	0	///
Hc	>	E2	0	///
Hc	>	C1	0	///
Hc	>	C2	0	///
Hc	>	F1	0	///
Hc	>	F2	0	///
Hc	>	H1	1	Certification of food and other products supports a more ecological production, which also takes care of biodiversity
Hc	>	H2	1/-1	Certification of food and other products supports a more ecological production. At the same time it may hinder regular intensive agricultural production
Hc	>	H3	0	///
Hc	>	H4	0	///
Hc	>	W1	0	///
Hc	>	W2	0	///
Hc	>	W3	0	///
Hc	>	W4	0	///
				WATER
Wa	>	E1	0	///
Wa	>	E2	0	///

Wa	>	C1	0	///
Wa	>	C2	0	///
Wa	>	F1	0	///
Wa	>	F2	0	///
Wa	>	H1	0	///
Wa	>	H2	0	///
Wa	>	H3	0	///
Wa	>	H4	0	///
Wa	>	W1	1	The Water Framework Directive supports ecological and chemical protection of water, thereby maintaining surface water quality
Wa	>	W2	1	The Water Framework Directive supports ecological and chemical protection of water, thereby maintaining groundwater quality
Wa	>	W3	1	The Water Framework Directive supports ecological and chemical protection of water, thereby maintaining wetland quality
Wa	>	W4	1	The Water Framework Directive supports cooperation and joint objective-setting, which helps to tackle flooding risk across basins
Wb	>	E1	0	///
Wb	>	E2	0	///
Wb	>	C1	0	///
Wb	>	C2	0	///
Wb	>	F1	0	///
Wb	>	F2	0	///
Wb	>	H1	0	///
Wb	>	H2	0	///
Wb	>	H3	0	///
Wb	>	H4	0	///
Wb	>	W1	0	///
Wb	>	W2	0	///
Wb	>	W3	0	///
Wb	>	W4	1	The Ordinance (SFS 2009:956) on Flood Risk regulates how to handle flooding
Wc	>	E1	0	///
Wc	>	E2	0	///
Wc	>	C1	0	///
Wc	>	C2	0	///
Wc	>	F1	0	///
Wc	>	F2	1	The voluntary agreement on water maintenance by forest owners ensures the protection of forest biodiversity
Wc	>	H1	1	The voluntary agreement on water maintenance by forest owners ensures the protection of agricultural biodiversity
Wc	>	H2	0	///
Wc	>	H3	0	///
Wc	>	H4	0	///
Wc	>	W1	1	The voluntary agreement on water maintenance by forest owners ensures the protection of surface water quality
Wc	>	W2	1	The voluntary agreement on water maintenance by forest owners ensures the protection of groundwater quality
Wc	>	W3	1	The voluntary agreement on water mainetnence by forest owners ensures the protection of wetland quality
Wc	>	W4	0	///

5.2.4 Overall Assessment

The results show that in most cases particular instruments used to achieve individual sectoral objectives were neither in conflict nor in synergy with objectives of other sectors.

However, in individual cases, the use of particular instruments had a potential to negatively influence on other sectors. For example, economic instruments supporting climate and energy goals had potential to negatively influence both forest and agricultural biodiversity (by supporting increased production of biomass and biofuels), or administrative regulations of the horizontal policies (i.e. Environmental Code) were constraining implementation of the production goals in both forestry and agriculture. These conflicts reflected the "traditional" conflict between production-oriented and conservation-oriented policies.

In other cases, there were positive interactions. For example, instruments from energy sector positively contributed to climate related policy objectives, and, similarly, instruments supporting climate policy supported implementation of the energy objectives. Another example is subsidies in the climate policies that support a market-oriented and competitive agricultural sector by providing development possibilities for the countryside.

In case of one instrument, namely food certification, both potential conflict and synergy could be observed concerning the objective of market-oriented and competitive agricultural sector. Food certification requires a limited amount of fertilizers and pesticides and higher environmental standards, thus limiting possibilities for intensive agricultural production. On the other hand, it had potential to contribute positively to the fulfillment of the objective in case of organic production, as certification standards supports its image on the market.

It is important to mention that the exercise regarding instruments at the first Stakeholder Workshop led to several comments, reflecting on the use of the instruments. First, stakeholders highlighted a multitude of local instruments that did not have high potential to influence sectors at larger scales. For example, there was a range of local conservation instruments in relation to both forest and water sector, as well as local support to small environmental projects, but the effects of such instruments were only local. Secondly, it was highlighted that which instruments are being used is changing with time, depending on the changing of the context (including political "climate"). Presently, climate change policies were perceived as the key priority. However, it was suggested that in the future the question of food security will gain much higher importance. Finally, the stakeholders claimed that there is a

considerable difference between (1) existing instruments, (2) potentially useful instruments, and (3) instruments that are actually applied. This depends largely on current political prioritization. In addition, it was underlined that in Sweden, there are few very strong instruments and in most cases, politicians do not take hard decisions but instead aim at information and democratic debates in the society. According to the stakeholders' discussions on the workshop, this is not a sufficient way to go forward. The stakeholders believed that if one was to utilize mostly information-related instruments in implementing important policies it was very important to introduce environmental aspects early on in education systems to create a society that is aware of and can deal with environmental problems.

5.2.5 Validation

The initial selection of instruments existing in individual sectors was done based on the review of all relevant sectoral policies. Then, based on authors'' expertise and literature review most critical instruments were selected, which were thereafter refined based on input from the stakeholders at the first Stakeholder Workshop. As the stakeholders mentioned a multitude of rather local instruments that in many cases could not have large influence at larger scales, we considered instruments as "critical" if they had some potential to interact with nexus critical objectives. Scoring of the interactions between critical instruments and critical objectives was conducted by two researchers independently and then compared and refined. The scoring was also informed by the information on the interactions between different sectoral objectives (see section 5.1).

5.3 Assessment of vertical interactions between policies

5.3.1 Description of Vertical Interactions

The vertical interactions were assessed by two researchers, based on their expert knowledge, the literature review and the inputs from the stakeholders met at the first Stakeholder Workshop.

Table 24: Assessment of vertical interactions between vertical policies.

HIGHER>LOWER	
Higher level policies **successfully** implemented at lower scale	
Directive on promotion and use of renewable energy (2009/28/EC)	The goal is fulfilled; Sweden has set higher goals than EU (50% versus 20% renewable energy).
Higher level policies **only partly** implemented at lower scale	
Water Framework Directive (2000/60/EC)	Lack of coordination of activities in water sector. E.g., water authorities have no influence on forestry management.
Directive on conservation of natural habitats wild fauna and flora (92/43/EEC)	There is a need for restoration of large areas of habitat to be able to fully implement this directive.
Directive on flood protection (2007/60/EC)	Lack of coordination of water management in general and lack of coordination with water and groundwater directive.
Higher level policies **poorly** implemented at lower scale	
Directive on the conservation of wild birds (2009/147/EC)	Species protection is relevant for forestry, but there has not been much focus on working with this issue within this sector.
LOWER>HIGHER	
Lower level policies **fully** supported by higher level policies	
Ordinance (SFS 2009:956) on Flood Risk	Fully supported by EU Directive on flood protection (2007/60/EC), essentially the same regulations.
Environmental Code (SFS 1998:808), chapter 6, about environmental impact assessment	Fully supported by EU Directive on Environmental Impact Assessment (2011/92/EU), essentially the same regulations.
Lower level policies **only partly** supported by higher level policies	
Climate Policy Framework for Sweden (Gov. Bill 2016/17:146, passed in parliament 15 June, 2017)	Sweden has set higher goals than EU (50% vs. 20% renewable energy sources). Consequently, the EU Directive on promotion and use of renewable energy (2009/28/EC) is supporting the Swedish goals, but only up to the level of EU goals.
Lower level policies only partly supported by higher level policies	
The Swedish Forestry Act (SFS 1993:1096)	Habitat and Birds Directives hamper forest production.

5.3.2 Link between Vertical Interactions and critical objectives

While Sweden has implemented most of the EU policies "on paper", the actual implementation on the ground is still facing some challenges. One of the key policies that is facing problems in actual implementation is Water Framework Directive. This is because lack of coordination between different sectors that influence water management. Water authorities have been created to manage water issues at catchment level. However, these authorities have not much power over forestry authorities (which are rather independent) and forestry activities, or over municipalities that are relatively autonomous in their decisions, particularly when it comes to local spatial planning. Although there is some effort to coordinate water-related activities of different sectors, voluntary collaboration is not sufficient in the situation where stronger legal instruments to support that coordination are missing. Similarly, there is lack of coordination between the activities linked to implementation of the Water Framework Directive and the Groundwater Directive, leading to implementation that is not optimal.

In land-related sectors, a long-standing conflict between conservation and production policies can be observed. While conservation policies "on paper" are supposed to have equal power as production and development oriented policies, they are relatively less implemented. For example, Habitat Directive is not fully implemented yet in Sweden, as this would require large restoration efforts. In addition, the Birds Directive is not treated as priority in the forestry sector and protection of species is seen as hindering production.

As highlighted at the stakeholder workshop, not all EU policies are being implemented "as EU would like", because the local level of administration (i.e. municipalities) are self-governing and have considerable level of autonomy in taking decisions. Thus, there is not always a direct national level legislation that would directly steer municipalities' work. For example, some aspects of the EU climate policies are not directly transposed to national level binding legislation, but are rather being presented as recommendations. In this situation, some municipalities choose to work a lot with climate change related issues, while others do not priorities this policy area. Similarly, there are no strict forestry-related regulations that would encompass all forest owners, but Sweden promotes a model called "Freedom with responsibility" which assumes that the forest owner should have own responsibility to pursue more environmental goals 8as added to production goals), with a help of advice form forestry authorities. This leads to situation that the potential activities of forest that support environmental and conservation objectives can only be done on voluntary bases.

Our analysis have also revealed some success stories. Particularly, the EU goals for **renewable energy sources of 20 % have already been achieved in Sweden, and Sweden has set a higher goal (50 %).** However, this also means that EU climate policy is too limited in relation to Swedish situation and thus does not support the ambitious Swedish policy goals (higher than EU goals). In addition, some Swedish legislation mean basically the same regulations as EU legislation, e.g. Sweden's policy on flood risks, or its regulations on environmental impact assessments included in the Environmental Code.

5.3.3 Validation

The researchers used the list of EU policies identified in the SIM4NEXUS WP 2 and selected the ones that were legally binding (mostly different Directives) for the evaluation in relation to the Swedish policies. The assessment of the vertical interactions was conducted based on researchers' expert knowledge and relevant literature. It was then validated on the first Stakeholder Workshop where the stakeholders provided their input on the level of implementation of particular policies and challenges linked to that.

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

Formal and informal arrangements (Table 25) were gathered from a literature review, expertise of the researchers, information from the first stakeholder workshop, and interviews conducted in previous research projects.

Table 25: Overview of formal and informal arrangements

TYPE OF ARRANGE-MENT	DESCRIPTION	FUNCTION	ENABLING & LIMITING FACTORS	EFFECT ON THE ACHIEVEMENT OF NEXUS-CRITICAL OBJECTIVES
formal	Appropriation directions from the government (public service agreements, so-called 'regleringsbrev')	Annual directions from the government provided to all authorities, outlining key activities, targets, budget and how the budget will be allocated to	Very strong regulatory instrument that authorities follow every year	Supports all critical objectives, however may change depending on priorities (e.g. Recent priorities in Sweden are

		different activities. Specifies what goals should be achieved and the reporting required		linked to climate and energy objectives)
formal	Supervisory role of county boards in following up national level interests in local decisions	County boards are supervising local level decision making, checking if they are in line with national level policies and particularly the key national interests	There are established routines for this work that has been in operation for many years, so it is working effectively. The authorities usually have a long experience in combining different objectives in their decision making	Contributes to fulfilment of all critical nexus objectives, with particular importance for the different environmental quality objectives (on agriculture, forests, water quality, wetlands). Facilitates synergies between objectives
formal	Spatial planning system	Spatial planning is conducted at the level of municipalities to support land use decisions	There are established routines for this work that has been in operation for many years, so it is working effectively. The authorities usually have a long experience in combining different objectives in their decision making	Contributes to fulfilment of the nexus objectives linked to land (particularly agriculture) and environment (horizontal objectives). Facilitates synergies between objectives, as it coordinates different goals simultaneously
formal	Formal process of public participation (consultations, exhibitions, land owner meetings, etc.)	Process of participation allowing actors outside the formal planning system to participate in	Sweden is seen as pioneer in public participation arrangement and have long history of stakeholder involvement. However, in practice the quality of participation depends on particular representatives of	Supports collaboration of different actors contributing to finding synergies between different critical objectives. Particularly important in land use (agricultural & environmental

			authorities, thus some participation processes are of low quality (superficial participation)	objectives) and infrastructural (energy objectives) decisions
formal	Ecological compensation required by Environmental Code	The legislation requires that compensation is conducted in situation of potential damages that an investment can impose.	There are no standards and routines yet on how to conduct a process of compensation, so it is still rarely conducted in practice. It only takes place if very strict legal requirement is in place, mostly in case of investments that can influence NATURA 2000 areas	Potentially would support environmental objectives, but still not well implemented in practice
formal	Regional development and cooperation in the environmental target system (RUS)	Network of county boards collaborating in the implementation of different environmental quality objectives. Main goal is knowledge exchange.	Driven by engaged individuals from county boards works quite well. Some funding from the environmental protection agency helped development of the important knowledge base. Still resources are lacking for full development of this initiative.	Relevant particularly for environmental objectives and to land sector objectives
informal	Collaboration organized by water authorities	Organized with an aim of coordinating activities across sector to facilitate implementation of water framework directive	The water authorities do not have formal power to influence forestry sector or municipalities, so they only can suggest collaboration. Forestry sector and municipalities participate but do not have strong incentives for common activities	Supports implementation of water related objectives, and, to some extent environmental objectives linked to forests, agriculture and water quality
Informal	EU project funding in the forestry sector	Forestry authorities apply for external funding to increase knowledge base, with focus on linking knowledge from different sectors	With sufficient funding there is potential. However, the application process is usually very long and time consuming,	Particularly forestry, water, energy and environmental objectives

		(e.g. recent large life project "Grip On Life IP" about wetlands, forests and water management that will improve collaboration of local forestry authorities, county boards and fisheries management organizations) in water-related questions	which may hinder the application	
Informal	Informal arrangements for knowledge sharing	Different authorities at local and regional level organize informal arrangements, working groups	The arrangements are not obligatory/binding and depend on "good will" of participants; thus in some situations they work very well, but not in others. Depend to large extent on local leaders	Depending on the sector may facilitate fulfilment of any objectives
informal	Informal collaboration with NGOs in promoting some goals	County boards and local municipalities collaboration with NGOs in pursuing some objectives (e.g. Wetland restoration by the Swedish Anglers Association supporting Thriving wetlands objective and different biodiversity objectives)	Works well through voluntary engagement of NGOs and support fork authorities side (win-win for both parts)	Depending on NGO, can be about any objective, however in most cases links to environmental or land sector objectives

Most of the formal arrangements that are used in handling potential conflicts and facilitate synergies in Nexus objectives are well-established arrangements that have been operating in Sweden for many years and thus they work well. However, with changing political situation, the priorities given to different objectives may change. For example, formal appropriation directions from the government are presently more focused on climate, energy and production-oriented objectives, with slightly lower priority given to some environmental objectives linked to biodiversity (e.g. the implementation of ecosystem services concept is not suggested for implementation by the regional authorities, which prevent them from active work with it).

Informal arrangements are usually about collaboration, exchange of knowledge and common creation of important knowledge base. They rely on engagement of individuals and thus do not have strong formal support. However, can also be strongly supported, if both parties gain something from collaboration, like in the case of authorities collaborating with NGOs in fulfilling some objectives (NGOs do the actual work, which contributes to fulfilment of authorities' objectives, while authorities provide formal support.

5.5 Success stories and failures

Success stories (Table 26) and failures (Table 27) were gathered through a literature review, including both scientific papers and reports from national level authorities, expertise of the researchers, information gained form the representatives of different sectors at the first stakeholder workshop, and interviews conducted in previous research projects. Some of the stories are strongly linked to the analysis of the formal and informal arrangements described in previous section, but also some other have been added.

5.5.1 Description of Success Stories

Table 26: Overview of identified success stories

TYPE OF SUCESSFUL POLICY ARRANGEMENT	DESCRIPTION	FACTORS OF SUCCESS, DO'S
Implementation of EU climate goals	While national level climate policies in Sweden are set very high, the EU levels for e.g. % of renewable energy have already been achieved	- High political will leading to prioritizing climate question - Publicity linked to climate objectives, image of Sweden as future fossil-free country
Progress in the implementation of Environmental Quality Objectives (EQOs)	The system of EQOs was introduced in Sweden in 1999. Although the country is presently not reaching many of the objectives set, there has been a clear progress in their implementation. Currently a well-established system of implementation and monitoring is in place and authorities from local, through regional to national level work with implementation of the EQOs.	- Presence of high level vision for the whole country - Presence of relatively structured system of implementing EQOs - Anchoring environmental work as one of the governmental priorities - Good communication of the EQOs at different levels - Annual reporting system - Good coordination system at County level
Implementation of agri-environmental measures in agriculture	Funding is provided within the EU Rural Development Programme to land owners that conduct different measures on	- Commitment of land owners - Financial support from European Union

	their land that support environment	
Implementation of voluntary conservation measures in forestry	Established routines exists for creation of voluntary agreements between forestry authorities and forest owners to conduct more environmentally friendly management in some forest stands (conservation agreements, in Swedish: Naturvårdsavtal). There is financial support to forest owner, but it is not large, so this is still more voluntary agreement.	- Commitment of land owners - Trust towards forestry authorities (recognized authority) - Well-known system present for a long time - Financial support to land owners
Progress in the implementation of Water Framework Directive (WFD)	Although implementation of the WFD faces some challenges (see next Table), there is a clear progress. Sweden has created five key Water Authorities based on main catchments, which coordinate water management issues, with some success.	- Common interests and goals - Sharing knowledge and expertise
Regional development and cooperation in the environmental target system (RUS)	Network of county boards collaborating in the implementation of different environmental quality objectives. The main objective of the network is to collaborate and exchange knowledge. It has involved many different country boards and has led to increasing awareness with regard to different environmental issues	- Engaged individuals - Good collaboration - Good development of network of formal and informal contacts for a few year
Collaboration between an NGO, authorities and land-owners in wetland restoration	A large scale project organized by Swedish Anglers Association to restore wetlands for the sake of predatory fish species. In last 5 years over 25 wetlands restore din different locations. Contributing to wetland and biodiversity related objectives of the authorities.	- Common interests and goals - Committed individuals within the NGO - Good contact between the NGO and the landowners commitment of landowners - Trust towards the established NGO form the landowners - Good relationship build overtime between the NGO and local and regional authorities

5.5.2 Description of Failures

Table 27: Overview of identified failures

TYPE OF SUCESSFUL POLICY ARRANGEMENT	DESCRIPTION	FACTORS OF SUCCESS, DO'S
Implementation of biodiversity conservation policies	Notwithstanding some progress, Sweden have not fully implemented Natura 2000 policies yet. Key problems is conflict between conservation and forestry. Among other things, to fully implement Habitat Directive there is a need for large restoration effort which is not in line with forestry production objectives	- Conflicting objectives and interests - Relatively low political priority given to biodiversity conservation, compared to production-oriented goals, particularly in the forestry sector
Failures in the implementation of Environmental Quality Objectives (EQOs)	Notwithstanding progress, most of the EQOs in Sweden are not being fulfilled. Main reason is that compared to energy, climate, forest production and economic development goals, environmental and particularly conservation-oriented goals have much lower priority in practice (even if they have the same priority on paper). Especially, political agenda regarding climate change goals dominates over other environmental problems.	- Relatively low priority given by politicians to environmental work - Lack of holistic view by politicians and decision makers - Sectoral divisions - Conflicting sectoral objectives - Lack of specific resources for the EQOs work - Unclear responsibilities of the implementing authorities - Fundamental conflict between economic development and environment - Fundamental conflict between production and conservation - Increasing social trends such as consumption short-sightedness and globalisation
Combining production and conservation objectives in forestry sector	The forestry sector in Sweden is mostly oriented on wood production, even if conservation related goals are equal "on paper". In addition, certification standards (FSC, PFC) are not very directed towards conservation objectives. Finally, Swedish forestry is characterized by the "Freedom with responsibility" approach, i.e. much of what is happening in the forest depends on free will of forest owners and advice given by forestry authorities, but few	- Conflicting objectives - Political priority given to production goal - Political priority given to climate change policies - Limited certification standards - Few regulatory instruments in forestry sector

	aspects are regulated by formal legislation	
Failures in the implementation of Water Framework Directive (WFD)	There is insufficient coordination of activities in water sector. Water authorities have no influence on forestry management or spatial planning of municipalities. There is some collaboration between these different actors, but not sufficient for implementation of all WFD's goal.	- Conflicting interests - Lack of power/political mandate by Water Authorities to influence other actors - Lack of regulations supporting such influence
Implementation of climate adaptation measures	There is no national level policy/objective to implement climate adaptation measures. Climate change policies focus entirely on climate mitigation. Although some actor, particularly forestry authorities and some mini9cipalities attempt to also introduce adaptation measures, it is not anchored in any policy	- Lack of political priority - Lack of knowledge
Ongoing conflict between housing development and environmental objectives, mainly conservation of biodiversity	In many locations in Sweden, there is a conflict between developing new housing areas and maintaining natural values, green areas, biodiversity, etc. Very often in such conflicts, the development objectives win over the environmental ones	- Population growth - Market forces - Higher priority given to economic development compared to environmental objectives
Certification of organic food	Although the market for organic production in food sector is growing, Fulfilling requirements for high quality organic production by food producers do not lead to competitiveness on the market	- Market forces - Lack of profitability of more environmentally friendly food production

The examples of success and failure stories are presented in the tables above. The analysis shows that the main factors of success are linked to political will and priorities given at highest governance levels (like in the case of climate policy), structured and organized system of implementing particular policies (such as Environmental Quality Objectives), good communication, collaboration and coordination between different actors, as well as common interests and goals that lead to win-win solutions (like in the case of implementing wetland restoration by an NGO supported by authorities with shared interests). The issue of resources availability also came up as important success factor. For example,

support from EU in implementation of agri-environmental measures in agriculture or financial support of conservation agreements in the forest are important for the implementation of biodiversity-oriented forestry and agricultural objectives.

The political will and priorities given at highest governance levels can also be factors behind failure to implement some objectives. For example, in contrast to climate, production and development objectives, objectives linked to environmental aspects and particularly biodiversity conservation have been given lower political priority, thus leading to limited implementation. Prevalence of priorities linked to economic development seem also to be linked to market forces that "promote" development and does not allow for higher "profitability" of more environmentally friendly activities (like in case of food certification). Similarly, in some cases lack of political mandate can be an obstacle to implementing particular policies, like in the case of Water Framework Directive, where Water Authorities have little influence over forestry and municipalities' activities related to water, and can only provide recommendations. Other factors behind the failures described above are linked to a lacking holistic view and to sectoral divisions, including conflicting interests leading to conflicts. This is particularly visible in the implementation of Environmental Quality Objectives that represent horizontal policy influencing and being influenced by many different sectors; and in the general conflict between environmental versus production objectives (like e.g. in forestry sector). According to the Swedish Environmental Protection Agency (2011), when the production objective in one sector (e.g. forestry) is in conflict with Environmental Quality Objectives, in most cases the production objective shows up as most important and is steering for the development.

In some cases implementation of some policies revealed both partial success and failure. For example, both implementation of Water Framework Directive and of Swedish Environmental Quality Objectives show relatively large progress, due to some particular success factors (see Table 26 for details), while at the same time these policies are still not fully implemented due to particular failure factors (see Table 27 for details).

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