CAN WE SOLVE IT IN THE WORKSHOP?

Learning in river restoration and climate policy implementation

Peter M. Rudberg

Propositions

1. Ineffective implementation of environmental policy can be largely attributed to legislative limitations, rather than any limitations inherent to coercion. (this thesis)

2. With favorable legislation, learning's promise lies in increasing policy coherence between interconnected environmental challenges. (this thesis)

3. Attributing causation is risky in policy sciences, choosing not to is even riskier.

4. In understanding some of the major global challenges, the focus should be on the knowledge-power-participation nexus (after Hisschemöller and Hoppe., 1995) rather than on the energy-water-food nexus.

5. The saying "You can't make an omelet without breaking eggs", does not help to answer the questions of who's eggs should be used, who will eat the omelet or whether it might be better to change to a vegan-based diet.

6. Given that the term robot originates from "rabu", meaning slave, the future of artificial intelligence emancipation looks rather bleak.

Propositions belonging to the thesis, entitled:

Can we solve it in the workshop? Learning in river restoration and climate policy implementation

Peter M. Rudberg
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Can we solve it in the workshop?

Learning in river restoration and climate policy implementation

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Thesis

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Abbreviations

Abbreviation	Description
6EAP	Sixth Environmental Action Programme
CAB	County Administrative Board (Sweden)
CBD	Convention on Biological Diversity
EIA	Environmental Impact Assessment
EPI	Environmental Policy Integration
EU	European Union
FAO	Food and Agriculture Organization
FERC	Federal Energy Regulatory Commission (United States)
FWS	Fish and Wildlife Service (United States)
GHG	Greenhouse Gas
GOVREP	Governance for Renewable Electricity Production
LFASA	Legal Financial and Administrative Services Agency (Sweden)
MEUR	Millions of Euro
Mistra-SWECIA	Swedish Research Program on Climate, Impacts and Adaptation
MS	Member States (of the European Union)
NEPA	National Environmental Policy Act (United States)
NGO	Non-Governmental Organization
NMFS	National Marine Fisheries Services (United States)
OECD	The Organization for Economic Co-operation and Development
RES	Renewable Energy Directive
RPS	Renewable Portfolio Standards (United States)
SEQO	Swedish Environmental Quality Objectives
SWWA	Swedish Water and Wastewater Association
USACE	US Army Corps of Engineers
WASS	Wageningen School of Social Sciences
WFD	Water Framework Directive
WW	Water and Wastewater

CHAPTER 1: Introduction

1.1 Introduction

There is increasing evidence of significant negative environmental trends, on a global scale, which are connected to human development, demographic growth and economic activities (IPCC, 2014; Hassan et al., 2005; Rockström et al., 2009). There are even suggestions that we have entered "the Anthropocene"; a new geological era where the scale and scope of human-induced environmental change is greater than that of natural processes (Crutzen, 2006; Steffen et al., 2007). Biodiversity loss and climate change are amongst the most urgent environmental challenges and pose the risk of fundamentally altering the basic functioning of global natural processes. Should these risks become reality, they could generate less favorable global climatic and environmental conditions for human development and prosperity (Rockström et al., 2009; Ceballos et al., 2015).

The last three decades of environmental policymaking have generated some very ambitious and comprehensively formulated policies, ranging from the local to the global level. These policies often have the explicit aim of tackling and reversing some of the most significant trends of environmental degradation. On a global scale, the United Nations Framework Convention on Climate Change was created in 1992, with the specific goal of stabilizing greenhouse gas concentrations, at a level that would prevent dangerous human-induced interference in the climate system (UNFCCC, 1992). The Convention on Biological Diversity (CBD) specifically aims to conserve biological diversity and to ensure the sustainable use of its components (UN, 1992). In many ways, the European Union (EU), a supranational, political and economic union comprising twenty-eight member states, can be considered a frontrunner in international environmental policy (Christiansen and Wettestad, 2003; Vogler, 2005; Kelemen, 2010). The EU has enacted significant environmental policies, including those that aim to halt biodiversity loss, to protect community water resources, to mitigate climate change and to adapt to the effects of climate change (EU, 1992; EU, 2000; EU, 2009a; EU, 2013). At the national level, Sweden has been identified as a leading EU member state in environmental policy (Andersen and Liefferink, 1999; Burns, 2018). For example, it has formulated sixteen Swedish Environmental Quality Objectives (SEQO) with the goal of solving its most pressing environmental problems (Riksdagen, 1999).

However, despite the evidence of successful progress in the formulation of environmental policies, the fulfillment of the goals of those policies is generally low. For example, the overall reduction of greenhouse gas emissions is far below the overall emission reduction targets (UNFCCC, 2005; Den Elzen and Höhne, 2008). The latest progress review of the CBD's targets noted that there has been significant progress towards meeting some components of the convention; but that, in most cases, progress will not be sufficient to achieve the biodiversity targets set for 2020. This generalized picture of moderate implementation success in biodiversity policy is similar for the EU (EU, 2015). Additionally, the moderate rate of EU environmental policy implementation also stretches to other environmental policy areas (Knill and Lenschow, 2000; Jordan, 1999; EU, 2016). In Sweden, the same implementation challenges exist for environmental policy; as shown by the fact that fourteen of sixteen SEQOs will most likely not be reached within the set timeframe (Naturvårdsverket, 2015).

Several reasons have been identified for the poor progress in the implementation of environmental policy, including insufficient administrative capacity, data, evidence and information (EU, 2016). This lack of data, evidence and information for implementation is exacerbated by the inherent complexity and "wicked" nature of environmental problems (Funtowicz and Ravetz, 2001). The term "wicked" is used to describe environmental problems because they often reveal significant uncertainty, complexity and numerous legitimate perspectives among stakeholders. This can mean that the identification and implementation of measures, to reverse the degradation of environmental systems and to achieve environmental policy goals, are issues that require a detailed and continuous input of information, and participation, from a broad set of stakeholders (Olsson et al., 2004, Matland, 1995).

In response to an increasing awareness of the wicked nature of many environmental problems, research on learning in environmental policy has grown substantially over the past two decades (Gerlak et al. 2018). At the same time, coercion-based environmental policy implementation – i.e., that which is founded on the authority and sanctions of governments (Rhodes, 1996; Jordan et., 2005) – has been identified as one important factor of limited goal-fulfillment in environmental policy (Newig and Koontz, 2014; Jordan et al., 2005; Knill and Lenschow, 2000; Bäckstrand et al., 2010).

In contrast to purely government-based environmental policy making and implementation, governance acknowledges the importance of broader policy processes, stakeholders and institutions in solving environmental problems (Armitage et al., 2012).[1] Researchers of environmental governance have proposed adaptive

[1] This change goes beyond the environmental field and is reflected more broadly in the debate on "governance". Herein, a central concern relates to an empirical question concerning the extent to, and manner in, which the central state governs society in increasingly complex political and social settings, as well as the

governance, which mandates broad stakeholder learning processes, as a suitable way to deal with the inherent complexity and uncertainty of wicked environmental problems (Cosens et al., 2018). Adaptive governance is meant to permit the gathering and processing of the relevant information that is required to manage complex and unpredictable environmental systems successfully (Olsson et al., 2004; Plummer et al., 2017). In addition, learning among stakeholders, who often have a wide variety of perspectives, is believed to increase the chances of finding consensus and fostering collective action (Ison et al., 2007).

There has also been a move in environmental policy implementation towards learning-based implementation, in order to improve environmental policy's goal fulfillment and to deal with its complexity. Learning-based implementation modes are based on public participation, cooperation, co-production of knowledge and voluntary agreements among stakeholders (Ison et al., 2007; Pahl-Wostl et al., 2008). For example, participation and learning-based implementation were identified as the new core policy modes in the implementation of EU environmental policy (Newig and Koontz, 2014). In the US there is also evidence of increasing attention to social learning, as part of the implementation of environmental policy (Fiorino, 2001).

The preceding paragraphs suggest that the perceived limitations, of using a coercive-based implementation mode to solve complex environmental problems, have been connected to the restricted fulfillment of environmental policy goals. Meanwhile, learning is gaining prominent as an implementation mode. Learning is an important aspect of adaptive governance, and one which appears more suited to handling the inherent environmental complexity. Although complexity remains important, it is only one of several decisive contextual factors, which affect environmental policy implementation and governance. For these reasons, this thesis aims to question and explore the extent to which, and under which circumstances, learning constitutes the most appropriate mode for environmental policy implementation. It does so by conducting a critical analysis of learning as an implementation mode, in order to contribute to the literature on learning in environmental policy and governance.

1.2 Learning in environmental policy literature

The literature on environmental policy uses an important variety of framings, terms and concepts to analyze learning. Some notable conceptualizations include sustainability learning (Tabara and Pahl-Wostl, 2007), transformative learning

normative question of how it should govern (Jordan et al. 2005; Kooiman 1999; Treib et al. 2007; Rhodes, 1996).

(Sinclair et al., 2008), reflexive learning (Reed et al., 2010; Dyball et al., 2007), adaptive co-management (Armitage et al., 2008) and experiential learning (Keen and Mahanty, 2006). In addition, a variety of different environmental domains were analyzed using one, or several, conceptualizations of learning. These include water management (Watanabe et al., 2014), forestry (Cheng et al., 2011), biodiversity conservation (Wise, 2014), agriculture (Nykvist, 2014), and climate change adaptation (Ensor and Harvey, 2015). One recent review identified the three most recurring learning categories that were used in recent publications in the environmental policy field: social, organizational and policy learning (Gerlak et al., 2018).

Social learning is the dominant learning concept in the literature on environmental policy and governance (Gerlak et al., 2018; Suškevičs et al., 2018). Gerlak et al. (2018) reviewed articles on learning in environmental policy and found that almost half of them referred to social learning (2017), whereas in a sample taken by Suškevičs et al. the number were as high as almost four out of five articles (2017). In addition, there are several reviews that focus exclusively on the literature of social learning in natural resource management and environmental governance (Cundill and Rodela, 2012; de Kraker, 2017; Muro and Jeffrey, 2008; Siebenhüner et al., 2016).

Organizational learning is relevant for environmental policy implementation, because organizations are often the target group for environmental policy. Schofield (2004) formally integrates ideas from the body of literature on organizational learning and policy implementation, in order to analyze the process by which administrators operationalize strategic policy instructions and routinize these tasks; thereby learning to implement the policy in question. Organizational learning has also been used to analyze organizational behavior relative to ecosystem management and sustainability (Manring, 2007; Michaels et al., 2006; Müller and Siebenhüner, 2007), as well as climate change adaptation among organizations (Berkhout et al., 2006).

Policy learning is a concept that can be attributed to environmental policy implementation scholars in general, and the authors Sabatier and Jenkins-Smith in particular (Sabatier and Jenkins-Smith, 1988). Sabatier and Jenkins-Smith developed an ”Advocacy Coalition Framework” based on insights from “bottom-up” authors and the implementation literature in general. Insights from the Advocacy Coalition Framework are used in the analysis of policy learning (Albright, 2011; Weible et al., 2010). However, it can be argued, for example by Winter (2006, p. 155), that the Advocacy Coalition Framework moves the focus of analysis away from implementation towards policy formation and change, creating an analytical focus that reappears in the policy learning literature more generally (Suškevičs et al., 2018).

This thesis engages, principally, with the literature on social learning, as it presents the most relevant and advanced discussion and analysis related to learning as an implementation mode. Furthermore, social learning has been extensively studied and applied in water and natural resource management, including river restoration as part of water management in an EU context (Blackmore et al., 2007; Pahl-Wostl et al., 2008; Ison et al., 2007).

This thesis also engages with the literature on organizational learning, because it represents an established and valuable theoretical lens through which to analyze climate change adaptation (Berkhout et al., 2006; Berkhout, 2012). Policy learning, in the shape of the Advocacy Coalition Framework is excluded from further analysis and use in this thesis, because the core focus of this thesis is learning for policy implementation, rather than for policy formulation and change.

This section has introduced the main concepts of learning to be found in the literature on environmental policy and has set out its rationale for the inclusion of social and organizational learning in the thesis. The following section argues for the combining of insights, from the literature on learning with those of policy implementation and introduces the three ideal implementation modes: coercion, market and learning.

1.3 Learning and policy implementation modes

This thesis frames learning as an implementation mode and uses this to combine theoretical findings from literature on learning in the environmental policy field, with those of the literature on policy implementation. Framing learning as an implementation mode goes some way towards responding to the various shortcomings identified in the literature on learning, as will be explained in the following paragraphs.

Large sections of the literature on learning in environmental policy view behavioral change, including collective, coordinated and concerted action, as the ultimate outcome of learning (Cundill and Rodela, 2012; Muro and Jeffrey, 2008; Suškevičs et al., 2018). Despite the expectation that collective action will result from learning, there is still significant scope for research into the conditions under which learning leads to action (Cundill and Rodela, 2012), as well as for integrating the analysis of behavioral change into the design of learning research (Siebenhüner et al., 2016). There is also an identified need for clear and consistent analytical distinctions between the various learning activities; such as, collaboration and cooperation, which are repeatedly conflated and identified as both the conditions for, and the outcomes of, learning (Armitage et al., 2017; Gerlak et al., 2018).

In its most simple form, policy implementation can be expressed as the transformation of policy intention into action, in order to resolve an identified problem (Dunsire, 1995). Thus, research into policy implementation is focused on the transformation of intent into action. Furthermore, it provides clearly established analytical distinctions that can be used to analyze this transformation: goals, instruments, target groups, outcomes and impacts (Crabbe and Leroy, 2012). For these reasons, the literature on policy implementation offers insights which can be integrated into research design. These insights also serve to analyze how, if at all, stakeholder participation and learning leads to collective action, in terms of behavioral change, among the target groups of environmental policy. [2]

The term “implementation mode” is inspired by research from the field of governance, where the term “governance mode” is used to differentiate between various types of mechanisms used to induce concerted action (Etzioni, 1975, p. 5; Thompson et al., 1991; Hill and Hupe, 2009, p. 186; Bowles and Gintis, 2002). This thesis uses the term implementation mode in a more restricted sense, to categorize the different types of policy instruments used to implement environmental policy. This use is in line with that of other authors, who have used the same term to differentiate more coercive and top-down implementation approaches from discretionary, participatory and/or voluntary approaches (Winkel et al., 2015; Bruijn and Hofman, 2000; DeLeon, 1999).

This thesis conceptualizes three ideal types of implementation mode: coercion, market and learning. A coercive implementation mode relies on the authority and sanctions of government to implement policy, including environmental policy (Rhodes, 1996; Jordan et al., 2005). A market implementation mode relies on economic incentives and market forces to implement policy, including environmental policy (Stavins, 2003; Rhodes, 1996). A learning-based implementation mode employs public participation, cooperation, co-production of knowledge and voluntary agreements among stakeholders (Ison et al., 2007; Pahl-Wostl et al., 2008). The following paragraphs illustrate how these three ideal modes could be applied to the implementation of the Water Framework Directive (WFD) (EU, 2000), a key EU policy that requires river restoration in its implementation.

The WFD (EU, 2000) establishes a framework for the protection of water, including inland surface waters. It mandates that no water body in the EU should experience a decrease in water quality. It also mandates that water bodies achieve

[2] The target groups of policy can include public and private organizations or broader groups such as consumers, motorist or farmers. They are groups in society whose behavior is identified as determinant to reaching the goals of the policy in question.

"good chemical and ecological status" by 2027, at the latest. There are target groups in society whose behavior is a determinant of achieving the WFD's goals. They include farmers, various types of industries and hydropower producers. To give an example; hydropower production is a significant driver of hydromorphological pressures and impacts on water bodies. This is one of the most important areas where improvement is needed and hydropower producers might be required to adjust their behavior, in the rivers where they are present, in order to reach the WFD's goals (EU, 2007). Other required changes in behavior include introducing new technology at stations, such as fauna passages; allowing a share of water to bypass the turbines and, in some cases, ceasing operations. These types of changes in behavior reduce hydromorphological pressure on the river which in turn leads to improved chemical and ecological status of the water bodies in question (EU, 2007).

An example of a coercion-based implementation mode, to implement the WFD, could include taking hydropower producers to court. There, environmental agency officials (or other stakeholders) could claim that in order reach the goals of the directive, the WFD requires hydropower producers to modify their behavior. If the court agrees, the policy outcome could be stipulated behavioral changes to one or several hydropower stations. Thus, coercion-based implementation modes can lead to a policy outcome of forcing hydropower producers to modify their behavior, in line with the requirements of the WFD, at the risk of sanctions.

An example of a market-based implementation mode is the calibration of taxes and charges for water services, which is considered within the WFD (Liefferink et al., 2011). Another possible market-based implementation mode is a certification scheme that gives hydropower producers positive publicity, if they are above average in terms of environmental protection and which provides economic incentives for river restoration. In both Sweden and the USA, Non-Governmental Organizations (NGOs) have created voluntary certification schemes such as this for hydropower production and river restoration.[3] These market-based modes could result in a policy outcome of motivating, or forcing, hydropower producers to modify their production behavior in line with the requirements of the WFD, through economic means.

A learning-based implementation mode can take the form of various types of participatory processes including public consultations (Barraqué et al., 2004), workshops and working groups (Mostert et al., 2007) and impact assessments in broad committees of inquiry (Nykvist and Nilsson, 2009). Such examples of a

[3] These include the certification of hydropower facilities by the Low Impact Hydropower institute in the US (http://lowimpacthydro.org) and the Swedish Society for Nature Conservation in Sweden (http://www.naturskyddsforeningen.se/in-english).

learning-based implementation mode could result in a policy outcome, where hydropower producers modify their behavior following agreement and concerted action among the river basins' stakeholders.

For stylistic reasons, the terms 'coercion', 'market' and 'learning' will be used on their own in the introductory and concluding chapters. In these two chapters the terms are used as shorthand for coercion-based, market-based and learning-based implementation modes as defined and explained in this section.

1.4 Conflict as crucial context for environmental policy implementation

The existing literature has thoroughly explored the inherent complexity and uncertainty in environmental policy and governance – as well as the benefits of participation and learning to deal with it (Suškevičs et al., 2018; Gerlak et al., 2018; Armitage et al., 2017; Cosens et al., 2018). However, environmental and social complexity is not the only fundamental variable that is a determinant of environmental policy and governance. The literature has also identified a need for further analysis and exploration into stakeholder conflict, as it concerns participatory processes and learning in environmental governance (Cundill and Rodela, 2012; Muro and Jeffrey, 2008; Ensor and Harvey, 2015; Armitage et al., 2012; Crona and Parker, 2012), as well as conditions under which learning leads to action and tangible outcomes (Cundill and Rodela, 2012; Suškevičs et al., 2018).

This thesis defines conflict in line with Matland (1995) and Van den Hoven's (2006) work: as an interdependence of actors who have incompatible interests and a zero-sum element to their interactions. This definition means that limited focus is given to other sources of conflict, such as cognitive conflict (Adams et al., 2003), cultural and gender conflict (Shaw and Kristjanson, 2014), inter-personal conflict (Young et al., 2010) and procedural conflict (Winkel et al., 2015).

This thesis, in addition, hypothesizes three facets of conflict may be particularly relevant in environmental policy implementation: (1) conflicts of interest between stakeholders, (2) conflict of environmental policy goals and (3) legislation. Legislation is defined as the formally sanctioned rules for regulating conflict in situations where interests cannot be harmonized (Vatn, 2005). The following paragraphs explain these three facets of conflict and provide the rationale for this hypothesis.

1.4.1 Conflicts of interest between stakeholders

Van den Hoven (2006) argues that all participatory processes can be located on a continuum between entirely co-operative processes and entirely conflictive ones. At the conflictive end, she places participatory processes that must produce some sort of collectively agreed outcome, and actions that results in zero-sum interactions. Therefore, and given Van den Hoven's insights, this thesis expects conflict to play a crucial role in learning which require collective action and a behavioral change in the target group.

The findings of Van den Hoven are in line with Matland (1995) who developed a conflict-ambiguity model in an attempt to synthesize the insights he had gathered, from decades of implementation research. He proposed his parsimonious model could be used to understand and predict policy implementation, largely based on the level of conflict of the policy to be implemented. Hill and Hupe (2009) agreed that Matland's model offered some important contributions concerning the effects that the nature of a policy itself has on its eventual implementation. Furthermore, Hill and Hupe showed that other authors, such as Hoppe et al. have made similar classifications of policy, which conferred a certain degree of validity to Matland's model, with its emphasis on conflict as an important contextual and influential variable of environmental policy (Hill and Hupe, 2009, p. 178). The prominence of conflict in environmental policy implementation is also reflected in empirical work. For example, Winkel et al. (2015) noted interest-based conflicts related to changing property rights, costs, and compensation in the implementation of Natura 2000 in forests; while Young et al. (2010) identified biodiversity conflicts resulting from the implementation of various biodiversity and forestry policies.

1.4.2 Conflicts between environmental policy goals

Researchers have shown that increased interaction between environmental policy domains increases the risk of conflicting environmental goals, which require trade-offs of measures and which risk low policy coherence (WEF, 2011; Phelps et al., 2012; Makkonen et al., 2015). Many environmental policy domains exhibit high interdependency and risk a conflict of interactions between the measures needed to reach their diverse environmental goals. An example would be measures to manage forests as carbon sinks and sources of renewable energy, while conserving their biodiversity (WEF 2011; Phelps et al., 2012; Makkonen et al., 2015). Researchers have identified measures to mitigate climate change, through renewable energy development (including tidal, wind and hydropower energy), and biodiversity protection as areas that comprise interactions with a particularly high risk of conflict, trade-offs and low policy coherence (Jackson 2011; Köppel et al., 2014; Abazaj et al., 2016). High domain interactions increase the need for policy coherence, to deal with the trade-offs and to ensure synergy between the different environmental domains (Dodds and Bartram, 2016).

1.4.3 Legislation: formally sanctioned institutions to regulate conflict

Institutions are granted significant attention in the recent literature concerning learning in environmental policy. Gerlak et al. (2018) found that a general understanding in the literature is that social learning is heavily influenced by institutional design. Siebenhüner et al. (2016) surveyed studies that showed considerable support for the institutionalist perspective, granting a significant role to both formal and informal institutions in learning and change processes. Suškevičs et al. (2018) also found that their surveyed literature paid considerable attention to institutions that could potentially link learning and natural resource management outcomes.

The study of institutions is comprehensive, but they can be defined broadly as societal rules, i.e. setting out which actions are required, prohibited or permitted. These rules are commonly understood and used, by a set of participants, to achieve order and predictability in repetitive, interdependent relationships (Ostrom, 2005). This definition of institutions incorporates formal institutions as well as a wide array of informal institutions such as the customs, traditions and norms of society (Vatn, 2005). This thesis focuses on the formal institutions, in the shape of legislation, since formally sanctioned institutions are needed to regulate conflict, in situations where interests cannot be harmonized (Vatn, 2005).

1.5 Effectiveness and coherence of policy outcomes

This thesis defines policy outcomes as the changes that are effected in a target group's behavior, by the application of policy instruments (Crabbe and Leroy, 2012). This thesis also proposes that some sort of explicit criterion is required, in order to discuss policy outcomes clearly. The Commission of the European Communities identifies the general and normative characters of ‘effectiveness’ and ‘coherence’ as two of the five principles of good governance (EU, 2011a). For this reason, this thesis will use effectiveness and coherence as its two normative and generalized goals to analyze the policy outcomes resulting from learning.

Evaluations of effective policy implementation are usually informed normative qualifications between the policy’s goals and the observed results of the policy (DeLeon, 1999; Matland, 1995). The text of the original policy document is generally the key to understanding the policy’s intended outcomes and impacts (Matland, 1995). Thus, the policy’s effectiveness is evaluated, as much as possible, by comparing the extent, timing and relevance of its outcomes to its expressed target goals. The policy’s impacts, i.e. any ultimate improvements in the environment, are not part of the analysis since this requires expertise in advanced natural science that goes beyond the scope of this thesis.

Evaluating a policy's effectiveness in isolation can be of limited value in those situations where there is high interaction between environmental policy domains; such as, renewable energy development and biodiversity protection. For example, a policy to promote renewable energy could be implemented effectively, through the large-scale expansion of hydropower production. However, at the same time, the outcome of such a policy might counteract the effective implementation of biodiversity and water quality policies. For this reason, where there is high interaction between environmental domains, it is necessary to incorporate an analysis of the policy's outcomes in terms of policy coherence. This thesis therefore defines policy coherence as an attribute that systematically reduces conflicts and that promotes synergies between different environmental policy domains (Dodds and Bartram, 2016).

1.6 Conceptual model

This section of the thesis combines the concepts and variables into a conceptual model, Figure 1-1. The first element of the model comprises environmental policy goals. The second step is the three aspects of conflict in policy context, which are

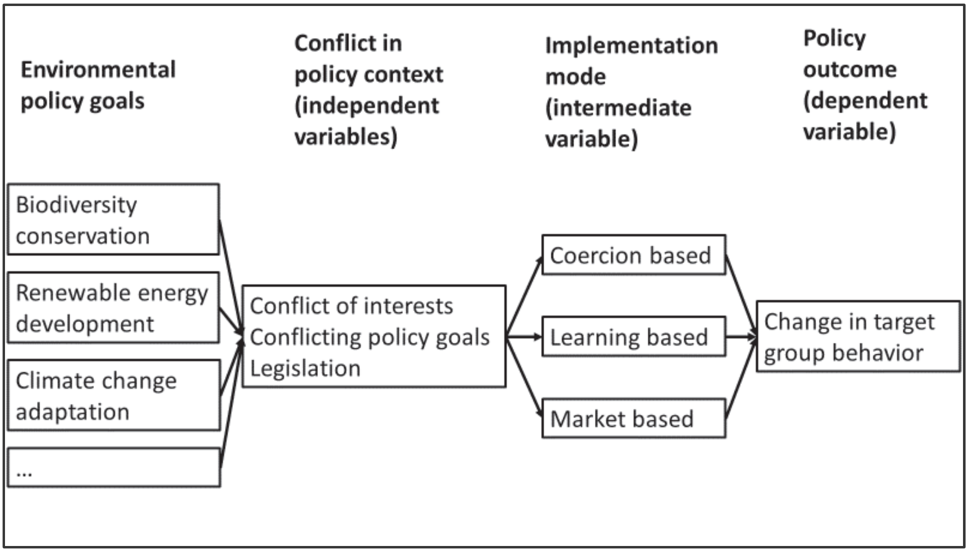


Figure 1-1: The thesis' research model

explored in this thesis and which are treated as independent variables of environmental policy implementation. The third step covers the three ideal implementation modes: coercion, learning and market, and these are maintained as intermediate variables. The final step is policy outcome, which is represented by a change in target group behavior; it is also treated as dependent variable in the model.

1.7 Research objectives and questions

This thesis aims to explore how conflict influences learning in terms of delivering effective and coherent implementation of environmental policy. This is done by posing two research questions; which, together, treat the three facets of conflict highlighted in the thesis. They are:

1. ***How do stakeholder conflicts of interest and legislation influence the effectiveness of learning as an implementation mode?***
2. ***How are conflicts in environmental policy goals manifested, and what role can a learning-based implementation mode play in increasing policy coherence?***

Consideration of the first question includes an analysis of stakeholder conflicts of interest and legislation, relative to the effectiveness of learning as an implementation mode. Stakeholder conflicts of interest and legislation are combined, since environmental domains with high levels of conflict are hypothesized to be highly legislated and vice versa. This thesis uses effectiveness as a relevant measure, to analyze and discuss the policy outcomes from a learning-based implementation mode under contextual conditions containing high and low levels of conflicts of interest.

The second question explores how conflicts in environmental policy goals are manifested in the implementation of environmental policy. In particular, it analyzes the role learning can play in increasing policy coherence.

1.8 Methodology

1.8.1 Research approach and design

The proceeding sections have illustrated how this thesis used relevant theory and scientific literature to build its conceptual model and to determine its research questions. The following sections explain the research approach and design; introduce the cases and illustrate how the conceptual model and research questions guided the selection of cases.

The thesis' research takes a critical realist stance, with asserts that reality exists largely independently of human minds but, that knowledge and representations of it are human and social constructions (Archer et al., 2016). Therefore, knowledge and representations of reality are dependent on context, concept and activity. This means that knowledge claims about reality, including causation, are contingent on context and explanations of causation require deep and robust contextual understanding. The case study approach to research allows for a detailed examination of the aforementioned types of contextual factors as well as exploration of the possible causal mechanisms (George and Bennett, 2005). This approach is also preferable when the investigator has limited control over events and asked “how” and “why” questions about contemporary phenomena within a real-life context (Yin, 2009; Rowley, 2002). Since the research questions and focus of this study align well with these criteria, the case study approach was chosen for this thesis.

Furthermore, in order to gain a deep and robust contextual understanding on which to base any claims of causation, this thesis features several case studies within the primary environmental policy domain of interest, of different scales: from supranational to subnational. In addition, the thesis uses a variety of data collection strategies; including document analysis, semi-structured interviews, and participant observation. This allows for strong contextual understanding, as well as for triangulations of the insights gathered from the various data sources.

1.8.2 Case studies introduction

The empirical material of this thesis consists of five cases from two different environmental policy domains. Four cases concern the primary domain of interest of this thesis, i.e. river restoration affecting hydropower production. These cases cover various scales: supranational (the European Union, in Chapter 2); national (Sweden and the United States, in Chapter 3) and subnational (Ljusnan River basin, Sweden, in Chapter 4). One case comes from the secondary domain of interest of this thesis; that is, urban water services related to climate change. This case is situated at the subnational scale, and focuses on the Stockholm Region, Sweden (Chapter 5).

River restoration, affecting hydropower production, lies at the crossroads of two of the most critical global environmental challenges of our times: the mitigation of biodiversity loss and climate change (Rockström et al., 2009; Ceballos et al., 2015). Hydropower offers a competitive and reliable source of renewable energy which, on one hand, can work as an important element in mitigating climate change (Bryson et al., 2008). On the other hand, hydropower causes habitat destruction and deterioration which, if unmitigated, leads to significant biodiversity loss in freshwater ecosystems (Malmqvist and Rundle, 2002; Nilsson et al., 2005; Dudgeon et al., 2006; Vörösmarty et al., 2010). This dual nature of hydropower production is reflected in the potentially conflicting interaction between environmental policies, which aim to secure biodiverse and well-functioning natural systems, and policies, which promote the expansion of renewable energy. This potential conflict is displayed at global (IPCC, 2011; UN, 1992), EU (EU, 2000; 2009a; 1992), EU member state levels, and is illustrated by Sweden, EU's largest hydropower producer (Riksdagen, 1999; EU, 2018*a*). Examples of measures to secure biodiverse and well-functioning freshwater ecosystems can include the halt of new hydropower construction, and the decommissioning of existing ones; as well as the dedication of water for fauna passage facilities. Simultaneously, these same measures can reduce existing, or potential, hydropower production and in turn limit hydropower's share in fulfilling the policy objectives of renewable energy development.

Adaptation in urban water services comprises an important environmental policy and a human health challenge (Milly et al., 2008; Bryson et al., 2008). The effects of climate change, such as increasing temperatures, rising sea levels and changing precipitation patterns, all have negative impacts on the quality and supply of drinking water, urban drainage and waste water treatment (Bryson et al., 2008). Therefore, climate change increases the risk that existing water service infrastructures will not be sufficient to maintain an adequate and safe supply of drinking water, efficient urban water drainage and adequate waste water treatment (Milly et al., 2008; Bryson et al., 2008). Many of these risks have yet to materialize; projections concerning the impact of climate change are made on a decadal time scale and where both the timing and extent of any impact is uncertain (Bryson et al., 2008). That being said, adjustments to existing urban water infrastructure are generally expensive, time-consuming and have a long-term focus (so, they should function adequately on a decadal time scale). Many investment decisions in the short term might thus have to include climate change occasioned adaptation of the urban water services' infrastructure, in order to deal with possible climate change impacts in the middle- to long-term.

1.8.3 Case studies selection

As mentioned, this thesis hypothesizes that three facets of conflict are particularly relevant to environmental policy implementation: conflicts of interest between stakeholders, conflict of environmental policy goals and finally legislation. Because of this hypothesis, cases were selected in two environmental policy domains with very different levels of conflict. At the same time, it was also ensured that the cases featured important cross-case similarities, as well, to ensure the relevance of a cross-domain comparison.

The following paragraphs explain the rationale of choosing high conflict; and low conflict cases. The section closes by outlining the important cross-domain similarities to justify the comparison of cases from the two different domains.

Different level of conflict across domains

River restoration that affects hydropower production brings high levels of stakeholder conflict of interest. This is because river basins with hydropower production contain various actors that are interdependent but who generally have incompatible goals. They often include: hydropower producers, environmental and fishing NGOs and public organizations. There is a zero-sum element to their interactions, since significant river restoration measures – including the removal of hydropower stations and dams, the establishment of minimum flows and passage facilities – generally reduce the extent and value of hydropower electricity production. In addition, the costs of river restoration are, largely, borne by the hydropower producers, whereas the benefits are enjoyed by the public.

The EU and Sweden's policies relating to river restoration and hydropower production are a clear example of policies where potential conflicts of goal exist. At an EU level, the WFD and the Renewable Energy Directive (RES) are clear examples of policies with potential conflicts of goal interaction, related to river restoration and hydropower production (EU, 2000; EU, 1992). As mentioned earlier (in section 1.2), the WFD establishes a framework for the protection of inland surface waters that are impacted by human activities. This includes hydropower production, which constitute one of the most important areas in need of improvement in order to reach the goals of the WFD (EU, 2000). Conversely, the RES establishes an EU wide target of 20% of renewable energy, as a percentage of the gross domestic consumption of energy, by 2020. Therefore, the existing hydropower production in the EU is significant to reaching this target. In 2015, hydropower was the largest renewable energy resource in the EU, accounting for more than 14% of the total primary energy production of renewable energy (EU, 2018*a*). Sweden, EU's largest hydropower producer (EU, 2018*a*), also displays similar, potentially conflicting, environmental policy interactions on a national scale (Riksdagen, 1999).

In addition, river restoration and hydropower production are densely legislated fields in natural resource management. There are clearly established regimes, across the EU, for granting rights, in the shape of permits, licenses and concessions to use hydropower. These are renewed either periodically or upon the active request from public or private stakeholders (Glachant et al., 2014). In Sweden, the dense legislation related to hydropower production is reflected in the Environmental Code, which includes various sections and chapters relating to the granting and modifications of permits for hydropower production (SFS, 1998a).

Adaptation of urban water services shows low levels of stakeholder conflicts of interest in the Stockholm Region. There is one major actor – the municipality – that assumes both the risks of inaction and the opportunities for adaptation in the urban water services' sector. Additionally, the Stockholm Region has faced few extreme weather events that might be connected to climate change. It also experiences ongoing land elevation, which is an important geological characteristic of the region and which moderates any expected impact from a rise in sea level.

At present, climate change adaptation policy features a limited risk of policy goal conflicts with other environmental policies since it lacks specific requirements for climate change adaptation. At both the EU and the Swedish level, the policy on climate change adaptation calls for increased resilience, coordination, knowledge production and dissemination. However, it makes few clear specifications about what these terms mean, nor which measures need to be implemented for these goals to be fulfilled. At an EU level, the main document on climate change adaptation is the adaptation strategy from 2013. This argues for making the EU more climate-resilient and for enhancing the preparedness and capacity of all governance levels, in order to respond to the impacts of climate change. The strategy argues that this should be done through mainstreaming adaptation and promoting adaptation among member states. The Swedish Commission on Climate and Vulnerability stresses the necessity of starting adaptations for climate change in Sweden (Holgerson et al., 2007). However, the Climate and Energy bill, which followed in 2010, does not include specific requirements for climate change adaptation. Rather it states, in general terms, that work on adaptation to a changing climate in Sweden has to be consolidated and coordinated at central and subnational levels, and should permeate all of society (Riksdagen, 2009).

The lack of specific requirements for climate change adaptation is also reflected in legislation related to urban water services in Sweden. For example, existing legislation for water provisioning requires the safe and secure provision of water, but makes only limited specific requirements for climate change adaptation (SNFA 2018a). During 2018, the national agency responsible for drinking water, the Swedish National Food Administration, will release a report offering guidance on, rather than requirements for, climate change adaptation (SNFA 2018b).

Similarities across domains

Notwithstanding the significant difference in the level of conflict between the cases examined in this thesis, there are also important similarities. This assures the relevance of a cross-domain comparison. All the cases feature wicked environmental problems, which exhibit endemic uncertainty, complexity and a plurality of legitimate perspectives among stakeholders. Equally importantly, the Ljusnan River basin and the Stockholm Region cases are both subnational cases in the same country, Sweden, which feature learning as an implementation mode. Thus, these two subnational cases provide in-depth examples of learning on the same scale and in the same country; but, in two different environmental policy domains, which exhibit high and low conflict, respectively. In light of this, a comparison of the two subnational cases should allow for a pertinent analysis, which may lead to insights into the performance of learning under varying degrees of conflict within the context of environmental policy implementation. Figure 2 illustrates the empirical focus and research scale of the case studies.

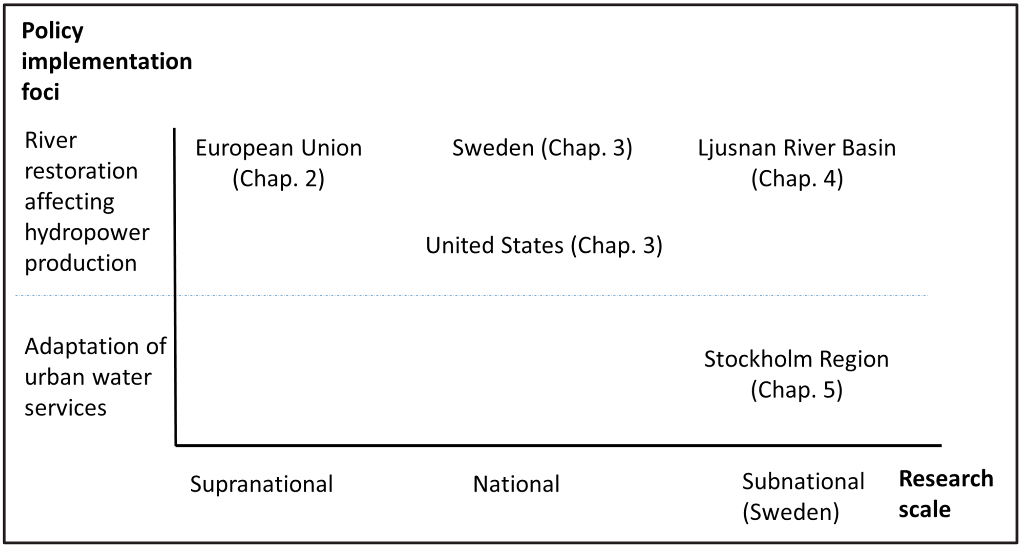


Figure 1-2: Empirical foci and research scale of the case studies

1.8.4 Data collection

The studies followed three main strategies for data collection: document analysis, semi-structured interviews and participant observation. The following sections explain why, and to what effect, these data collection strategies were employed.

Document analysis

Document analysis was a key data collection method in all chapters of this thesis. It was used to gather the relevant quantitative information concerning river restoration related to hydropower production in Sweden and the United States (Chapter 3) as well as the growth of production capacity of renewable energy in the EU (Chapter 2). The study made a document analysis of EU directives, national laws, and different forms of regulations to gain empirical data about relevant formal institutions, as concerns the study areas of water governance. This was also done to understand the extent to which legislative differences might explain differences in river restoration performance between Sweden and the United States. The thesis used the scientific articles on the studied topic extensively, as secondary sources of information, both to frame the research and to gather relevant information regarding the case studies.

Document analysis was the dominant data collection method in Chapters 2 and 3, since the available primary and secondary documentation offered comprehensive and sufficient empirical data to answer the research questions.

Semi-structured interviews

Semi-structured interviews were a significant complementary method of data collection, in the research for Chapters 4 and 5 of this thesis (see Appendices 4-7). Chapters 4 and 5 are both single in-depth revelatory case studies, where a relevant portion of the target group population of policy was interviewed to identify any potential behavioral changes; as well as the motivation and reasons behind any changes. By gaining insight into the target group’s motivation for making certain behavioral changes, it is possible to gain a better understanding of whether an observed change is a policy outcome. This understanding can be gained by assessing the extent to which, and how, the application of policy instruments influences the behavior of the target group compared to other societal and economic developments, which are not related to the policy of interest.

Participant observation

The research contained in this thesis took place within the scope of larger research programs: the Governance for Renewable Electricity Production (GOVREP) and the Swedish Research Program on Climate, Impacts and Adaptation (Mistra-SWECIA).

The author was part of a research team that organized thirteen stakeholder meetings, as part of the Mistra-SWECIA program during 2008. The meetings brought together twenty participants, who had been selected as being the relevant stakeholders for research into climate change adaptation in the Stockholm Region

(André et al., 2009). Each meeting lasted around two-and-a-half hours. All the stakeholder meetings were recorded and transcribed by the author and one research colleague. Participation in these meetings served to provide the author with insight into the relevant research questions, interviewees and premises for the empirical work presented in Chapter 5.

As part of the GOVREP program, the author participated in two stakeholder meetings, between 2010 and 2011, that were two-day long conferences with research and hydropower industry representatives. Participation in these meetings served to provide the author with insight into the relevant research questions, interviewees and premises for the empirical work presented in Chapters 3 and 4.

Additionally, between 2009 and 2013, the author presented intermediary results and conclusions, which are either included in, or directly relevant to this thesis, to both stakeholders and fellow researchers at a total of fourteen seminars and research conferences. The comments and criticism received at those events assisted in correcting and improving the final interpretation and formulation of the research results. Participation in those events also engendered feedback and discussion with stakeholders and fellow researchers, which allowed the author to correct possible errors and misconceptions. Table 1-1 provides an overview of the main data collection methods used in the different chapters of this thesis.

Table 1-1: Overview of main data collection methods in the thesis, by chapter

	Document analysis	Number of semi-structured interviews	Participant observation
Chapter 2	X		
Chapter 3	X		X
Chapter 4	X	5	
Chapter 5	X	25	X

1.8.5 Data analysis

The thesis makes use of three main data analysis strategies: framework synthesis (Barnett-Page and Thomas, 2009), counterfactual approach (Brady, 2008) and meaning categorization (Kvale, 1996).

Chapter 2 uses the existing literature on policy interaction, change and implementation to develop a framework which is subsequently used for analyzing policy coherence across different policy domains. This framework guides the analysis of the cases on cross policy interaction related to objectives, instruments and implementation. One out of three case studies in Chapter 2 constitutes a coherence analysis of EU policies, related to renewable electricity promotion and inland water protection. Chapter 4 uses the existing literature on social learning in natural resource management and governance to create a framework that is used for an in depth-analysis of an important learning-based intervention for river restoration affecting hydropower production in the Ljusnan River basin. This framework directs the analysis towards procedural and institutional factors that are relevant to the case, in order to understand the lack of natural resource management outcomes from the process.

Chapter 3's data analysis follows a counterfactual approach, where Sweden and the United States are treated and compared as two "most similar worlds". They are comparable because they are both democratic and mature hydropower producing countries with a high level of hydropower production. Despite their similarity, however, a quantitative analysis reveals that the two countries experienced significant differences in the extent to which river restoration affecting their hydropower production, between 1990 and 2010. Since hydropower production and river restoration are highly regulated in both countries, the qualitative analysis is directed towards similarities and differences in procedural and substantial legislation, as a bid to discover a plausible explanation for the significant extent of the differences in river restoration.

Chapter 5 analyzes the large set of qualitative data, gathered from the twenty-five semi-structured interviews. It follows an analytical approach that is based on meaning categorization as suggested by Kvale (1996). Recurring types of answers to the interview questions were identified in the interview transcriptions, in an iterative process. Using Excel, the number of interviewees, who expressed answers which fit into each reply category, was quantified. This allowed an identification of the most recurrent types of issues and factors as reported by the interviewees. This quantitative identification of the most salient issues and factors, in turn, guided the qualitative analysis of the chapter.

1.8.6 Research validity

Research validity is usually discussed in terms of internal and external validity. Yin (2014) and Rowley (2002) identify internal validity, in explanatory or causal studies, as the establishment of a causal relationship between certain conditions that is believed to lead to other conditions. External validity is the extent to which a study's findings can be generalized. The following paragraphs will specify challenges to the internal validity, as well as expectations of external validity, of the thesis.

Internal validity

The core of this thesis' research can be summarized as explanatory case study research in which a possible causal link, between policy initiatives and behavioral changes in the target group of the policy, is investigated. The conceptual model of the thesis (Figure 1-1) combines the various concepts and variables introduced in this thesis, in order to suggest a direction of causation between environmental policy goals and policy outcome. The model's main contribution is to provide a simple and transparent guide to the basic ideas and concepts that guide the research. The research model is limited, however, in that it does not pay specific attention to multi-layer problems in implementation research, despite there being ample literature on the subject. This literature highlights the causal relationships, between the fit of national regulatory patterns and those required by EU legislation (Knill and Lenschow, 2000); between different national cultures (Falkner et al., 2007; Falkner and Treib, 2008) and domestic politics (Liefferink et al., 2011) and the extent of implementation of EU legislation. Section 6.4, in the concluding chapter, will return to this omission and will discuss the extent to which the model has the explanatory power to understand change in target group behavior, in this thesis' areas of empirical research.

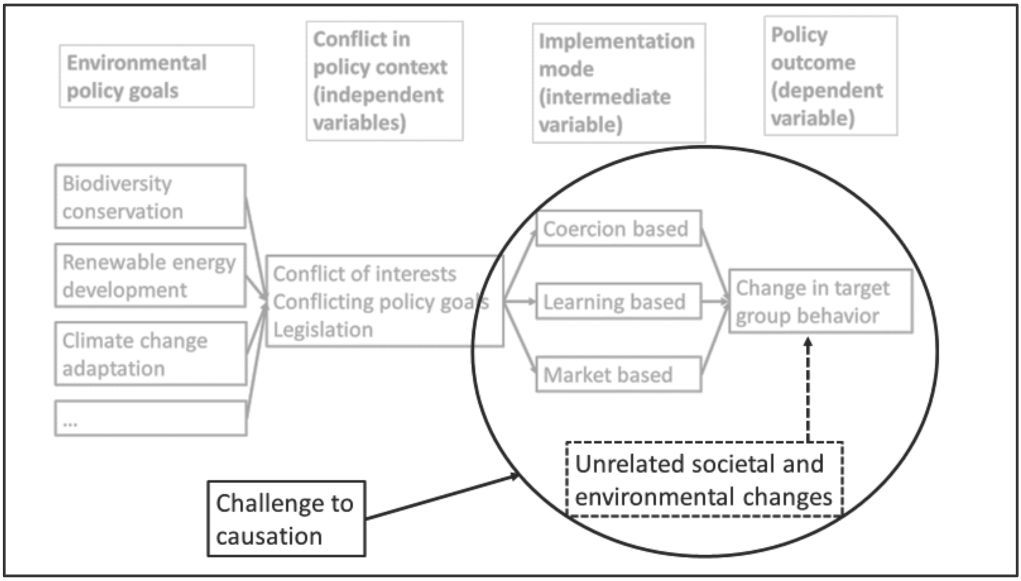


Figure 1-3: Important challenge to causation, relative to change in target group behavior, in environmental policy

In each analytical step of the conceptual model, from policy goals, through to policy outcomes, there are important challenges to causation. The main challenge is to demonstrate that it is the policy, and its subsequent implementation, that causes the desired effect, in terms of changed target group behavior. This task is exacerbated by the fact that various simultaneously occurring and unrelated societal and environmental developments occur, which will also influence the target groups' behavior (Crabbe and Leroy, 2012). Figure 3 highlights the important challenge to causation in the conceptual model of the thesis.

The internal validity of this study depends, largely, upon how the challenge of establishing causation is treated. In order to increase the internal validity of the research findings, the study selected cases from two domains of environmental policy, where relevant policy outcomes are relatively concrete and easy to identify and quantify. In the domain of river restoration affecting hydropower production, the behavioral changes include dam removal, the construction of fish passage facilities and fish screens, and the introduction of minimum flow requirements. In the domain of adaptation of urban water services, the behavioral changes include investments to improve the water purification and the wastewater treatment infrastructure; changes in the planning of new urban areas, to raise the minimum connection level to the sewer; and increased capacity for storm-water drainage.

In addition, the selected empirical cases feature relatively limited and well-defined target groups of policy. For hydropower and river restoration, the target group consists, predominantly, of hydropower producers. For climate adaptation in urban water services it consists primarily of urban water utilities. A significant portion of the target group could thus be interviewed to understand and document the extent to which a certain policy and implementation mode is related to an observed change in target group behavior.

The main approaches taken for establishing claims of causation between policy initiatives, implementation modes and policy outcomes in the examined cases are the counterfactual and the mechanism and capacities approaches (Brady, 2008). The results are in line with the modus narrandi of causal argumentation and assessment identified by Gysen et al. (2006), whereby middle-range theories, inductive claims and quantitative data are used to explain and illustrate a causal narrative. By presenting the causal claims, and the observations on which they are based in a thorough and comprehensive way, it is possible for the reader to confirm or refute the proposed causal narrative and create another causal narrative.

External validity

The empirical material of this thesis consists of a set of cases drawn from Sweden, the EU and the United States. Most of the cases concern this thesis' primary environmental domain of interest – river restoration affecting hydropower production – while one case examines climate adaptation in urban water services. The empirical material is analyzed from the perspective of conflict as a crucial contextual factor for environmental policy implementation.

Two arguments support this thesis' expectations of external validity as outlined in this section. The first is that the findings, in the two domains, should be relevant to understand the same environmental domains in other regions and nations that experience similar challenges, and that have comparable policy and legislation. The second is that the findings are expected to provide general insights about the viability, requirements and potential of learning as an implementation mode since it features analysis and comparison of learning across two environmental domains, thus highlighting the different level of conflict in different policy contexts.

The insights gained from the adaptation of urban water services, in the Stockholm Region, are expected to inform research and aid in the understanding of adaptation processes across other industrialized nations, in the EU and globally. These countries feature significant policy and legislative similarities and possess a relatively high generic adaptive capacity to respond to climate change impacts. In the first instance, insights from the Stockholm Region could serve to inform adaptation challenges and processes of water services in other urban regions. Several of the insights from the Stockholm Region study could also serve to inform the science of climate change adaptation in general. This includes organizational processes of adaptation to climate change as well as the adaptation of a large-scale infrastructure to climate change. Such more general insights can be drawn from the Stockholm Region as well, as it features an analysis of the organizational adaptation of four urban water companies and because urban water is a service provided through a large-scale infrastructure.

Insights related to the domain of river restoration affecting hydropower production are expected to inform learning and the role of legislation, in implementing potentially conflicting policy goals, in mature and significant hydropower-producing countries. This is possible because the thesis draws extensively on Sweden, the largest hydropower producing country in the EU, and includes an overall EU analysis as well as insights from a subnational case in France, the second largest hydropower producer in the EU. Together with France, Sweden shares its condition, as a mature and significant hydropower-producing country, with seven other EU member states.[4] These nine EU countries are experiencing similar

[4] Nine EU member states are mature hydropower producing countries – in the sense that they experienced the bulk of hydropower expansion during the last century – and significant in that they have experienced an

challenges, in terms of their having to adjust important hydropower production to potentially conflicting EU policies and legislation on biodiversity conservation and renewable energy development. Furthermore, this thesis provides empirical material and analysis from beyond the EU, by including a country analysis of the United States, as well as an analysis of a well-studied subnational case within the same country. The United States and various other mature hydropower-producing countries, globally, are facing similar challenges: dealing with the potentially conflictual interaction of biodiversity conservation and renewable energy development goals relative to existing hydropower production. For this reason, insights from this thesis could inform learning as part of the implementation of potentially conflicting policy goals in these like countries.

By analyzing and comparing learning across environmental domains, while highlighting different levels of conflict in different policy contexts, it is expected that this thesis provides general insights about the viability, requirements and potential of learning as an implementation mode. Such insights are expected to be particularly relevant to informing the implementation of environmental policy that affects industrial use and extraction of natural resources. River restoration affecting hydropower production is, then, an example of environmental policy implementation that affects industrial use and the extraction of natural resources.[5] In the short-term, these industries are negatively affected by the implementation of environmental policies, because this usually increases production costs and reduces profitability and business scope. In general, such situations tend to feature high conflict since they share the same basic premises and a similar high level of conflict as river restoration affecting hydropower production – including an interdependence of actors with incompatible interests and a zero-sum element to the interactions.

1.9 Thesis outline

This introductory chapter framed learning as an implementation mode, introduced conflict as a crucial context for policy implementation and provided an overview of the topics of the thesis. Furthermore, it detailed the methodology the thesis will follow and established the research questions and objectives of the thesis. The following chapters form a body of empirical research that allows for critical analysis and that provides insights which enable responses to the thesis' research questions.

average hydropower production above 10 TWh/year during the last ten years. These are, in decreasing order of average production, Sweden, France, Italy, Austria, Spain, Germany, Romania, Finland and Portugal (EU 2018a)

[5] Industrial use and extraction of natural resources are present across the globe and include conventional and renewable energy production, fisheries, agriculture, forestry and mining.

Chapter 2 introduces the concept of policy coherence. It elaborates a policy-analytical framework and develops illustrative multiple-case studies that test and elucidate the framework for policy coherence analysis. The chapter illustrates how environmental policy goal conflict is manifested in biodiversity conservation and renewable energy development policies in the EU. It also proposes some possible avenues for increasing policy coherence on an EU scale.

Chapter 3 is a contrasting case study that compares policy outcomes, between Sweden and the US, in terms of river restoration measures affecting hydropower production. The two countries are analyzed as "most similar worlds" since they are both democratic, mature, large-scale hydropower producing countries, with advanced environmental legislation and policies. The analysis reveals a significant difference in river restoration outcomes between the two countries, which the chapter hypothesizes stem from legislative differences. The chapter provides an in-depth analysis of the legislation of the two countries. It attempts to explain the observed discrepancies by referring to differences in the substantive and procedural environmental legislation, which guides the potential use of coercion to implement river restoration measures.

Chapter 4 is a single in-depth revelatory case study of the Ljusnan process, a learning-based intervention to implement environmental policies, which require river restoration measures that affect hydropower production. A framework is created to analyze the Ljusnan process, which is based on the existing literature of social learning in natural resource management and governance. This framework is also used to understand the process' lack of outcomes, in terms of river restoration measures. The analysis reveals that the existing legislation was a significant factor, in understanding the lack of change in target group behavior, despite the Ljusnan process.

Chapter 5 is a single in-depth revelatory case study of urban water services in the Stockholm Region. Four urban water service companies, which provide most of the urban water services in the region, are embedded units of analysis. The policy outcome of interest, in this case, is the extent of climate change adaptation in the water services. As legislation specifically requiring climate change adaptation is lacking in Sweden, organizational learning through acquisition and the use of climate knowledge play key roles in understanding the shape and extent of adaptation outcomes.

Chapter 6 provides the conclusions of this thesis and answers the research questions. The chapter also offers theoretical and methodological reflections and discusses policy and research implications

CHAPTER 2: Understanding policy coherence: analytical framework and examples of sector-environment policy interactions in the EU

This chapter has been published as: Nilsson, M., Tony Zamparutti, Jan Erik Petersen, Björn Nykvist, **Peter Rudberg**, and Jennifer McGuinn. 2012. "Understanding policy coherence: analytical framework and examples of sector-environment policy interactions in the EU." *Environmental Policy and Governance* 22: 395–423.

N.B. Some references have been updated where newer versions of a cited document have become available since the original article was published.

Abstract:

This chapter presents a framework for analyzing policy coherence in a European Union setting through the perspective of policy interaction. Building on a simple policy-analytical approach and theories of institutional interaction, the framework develops a three-step analytical approach, consisting of the inventory of policy objectives, the screening matrix, and a more in-depth analysis of key interactions. Central to the analytical framework is the identification of synergy and conflict at three levels: policy objectives, policy instruments and implementation practices, also taking into account as far as possible also outcome and impacts. The chapter presents illustrative examples from EU renewable energy and cohesion policies in relation to different environmental policy areas such as biodiversity, habitats, resource efficiency and water. It finds that policies are often coherent at the level of objectives, but that associated instruments and in particular implementation practices cause concern for policy conflict in all three examples. Finally, the chapter identifies emerging challenges in the application of policy coherence analysis and a need for further development of the analytical approach.

Keywords: *Europe, coherence, waste policy, cohesion policy, energy policy, integration*

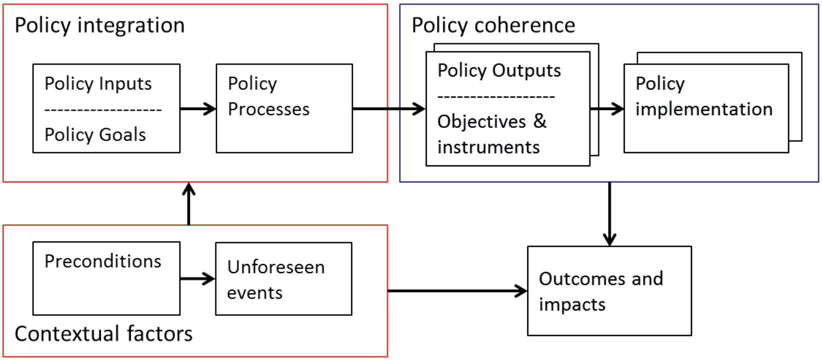
2.1 Introduction

Policy coherence is becoming an increasingly important objective in governance and policy making in the EU and its member states (MSs). Demands for more coherent policy making are frequently made with reference to the ever-strengthening interconnections between different economic, social and environmental policy areas, and the need for smarter regulation. Coherence is pursued not only in relation to improving the environmental sustainability of policies, but also to enhance synergies and reduce conflicts between other interacting policy domains such as fiscal, regional development, welfare and public health policies. Attempts at better coherence have been manifested through, for example, the development of national sustainable development strategies globally, the impact assessment procedure in the EU, and more recently various “road maps” (EU, 2011a; EU, 2011c), the “better regulation” agenda pursued by both the EU and the Organization for Economic Co-operation and Development (OECD) (EU, 2010c), and a growing concern amongst policy makers for systems interaction such as between water, energy and land (see, e.g., Waughray, 2011). The need for coherent policy is being acknowledged in an increasing number of official EU documents (e.g. EU, 2011a; EU, 2011b; EEA, 2010).

Although the objective of policy coherence has long been recognized, little research has been undertaken on the concept, what it means and how it can be assessed. This chapter aims to address this gap, presenting some conceptual foundations for the study of policy coherence and a preliminary analytical approach tested with three illustrative examples. Our approach does not develop a quantitative analytical tool ready for use. Further work is needed to probe into this direction, in dialogue with policy makers, but the multifaceted and qualitative nature of coherence may very well prove incompatible with a "tool", although more numerical proxy indicators can be explored.

We define policy coherence as an attribute of policy that systematically reduces conflicts and promotes synergies between and within different policy areas to achieve the outcomes associated with jointly agreed policy objectives. In the following we discuss the conceptual foundations for this definition. Turning first to the academic field, work on policy coherence has identified different types of coherence, such as horizontal, vertical and internal coherence. The most active debate around policy coherence has taken place in EU law and foreign policy. Summarizing this debate, den Hertog and Stross discuss the legal foundations of policy coherence, in particular relating to external policies (den Hertog and Stross, 2011). Their definition is well-aligned with the approach taken here; "policy coherence refers to the synergic and systematic support towards the achievement of common objectives within and across individual policies" (den Hertog and Stross 2011: 4). They emphasize the need for a multilevel understanding of coherence and look at both vertical coherence (between European and MS policies) and horizontal coherence (between policy areas at one level) (Hoebink, 2004; Nuttall, 2017). Outside the field of EU studies, there has been some work on internal policy coherence, i.e. coherence of a single policy domain. For instance, May et al. (2006) measure factors such as issue concentration (as measured by word counting in bills and hearings), interest group concentration (as measured by participation in hearings) and targeting of groups and entities.

Outside academia, various organizations have addressed the topic. Kumar Duraiappah and Bhardwaj examined development and environment policy coherence at the international level for the International Institute for Sustainable Development, using content analysis of policy documents between fields (Duraiappah and Bhardwaj, 2007). The Food and Agriculture Organization (FAO) (FAO, 2004) discussed coherence between agriculture and trade policies. Like den Hertog and Stross, FAO emphasized the need to tackle both vertical and horizontal coherence. In the field of environment most coherence-related work has been addressed under the banner of environmental policy integration (EPI) (Nilsson and Eckerberg, 2009). From around the mid-1990s, the EU and several of its MSs engaged in strong efforts at enhancing EPI, launching both political initiatives (e.g. the “Cardiff” process), and introducing procedures such as impact assessments and joint preparations (Jordan and Lenschow, 2009). Since then, although the political attention to EPI has diminished (as policy interest moves on to other topics), many procedures have become institutionalized, e.g. via the European Commission impact assessment on policy proposals.



Basic concepts

- policy inputs - knowledge, resources, actors that feed into policy making
- policy processes - procedures and institutional arrangements that shape policy making
- policy goals - strategic targets defined by policy actors (at a general level)
- policy outputs - decisions on objectives and instruments that are meant to achieve policy goals
- policy implementation - arrangements by authorities and other actors for putting policy instruments into action
- outcomes - behavioral changes and responses of actors in society, such as industry or households
- Impacts - environmental and other effects resulting from the outcomes

Figure 2-1: Policy coherence in a policy-analytical framework[6]

The OECD published a checklist for improving policy coherence and integration for sustainable development within the context of good governance (OECD, 2002). OECD’s take on policy coherence focuses on the policy-making process and identifies criteria such as stakeholder involvement, knowledge management, and commitment and leadership as criteria for policy coherence. An EU study on development policy reviewed the coherence of 12 policy areas – including trade, environment, agriculture and energy – with development cooperation, aiming “to build synergies between those policies and development objectives” (EU, 2009d). The study found awareness

[6] Source: adapted from Dunn (2003) and Nilsson et al. (2009).

of the external impacts of policies and recognition of the importance of coherence but also that policy coherence for development was not adequately institutionalized.

Den Hertog and Stross (den Hertog and Stross, 2011) found a lack of delineation between the terms coherence and consistency. Similarly, a potential source of confusion is arguably the lack of delineation between policy integration and policy coherence. As seen above, many coherence studies have tended to focus on procedural aspects (OECD, 2002; EU, 2009d; Kivimaa and Mickwitz, 2013). The approach taken in this study to delineate policy coherence analysis is to focus on policy outputs (including objectives and associated implementation arrangements), whereas policy integration analysis is primarily concerned with upstream policy making processes and the associated institutional arrangements. The separation is a heuristic aid – in reality process, outputs and outcomes are of course closely linked (see Figure 2-1).

Policy-analytical frameworks such as that in Figure 2-1 have in the past been predominantly used to evaluate policy effectiveness. However, while policy effectiveness typically refers to a single policy, policy coherence refers to relationships between policies (as indicated by the “double boxes” in the diagram). A sectoral policy can be effective in achieving its specific objectives without being coherent in relation to the objectives of other policy areas.

Our analysis of policy coherence thus focuses on outputs (including policy objectives as well as policy design and instruments for reaching them) and implementation practices (at different levels). These are linked to integration efforts in policy preparation processes on the one hand, and environmental outcomes and impacts on the other. Thus, strong integration mechanisms in the policy process are expected to help reach more coherent policies, and the degree of coherence between two or more policies will affect outcomes and impacts. Integration analysis, coherence analysis and impact analysis can be seen as part of a wider comprehensive coherence analysis. Following the entire chain from process to impact requires a strong multidisciplinary effort, from political and institutional analysis, through to knowledge and models about the link from policy design and instruments to the behavior of economic sectors and/or individual actors in the ‘real world’. It should be noted that changes in preconditions and unforeseen events can influence outcomes and impacts, requiring a degree of caution in the interpretation of data. It is likely, for instance, that reduced usage of fossil fuels and reduced greenhouse gas emissions in the European Union in recent years have not primarily been the result of an increasingly coherent set of environmental and energy policies, but that in fact a global economic recession and spiraling fossil fuel prices have driven this development independently from policy influence. For example, in 2009, carbon emissions from EU emissions trading system installations fell by 11%, as a result of the recession, actually putting overall emissions below the cap. This is a common problem in policy evaluation methodology, but cannot be avoided as long as a comparison with “policy-off” cases is not possible. However, close knowledge of specific sectors and analytical tools that aim to identify the impact of different influencing factors can help distinguish the effect of policy measures.

2.2 Policy coherence as a problem of interaction within and across levels

Our definition implies that coherence is about eliminating conflict and promoting synergy. Those concerned with the question of how to deal with conflict and synergy between different policies will inevitably come across the question of how policies interact. A growing literature on the functioning of international environmental regimes has taken an interest in the question of interaction (Oberthür and Gehring, 2006). However, questions about interaction apply at any level of institutional structure and policy making. Institutional interaction relates to a cause–effect relationship between two institutions, and will occur if one institution affects the development or performance of another institution (Breitmeier, 2000). Effects may be beneficial, adverse, or neutral for the target institution. Beneficial effects will create synergy between the two institutions because the policy direction of the target institution is supported by measures originating from the source institution. Adverse effects will result in disruption of target institution policies because measures originating from the source institution undermine the effectiveness of the target institution’s own measures (Oberthür and Gehring 2006, 46).

In the context of policy analysis, the equivalent of interactions between institutions can be interactions between policy outputs and implementation practices. Just as improving policy coherence requires addressing integration of the process upstream, dealing with interactions requires processes of deliberation upstream, which has been termed interplay management. Oberthür identifies four levels of interplay management (i.e. efforts to influence the interactions between institutions): overarching management by a hierarchical body; joint management between institutions; unilateral management; and autonomous management (Oberthür, 2009). In our framework, the equivalent of interplay management would thus be integration efforts in the policy making process, such as organizational arrangements and mandates, and administrative procedures such as impact assessments.

As observed earlier, interactions can be studied within a single policy domain (internal coherence) as well as between different policy domains such as between different environmental or sectoral policies (external coherence). As also observed, the analysis of interactions can be applied both horizontally and vertically. Also here there are links with the analysis of international institutions. For example, Young's work on institutional fit, interplay and scale discussed the concept of horizontal interplay (Young, 2002). This is concerned with the relationship between policies at the same level of governance. One example in the EU would be how transport policy instruments negatively or positively affect different EU-level environmental goals. Vertical interplay, on the other hand, refers to relationships across different (spatial) scales of governance. In vertical interplay, for example, international treaties could be in conflict or synergy with EU or national policy objectives or EU or national policy could be in conflict with local and regional policies.

Table 2-1 displays the two dimensions and the resulting four main types of coherence analysis.

Table 2-1: Combinations of vertical / horizontal and internal / external interactions

Policy Dimension	Administrative Dimension	
	Horizontal	**Vertical**
Internal	e.g. local climate change mitigation policy in relation to local air pollution policy	e.g. global climate change policy in relation to EU climate policy
	e.g. national transport access for all in relation to the cost efficiency of national transport budgets	e.g. EU agricultural policy in relation to national agricultural policy
External	e.g. national transport access policy in relation to national air pollution policy	e.g. global trade policy (WTO) in relation to EU climate change mitigation policy
	e.g. EU agricultural production policy in relation to EU climate change mitigation policy	e.g. EU agricultural policy in relation to national water quality targets

Whereas Oberthür and Gehring (2006) do not venture into the question of the different levels and layers of policy making, our framework allows the consideration of different types of interaction going on at different levels of policy making. Therefore, an analysis of the interaction between two (or more) policies will need to take into account these different levels. Taking inspiration from Hall's (1993) work on policy change, which distinguished the analysis of overarching goals, instruments and the calibration of these instruments, the suggested approach here distinguishes between *policy objectives* and *policy instruments* in the “policy output” box. In addition, it treats *implementation practices* as a third observation unit. Here, several decades of implementation research have highlighted how administrators and bureaucrats filter, interpret and distort formal policy in a number of ways that may result in outcomes that differ significantly from the legislators’ intentions (Pressman and Wildavsky, 1973). Furthermore, it is well known in policy making that conflicts are often hidden at the higher levels of abstraction such as overarching goal formulations and strategies, in order to facilitate the adoption of decisions. These conflicts may come to the fore in the selection of instruments and how these instruments are applied “on the ground”. The layered approach (Figure 2-2) allows us to juxtapose not only two or more sets of policy objectives, but also instruments and implementation practices, against policy objectives. As far as data allows, the approach also includes estimated resulting changes in economic sectors and associated environmental outcomes.

This “layered” analysis of coherence, and the horizontal and vertical interactions therein, speaks directly to studies of EU policy implementation and the “Europeanization” process, which attempt to capture the interaction between EU policy and national level policy (Bache and Flinders, 2004; Jordan and Schout, 2012). The multilevel governance character of the EU to some extent reflects the analytical layers from objectives to instruments to implementation practices, where the overarching objectives and overarching types of instruments are set centrally whereas specific instrument design and implementation is defined at the MS or regional level. However, there are certainly variations. For instance, in the case of renewable energy policy, overarching objectives are established at EU level, whereas the MSs decide on the instruments. In the case of cohesion policy, the EU level establishes the instruments, but the MSs decide which objectives to prioritize and how instruments get implemented.

2.3 The three steps of policy coherence analysis

Below we present a simple template for analyzing policy coherence, with three illustrative examples across different policy domains. Our examples draw in particular on the interaction between sectoral and environmental policy at the EU level, i.e. external and horizontal policy interactions (see Table 2-1). The case studies focus on the interplay between objectives, instruments and implementation practices of an economic-sector policy (such as energy) and the objectives of a particular environmental policy (such as the Water Framework Directive). It should be noted that, fitting with the aims and scope of this journal, our coherence analysis emanates from an environmental policy reference framework. The analysis primarily addresses how sectoral policy objectives, instruments and implementation practices interact with environmental policy objectives. Figure 2-2 shows that interactions in both directions are important: from a sectoral policy perspective, one might consider in detail the increasing influence of environmental policy objectives on those reverse relationships in sectoral policy fields, such as the implementation of biodiversity protection policies and how it affects the attainment of agricultural production objectives.

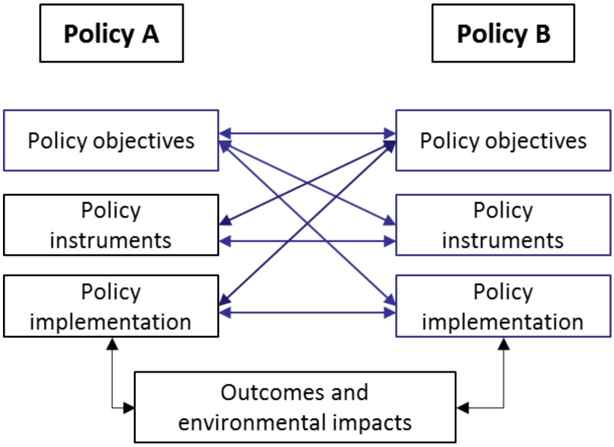


Figure 2-2: Interacting layers of policy from objectives to implementation

The three steps leading to an overall assessment of coherence for two policy fields, are first an inventory of policy objectives, second a review of interactions by way of a screening exercise and third a more in-depth mapping of key interactions.

Step 1. Inventory of policy objectives

The purpose of the inventory step is to get a comprehensive view of the policy objectives of key environmental and sectoral policies. This is a descriptive analytical task and it is analytically undemanding, but it is not a trivial effort, as the subject is both difficult to delineate and constantly changing. Illustrating this complexity, Table 2-1 provides an inventory of the key environmental objectives in four areas (climate change, nature and biodiversity, natural resources and waste, and environment and health), and Appendix 2 shows the inventory of energy policy objectives and instruments as per September 2011.

Step 2. The screening matrix

The purpose of the screening step is to do a "quick-map" of the overall interactions between main areas of sectoral policy activity and (in this case) environmental policy objectives. The main tool is a screening matrix which presents environmental objectives on the horizontal axis and sectoral objectives and policies on the vertical axis. The sectors are sub-divided into their main sub-sectors or objectives. In the screening in this study, sectoral policies are tentatively assessed in terms of (a) the strength of the interaction and (b) their overall coherence with EU environmental policy themes of climate change, nature and biodiversity, natural resources and waste, and environment and health (EU, 2002). The screening matrices display environmental objectives on the horizontal axis – the latter have been coded due to space constraints (see Table 2-2).

Table 2-2: Seventeen overarching EU environmental objectives in the screening matrix

<table>
<tr><th colspan="5">Climate</th></tr>
<tr><td>C1: Reduction in greenhouse gases</td><td>C2: Renewable share of energy</td><td>C3: Reduction in energy consumption</td><td colspan="2">C4: Resilience to deal with climate impacts</td></tr>
<tr><th colspan="5">Nature and biodiversity</th></tr>
<tr><td>N1: Well-functioning natural systems, habitats, wild flora and fauna</td><td>N2: Limiting emissions of eutrophying pollutants</td><td>N3: Reverse negative species trends</td><td colspan="2">N4: Keep fishing within safe limits</td></tr>
<tr><th colspan="5">Resources and waste</th></tr>
<tr><td>R1: Consumption of resources within limits</td><td>R2: Breaking linkage between economic growth and resource use</td><td>R3: Reduction of waste volumes</td><td colspan="2">R4: Waste prevention, reuse, recycle and recover</td></tr>
<tr><th colspan="5">Environment and health</th></tr>
<tr><td>H1: Improving air quality</td><td>H2: Good chemical and ecological status of (inland and coastal) waters</td><td>H3: Making cities more attractive and healthier places to live</td><td>H4: Chemicals used and produced without significant negative impact</td><td>H5: Avoid harmful effects of noise</td></tr>
</table>

The screening is performed as a rapid assessment exercise gathering environmental and sectoral experts in a workshop. The screening as performed in the present study builds on a reference framework on sector-environment interactions that is described in an EU-level environmental assessment by the European

Environment Agency (EEA, 2010). This reference framework provides an essential analytical context within which expert judgement can be developed to determine the level of interaction between each main sectoral activity area and environmental objectives. Experts should be assembled across sectoral areas and environmental themes in such a way that in-depth understanding is available for each sector-environment interaction of interest to the analysis foreseen. A combined panel of scientists and expert policy officers is recommended, with an ideal number of four to eight participants depending on the sector and how multifaceted it is in terms of environmental interactions.

In our illustrative exercise (see results below), the strength of interaction was scored as strong (2), weak (1) or neutral/not known (0). The screening does not analyses the nature of interaction but looks at the importance of each interaction between two policies. Thus it identifies important interactions between sector and environmental policies, their overall strength and likely direction (synergy, +, or contradiction, -), as a precursor for selecting cases for further analysis. The screening results in a matrix that maps key interactions and identifies areas for further evaluation of coherence. The interactions identified for further analysis are not necessarily those where there is a strong interaction (i.e. score 2). Rather, the selection of suggested cases is based on the expert group judgment that there is an interesting interaction identified that, for instance, displays a differential pattern depending on assumptions that need to be made. In a full screening, substantial analysis and supporting data sets could be compiled for each box of the matrix, but such detailed documentation was beyond the resources of this pilot exercise.

Illustrative screening results for cohesion policy

Table 2-3 presents screening results for cohesion policy. In this domain, specific spending plans are set in the Operational Programmes, many at the regional level. A large share of funding is used for infrastructure investments in roads and rail, but also airports, inland water, multi-modal and short sea shipping, water services, waste management, renewable energy, energy efficiency and grid infrastructure. The area “Knowledge and innovation for growth” supports business development. Certain measures directly support improvements in resource efficiency, including environmental management schemes in small and medium-sized enterprises, and support for businesses working on renewable energy, ecotourism or waste reduction. Co-funding support for environmental infrastructure in the field of waste treatment was identified as particularly interesting, displaying a potentially complex set of interactions, in particular in terms of the EU environmental goal of promoting waste prevention, reuse, recycling and recovery. Several other interactions appear as quite important in terms of their interaction with environmental goals. Cohesion policy support for transport infrastructure was identified as having strong links with both climate change goals and those for improving cities. Co-funding support for knowledge and innovation can have wide-ranging implications for the environment: in this area, it should be noted, the Operational Programmes have great latitude in setting the mechanisms and priorities, creating significant complexity for coherence analysis. A similar analytical problem is seen for cross border, transnational and interregional cooperation, an area of cohesion policy that funds a great number of programmes across different policy areas.

Illustrative screening results for energy policy

Table 2-4 presents screening results for energy policy, including four areas of energy policy: security of supply, internal market, efficiency and renewable energy. Within these, 11 relevant objectives were used in the screening. As regards the pure supply security objectives that relate to fossil sources of energy, there are obvious direct conflicts with climate change objectives. Much of supply security policy relates to pipelines and storage. In contrast, efficiency measures have by their nature highly synergistic interactions with various environmental issues, as they reduce overall energy demand. Biomass, biofuels and hydropower were chosen as more interesting areas to examine as they exhibit both synergy and conflict with resource and environmental protection objectives. Another interesting area is the energy market integration policy, and the relationships implied through the development of electricity transmission and distribution infrastructures.

The scoring in Table 2-3 and Table 2-4 was developed in an iterative process between experts in the project team. The individual scores for each cross-relationship evaluated here take account of known sector-environment interactions within Europe but do not include potential knock-on effects outside Europe, as the knowledge about such effects is still too uncertain. Similarly, the evaluation of likely impacts considered only first-order effects but not potential second-order consequences, such as the “rebound effect”. In many instances, there are also different implementation paths for the achievement of individual sector-policy targets, as reflected in the overall score ranges.

Table 2-3: Illustrative screening matrix for cohesion policy

	C1	C2	C3	C4	N1	N2	N3	N4	R1	R2	R3	R4	H1	H2	H3	H4	H5
1. Attractive places in which to invest and work																	
1.1 Expand and improve transport infrastructure	-2/ +1	-1	-1	-1/ +1	-1	-1/0	-1	0	-2/ +1	-2/ +1	-1	0	-2/ +1	-1	-2/ +2	0	-2 / -1
1.2 Strengthen synergies between environmental protection and growth	+1	+1	+1 /1	+1/+2	+1	+2	+1	+1	+1	+1	+1	+2	+1	+1	+1	+1	0
1.3 Address Europe's intensive use of energy	+2	+2	+2	0 / +1	-1/ +1	0 / +1	-1/ +1	0	+2	+2	0 / +1	0/+1	+1	0/+1	+1	0	0
2. Knowledge and innovation for growth	-1/+2	-1/+2	-1/+2	-1/ +2	-1/+2	-1/+2	-1/+2	-1/+2	-1/+2	-1/+2	-1/+2	-1/+2	-1/+2	-1/+2	-1/+2	-1/+2	-1/+2
3. More and better jobs																	
3.1 Attract and retain more people in employment; modernise social protection	0	0	0	0	0	0	0	-1	0	0	0	+1	0	0	0	0	0
3.2 Adaptability of workers and enterprises; flexibility of labour markets	0	0	0	0 / +1	0	0	0	0	0	0	0	0 / +1	0	0	0	0	0
3.3 Increase investment in human capital	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1
3.4 Improve capacity of administrations and services	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1	0 / +1
3.5 Maintain a healthy labour force	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 / +1	0 / +1	0 / +1
4. Territorial dimension																	
4.1 Ensure the contribution of cities to growth and jobs	+1	+1	+1	0	0	0	0	0	-1/ +1	-1/ +1	0	0 / +1	0	0	+2	0	0
4.2 Support diversification of rural areas, fisheries, and areas with natural handicaps	-1/ +1	-1/ +1	-1/ +1	-1/ +2	-1/ +1	+/- 1	-1/ +1	-1/ +1	-/+ 1	-/+ 1	0	-/+ 1	0	-/+ 1	0	0	0
4.3 Promote cross-border and interregional cooperation	0 / +2	0 / +2	0 / +2	0 / +2	-1/ +1	0 / +2	-1/ +1	0 / +2	-1/ +2	-1/ +2	0 / +2	0 / +2	0 / +1	+1/+2	+1/+2	0	0

Table 2-4: Illustrative screening matrix for energy policy

	C1	C2	C3	C4	N1	N2	N3	N4	R1	R2	R3	R4	H1	H2	H3	H4	H5
1. Supply security																	
1.1 Securing gas supply	-1/+2	0 / -2	0 / -1	0	0 / -1	0	0	0	0	0	0	0	+1/+2	-1 / 0	+1/+2	0	0
2. Internal market																	
2.1 Grid Investments/infrastructure	0 / +2	0 / +2	0 / +1	+1	0 / -2	0	0	0	-1/ +1	-1/ +1	0	0	0 / +1	0	-1/+ 1	0	0
2.2 Common rules	+/-1	+2	+2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3. Promoting renewable sources of energy																	
3.1 Biofuels	-2/ +2	+1/ +2	0	-1 / 0	0 /-2	0 / -2	0 / -2	0	+/-1	0	0 / +1	0 / +2	0 / -1	0 / -1	0	0	0
3.2 Offshore wind energy	+2	+2	0	0	0 / +1	0	0	+/-1	0 / +2	0	0	0	+1	0	0 / +1	0	0
3.3 Biomass Developed	-1 /+2	+2	0	-1 / 0	-1/+1	0 / +1	-1 / 0	0	+/- 1	0	0 / +1	+1/ +2	0 / -1	+/-1	0	0	0
3.4 Hydroenergy	+1 /+2	+2	0	-1 / 0	-2 / 0	0 / +1	-2 / 0	0	0 / + 1	0	0	0	+ 1	0 / -2	0	0	0
3.5 Renewable energy general	+2	+2	0	-1 / 0	-2/+ 1	0	-2 / 0	+/-1	-1/ +2	0	0 / +1	0 / + 2	+/-1	-2/ +1	0 /+1	0	0
4. Energy efficiency																	
4.1 Building efficiency	+2	0	+2	+1	0	0	0	0	+2	+1	0	0 / +1	+1	0	0 / +2	0	0
4.2 Co-Generation	+2	0	0 / +2	0	0	0	0	0	0 /+1	0 /+1	0 / +1	0 / +1	+1	0	0	0	0
4.3 Products and Services efficiency	+2	0	+2	0	0	0	0	0	0 /+1	+2	0 / +1	0 / +1	+1	0	0 / +2	0	0

Optional case study selection through a simple data analysis

On the basis of tentative screening results, and as an additional input into the case study selection, a measure of relative need for further work on coherence can be created. This involves dividing interaction by coherence to identify areas where further work is needed. In order to avoid division by zero when performing the arithmetic operation of dividing the interaction score (I) with the coherence score (C), the original score for I in the interval [0, 2] is rescaled to Î [0, 1], and the original score for C is re-scaled from C [-2, +2] to C^ [1, 5]. The resulting measure of relative need for further work is then defined as Î/(C^/5). This measure highlights where further analysis is most warranted. The final measure is in the interval [0, 5], with the least interest in further consideration assumed when coherence is high (rescaled C^=5, original C=2), and the interaction is low (Î =0, I = 0), and the largest interest is presumed when coherence is low (C^=1, C=-2), but the interaction is high (Î =1, I = 2). The data analysis was performed for energy, cohesion, agriculture and transport screening matrices. Figure 2-3 shows that the greatest interest in further analysis was found for agriculture in relation to nature and biodiversity, transport in relation to environment and health, and energy/transport versus climate.

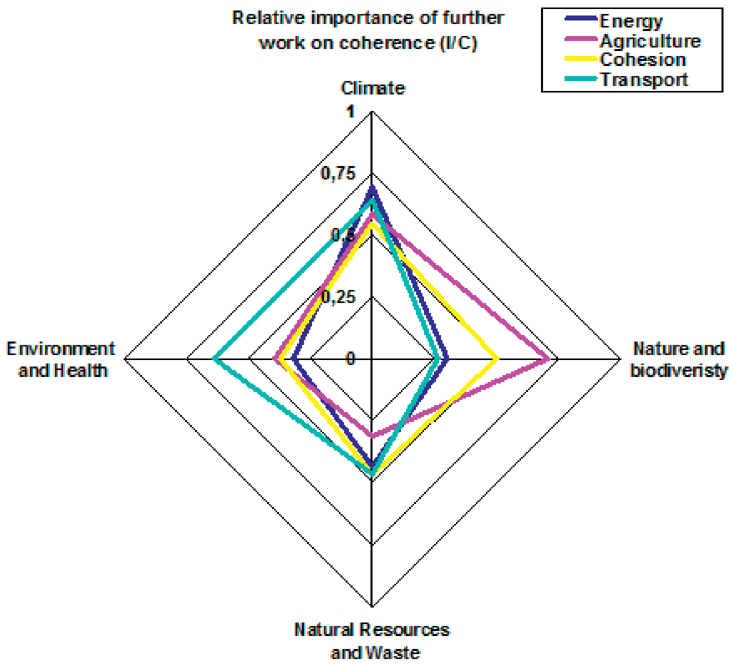


Figure 2-3: Case selection graph

2.4 A closer examination of policy coherence: illustrative examples

Here we examine policy coherence more closely in some of the areas where the screening indicated a high or complex level of interaction. We look at interactions at the level of policy objectives, instruments, implementation and outcomes following an analytical template (Table 2-5). Due to space constraints, the presentations are collapsed into three categories: policy context and focus, assessment of key synergies and conflicts, and implications and opportunities.

Table 2-5: Case study template

Policy background	**Introductory description of the activity in focus and EU policy frameworks steering this activity, including sectoral and environmental policies.**
Overall assessment of interactions	**1. What are the main types of interactions?** What components within the policy domains interact? What are the key environmental physical interactions that the policy relates to and what are the main trends? **2. Interactions of the policy objectives, instruments, implementation** Describe the main interactions. Assess (but do not score) level of coherence: Strong synergy, Weak synergy, Neutral, Weak conflict, or Strong conflict (May be several combinations due to objectives, instruments, implementation revealing differential patterns of conflict and synergy) **3. Outcomes and impacts** Supporting data, assessments or modelling results that describe the sector policy’s actual outcomes and impacts (Basic data to be collected for the entire EU. When it comes to specific interactions, it is often necessary to go into specific member states as examples or case studies.)

Policy background	Introductory description of the activity in focus and EU policy frameworks steering this activity, including sectoral and environmental policies.
Key synergies and conflicts (drilling down in more specific interactions)	What are the key policy interactions, at the level of objectives, instruments and implementation, where there are synergies or conflicts? What is the nature of these interactions? What is the strength and conditionality of these interactions? What is the level of confidence in the analysis?
Opportunities for synergy enhancement and conflict mitigation	Where are the opportunities for mitigation to reduce policy conflict and develop a more synergetic interaction? Where are the opportunities to enhance, develop and achieve stronger policy coherence?
Issues and implications	Concrete and brief recommendations. Could be for a wide range of stakeholders, and a wide range of issues (research and monitoring needs, institutional reforms, process recommendations to make evidence and systems thinking part of the process, safeguards).

2.4.1 Coherence of biofuels promotion in relation to land use change and its impacts on biodiversity

This example discusses the coherence between biofuels promotion in the Renewable Energy (RES) directive, and the EU objectives and legislation on biodiversity and habitats, in particular with regard to impacts resulting from land use change associated with energy cropping for biofuels. Another important policy debate relates to net Greenhouse Gas (GHG) effects from promoting biofuels. Due to space constraints this was not tackled in the current chapter, although climate change in turn can impact on biodiversity. It remains an important issue to be reviewed in further work.

Policy context and focus

In 2009, the EU committed to increase the use of renewable energy as a key strategy in combating GHG emissions. The RES directive (EU 2009a) states that: "Each

Member State shall ensure that the share of energy from renewable sources in all forms of transport in 2020 is at least 10% of the final consumption of energy in transport in that Member State" (Article 3, §4). As part of the EU climate and energy package of 2008, the objective is obviously embedded in the context of climate change, but it also interacts with environmental targets *inter alia* related to land use, and impacts on nature and biodiversity (EU, 2002). These objectives have been updated: by 2050 the aim is that the "…biodiversity and the ecosystem services it provides – its natural capital – are protected, valued and appropriately restored…" (EU 2010b). At the timescale coinciding with the shorter term target of 10% renewable energy in the transport sector (until 2020) a headline target is established that aims at "…halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss." (EU 2000b). Additionally, the habitats directive (EU, 1992) and the birds directive (EU 2009b) constitute key pieces of binding EU legislation related to biodiversity. Several other interactions between bioenergy/biofuels and environmental objectives could be investigated, such as water use and soil conservation, but this case focuses on key interactions between bioenergy and nature and biodiversity – related to land use change as a driver that influences nature and biodiversity objectives.

Key synergies and conflicts

The sub-objective of renewable energy for transport in the RES directive is neutral towards type of primary renewable energy (not only biofuels) and concerns all types of transport technology. Thus, at the level of *objectives*, the interaction is weak. However, the RES directive builds on the previous biofuels directive (EU, 2003b) and the intention to promote biofuels in road transportation for the purpose of climate change mitigation is clear, making the interaction stronger in practice. Assuming that an increased share of biofuels will indeed reduce global GHG emissions and considering possible positive impacts from reduced climate change on biodiversity loss, there are synergies with the objective on nature and biodiversity. However, increased used of biofuels will cause direct and indirect effects on land use, and will likely impact negatively on biodiversity. Impacts from production of biofuels, on nature and biodiversity, have to some extent been considered. Sustainability criteria for biofuels are outlined in terms of direct land use change effects and actual mitigated CO2 emissions, Articles 17-19, and Preamble 65-85). The provision of the sustainability criteria in the RES directive is a first step in defining more environmentally friendly biomass production in agriculture with the aim to prevent potentially negative interactions, and the desire for coherence between the two targets is made explicit in Preamble 44. However, while this suggests policy coherence on the surface, there are limitations to the current criteria, as indirect effects are not addressed by the current policy framework. In reality, the formulation of these criteria is not based on environmental performance only, but reflects political compromises, as more stringent criteria would disfavor e.g. biodiesel produced in Europe.

At the level of *instruments*, few concrete measures are outlined, and instead MSs are given the responsibility for implementation of action plans (Article 4). Therefore, vertical coherence patterns between the EU and MSs are relevant to examine, but cannot be covered here. At the level of *implementation practices*, however, biofuels for transport are dominated by first-generation technologies such as liquid ethanol and bio-diesel (Bringezu et al., 2009, p. 33-34). This translates to increasing use of primarily cereals and sugar cane for ethanol, rapeseed for biodiesel, and imports of palm oil (EU 2008b). The agriculture sector is thus the primary producer of biomass used in biofuels. Few production plants for second-generation biofuels are currently in commercial operation, and successful commercialization will take another decade (IEA, 2008). Thus, current implementation practices require that more land is used to produce biomass for first generation biofuels. The agricultural sector is in turn the key driver behind land use change with substantial impacts on nature and biodiversity.[7] More extensive use of biomass from the agricultural system is associated with a high risk of increasing pressures on land, and land use change resulting in habitat fragmentation (Tilman et al., 2009; Fisher and Lindenmayer, 2007; EEA, 2006). Further increased production of provisioning ecosystem services is also often in direct conflict with good quality of regulating or supporting ecosystem services (WHO, 2005).

The EU biodiversity strategy (see above) as well the EU resource efficiency roadmap (EU, 2011a) establish qualitative policy targets with regard to habitat protection and associated ecosystem services, and they provide a statement of intent to deal with (global) indirect land-use effects of EU policies and supporting global biodiversity protection. In the Council communication from March 2010 it is “recognized” that land-use change is the key driver for habitat destruction and fragmentation of landscapes, but no objectives or instruments are outlined (EU 2010a). In the habitats directive that established Natura 2000 the need for coherence

[7] Concerning net GHG emissions of such increased or converted land use requires careful assessment of indirect land use change, but also the alternative land use (“policy-off option”). The assumption that all bioenergy is carbon neutral is in many ways a flawed assumption (EEA, 2011) and the actual greenhouse benefits of many forms of bioenergy are highly questionable (for recent reports in the context of EU RES see Bowyer (Bowyer, 2011) and Laborde (Laborde, 2011).

with wider land use planning is mentioned (Article 10), but Natura 2000 sites are not primarily concerned with the protection of biodiversity within the broader agricultural landscape (EU, 1992). The coherence between biofuel promotion and land use and biodiversity can hence only be assessed given overarching objectives to halt biodiversity loss. The final outcomes of policy in terms of global direct and indirect land use change are difficult to assess (Bringezu et al., 2009). There is, however, little doubt that future global increases in agricultural biomass production, partly driven by EU policies on biofuels, are likely to increase current global pressures for conversion of forests and grasslands to arable land (Schubert, 2013).

Selected implications and opportunities for enhanced synergy and conflict mitigation

Objectives of the EU biofuels policy are ambitious in scope and timeframe. To achieve their GHG reduction goal the global land use implications of the 10 % target by 2020 need to be put in the context of global land use change and biofuel targets (Petersen, 2008). Indirect land use effects strongly decrease the GHG reduction and need to be included in relevant accounting systems (EEA, 2011).

Policy instruments to safeguard sustainability are necessary, as agricultural biomass production is associated with pressures for land use change and intensity. However, the instruments adopted so far focus mainly on preventing damage rather than on encouraging the most environmentally friendly bioenergy production systems, notwithstanding certain provisions in the sustainability criteria of the RES directive. The considerable range of additional policy instruments at both EU and MS levels could be explored (EEA, 2007).

Implementation practices for the production of biofuels so far give rise to concern. Stronger support for the most effective and/or least damaging biomass crops and sources would be helpful but may raise technology neutrality concerns. Dedicated information about, and practical training in, the most environmentally-friendly energy crops or other biomass sources could complement. Last, the EU needs to follow the evolving scientific understanding, and develop methods to certify and discriminate between different fuels with different impacts. A part of this would be to conduct science-based impact assessments at regular intervals (as prescribed in related legislation).

2.4.2 Coherence of cohesion policy for environment and growth in relation to waste treatment

This example discusses the coherence between cohesion policy co-financing for environmental infrastructure, and the EU ambition to increase the re-use, recycling and recovery of materials, as set out in the Sixth Environmental Action Programme (6EAP) (EU, 2002), the Waste Framework Directive (EU 2008a) and the EU Resource Efficiency Roadmap (EU 2011a).

Policy context and focus

EU cohesion policy, including the European Regional Development Fund, the Cohesion Fund and European Social Fund, represents 35.7 per cent of the total EU budget for the period 2007-2013. EU cohesion policy funds have provided substantial financing for environmental improvements, particularly so through the Cohesion Fund itself, which finances only environment and transport infrastructure. This has been motivated primarily by the desire to assist MSs in complying with the EU *environmental acquis communautaire* in heavy investment areas, including management of waste. The overall objective of cohesion policy, as stated in the Community Strategic Guidelines for 2007–2013, is to support the economic and social cohesion of the EU territory, including the objectives of the renewed Lisbon Agenda, namely maximizing conditions for economic growth and creating more and better jobs (EU 2006b). The key environmental objective contained within the Community Strategic Guidelines is "Strengthen the synergies between environmental protection and growth", meaning that the rationale for supporting environmental infrastructure is expressed in terms of its importance for economic development.

EU environmental objectives for the waste sector are contained in the 6EAP, the Waste Framework Directive and the EU Resource Efficiency Roadmap (EU 2011a). All documents express a preference for waste reduction, re-use and recycling over disposal, based on the waste hierarchy. Recovery such as energy recovery via incineration should be a lower priority, and disposal (e.g. land filling) is the last choice in this hierarchy. Several MSs have largely ended their reliance on landfills for waste management — but others continue to rely on them extensively.

Cohesion policy finances investments for the "management of household and industrial waste". The cohesion policy funds are programmed by the MSs and regions, based on strategic plans (National Strategic Reference Frameworks) and more specific funding documents (Operational Programmes), which contain the specific measures to be financed. These planning documents are based on national laws (conforming to EU directives) and, for the waste sector, the waste management plans drawn up by the MSs. While cohesion policy objectives and implementation modalities are set at the EU level, the actual types of spending and outcome are mainly determined by the MSs and regions that carry out the funding programmes.

Assessment of key synergies and conflicts

At the level of *objectives*, there are clear synergies between cohesion policy and the objective to promote the prevention, re-use and recycling of waste, even though they highlight different rationales (economic development versus environmental protection). The Cohesion Policy Community Strategic Guidelines state that: “In order to maximize economic benefits and minimize costs, priority should be given to tackling environmental pollution at its sources. In the waste management sector, this implies focusing on waste prevention, recycling and biodegradation of waste which are cost-effective and help to create jobs” (EU 2006a).

At the level of *instruments*, the main instruments used in the two types of policy are quite different: financial instruments for cohesion policy compared with legal instruments for EU waste policy. Nevertheless, under the regulations governing cohesion policy funds, the intent is to finance only investments that are in line with EU policy and legal provisions. The level of coherence is therefore again one of synergy. At the level of implementation, the interaction between cohesion policy and the waste legislation becomes more complex. Implementation of cohesion policy is carried out by the MSs and regions and varies considerably from case to case. In theory, to implement cohesion policy, the MSs and/or regions must prepare spending programmes that are in line with EU and national legislation, including other strategic plans such as waste management plans. Indeed, cohesion policy investments have contributed to substantial improvements in waste management that have taken place in recent years (EU 2009c). Waste collection services, particularly in rural areas and much of the EU-12 have been expanded and made affordable for citizens. Many unregulated and unsanitary dumpsites have been closed down and remediated, or replaced with new, modern landfills and more sophisticated integrated waste management centers.

However, MSs do not always focus equally at all levels of the waste hierarchy when preparing and implementing cohesion policy spending programmes; particularly not the first three options in the hierarchy – the prevention, re-use and recycling of waste. Part of the reason for this is a desire on the part of the MSs to absorb as much EU funding as quickly as possible through cohesion policy. If funds are not absorbed, it may negatively impact future funding allocations. The result is tremendous pressure on MSs and regions to focus on large investment solutions for tackling their waste management problems, such as the construction of waste incinerators.

In sum, *horizontal coherence* is seen at the highest level, that of objectives. However, conflicts are stronger when it comes to the level of implementation. These conflicts are seen between waste policy goals and cohesion policy implementation, and thus they extend diagonally across both the horizontal and vertical dimensions. At the same time, there is also an *internal conflict* within cohesion policy, between objectives that are in synergy with EU waste policy objectives and implementation at national and regional levels. The conflict cannot be simply ascribed to one between EU goals and MS implementation: the policy instruments designed at EU level also play an important role.

Selected implications and opportunities for enhanced synergy and conflict mitigation

At the level of *objectives*, the drafting of EU, national and regional plans and proposals for the next financial perspectives and the cohesion policy 2014–2020 programmes will provide an opportunity to enhance synergy by strengthening key environmental references and requirements within planning documents. Indeed, the Commission's proposal (EU 2006c) for the new period includes a stronger overall framework for cohesion policy objectives, based on the EU 2020 strategy; under this framework, environment and resource efficiency are together identified as one of the 11 thematic objectives, thus highlighting the goals and targets provided by the EU Resource Efficiency Roadmap.

At the level of *policy instruments*, it will be important to look more closely into the design of EU regulations and implementation procedures. One important opportunity is to establish stronger references to the use of environmental assessments. The EU directives on environmental assessment of certain plans and programmes (EU 2001a) and Environmental Impact Assessment (EIA) (EU, 1985) serve as safeguards against environmental damage from plans, programmes and projects, and seek to maximize the environmental benefit from planning and investment decisions. In this regard, however, the Commission's proposal for the 2014-2020 funding period calls for the use of SEA in the ex-ante assessment of each Operational Programme 'where appropriate'; the proposal only make this mandatory for transport infrastructure (CEC, 2006c).

Guidance on *implementation practices* could strengthen environmental authorities and stakeholders during the process and assist practitioners to improve results. Moreover, it could be useful to set criteria for funding large-scale investments to encourage a stronger emphasis on cost effectiveness and cost recovery for investments that receive support. This may include ceilings for co-financing contributions, revision of minimum project size requirements and other specific parameters. This could remove some of the incentives for MSs to prioritize large-scale infrastructure over alternative solutions with less reliance on disposal.

2.4.3 Coherence of renewable electricity promotion and inland water protection

Policy context and focus

The RES directive (EU, 2009a) establishes a common framework for the promotion of energy from renewable sources and sets mandatory national targets consistent with a 20 per cent share of energy from renewable sources. The directive is an important part of the package of measures needed to reduce greenhouse gas emissions within the EU and a measure to increase security of supply. The WFD (EU, 2000) concerns the protection of inland surface waters, transitional waters, coastal waters and groundwater, which protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and wetlands directly depending on them. The WFD is a response to trends of deteriorating status of water and increasing scarcity due to pollution and high uptake of freshwater in the EU. The overarching goal is for all water bodies to achieve good chemical and ecological status by 2015, with the possibility of extending the timeframe for reaching these targets until 2027.

Wind power, which represents the main part of *growth* of production capacity of renewable energy since 2001, growing by 47 Gigawatt (GW) and reaching a total of 65 GW, has limited effect on water quality. The main part of renewable electricity production capacity in the EU, however, comes from hydropower, 143 GW, where the potential for conflict between these policies is substantial (EU, 2018a). Hydropower stations and dams lead to fragmentation and deterioration of aquatic habitats which has a negative effect on aquatic biodiversity and habitats (Rosenberg et al., 1997; Bunn and Arthington, 2002; Abell, 2002). Storage hydropower stations can respond flexibly to peaks in power demand, and with an increasing incorporation of intermittent power sources, such as wind power, the value and importance of such balancing capacity will increase (Holttinen and Hirvonen, 2005; Bélanger and Gagnon, 2002). The potential for further construction of large hydropower stations (which represent about 90% of total production) in the EU is limited. However, there is a potential for around 5 per cent growth from refurbishment of existing facilities (EU, 2011b).

Assessment of key synergies and conflicts

At the level of *objectives*, there are no immediate conflicts in coherence between RES and WFD since they are both directed at prioritized (and positively linked) environmental objectives such as biodiversity conservation, human environment and health and greenhouse gas reduction. At the level of *instruments*, RES is primarily handled by MSs through feed-in tariffs, certificate schemes and other measures that provide incentives for increasing renewable energy production, such as hydropower, solar and wind. The WFD introduces national monitoring programs in each MS to classify the status of each water body according to a five-class scale (EU 2009e). MSs develop river basin water management plans, including programmes of measures and specify the measures that are needed within each water basin to reach the goals of the WFD. At one level, the interaction between the instruments of the directives is relatively neutral, since there are a number of instruments in the WFD, such as the designation of heavily modified and artificial water bodies with less strict quality requirements, designed to reduce contradictions with other societal needs such as electricity production. There is also the possibility of exemption for specific water bodies if the achievement of the objectives of good water quality would be infeasible or disproportionately expensive (Article 4:5). This allows maintaining or modifying existing hydropower installations. At a second level, however, the WFD requires MSs to work on achieving or maintaining good ecological status. This implies a significant barrier for the installation of new hydropower schemes, even if small, as they generally impact on water flows and morphological structures in flowing waters, which are crucial parameters for achieving good ecological status.

The *implementation practices* in RES and their relation to the WFD show a mixed picture when it comes to vertical coherence, since implementation, to a large extent, is decided by individual MSs with their own legal and administrative systems. Due to space constraints the analysis will however focus on the horizontal coherence of implementation in the EU generally. The EU Directive on Electricity Production from Renewable Energy Sources, in place since 2001, provides an opportunity to analyses implementation practices. The WFD was passed in 2000 but the finalized river basin management plans, including programmes of measures, were only recently released. This limits the amount of information on implementation practices.

The implementation of the WFD will probably differentiate between existing and new hydropower stations. With existing hydropower stations the environmental damage has already been done and the impact of particularly large hydropower stations is usually large enough to lead to the surrounding water to be classified as “heavily modified”. This entails less strict measures, which should not have significant adverse effects on energy production from hydropower. It is however likely that some quality improving measures will be needed even in heavily modified water, which could result in some loss of energy production (Ecologic, 2009).

Selected implications and opportunities for enhanced synergy and conflict mitigation

At the level of *objectives*, further specifications could be made to identify those renewable energy options and related infrastructure that have the least impact on the aquatic environment. For example, further preferential expansion of sources of renewable energy that do not negatively affect the aquatic environment, such as wind and solar energy, would limit the conflict between the two directives. In addition, alternative ways of balancing the energy system, such as strengthening grid transfer potential and creating smart grids, could decrease the need for balancing power such as storage hydropower as a result of the expansion of wind power.

At the *policy instrument* level, a possibility is to use part of the increased energy producing potential from refurbishment of existing hydropower stations for improvements of the aquatic environment necessary to reach good ecological potential. Capacity enhancement could lead to both increased energy production and improved water quality (Rudberg, 2011). One mechanism could be to develop a jointly managed private-public fund based on fees from hydropower production, from which grants can be provided for investments in enhancing aquatic ecosystems functions during refurbishment.

Implementation practices at the EU level would benefit from sharing examples of good practices in hydropower planning and construction between MSs. Ideally, this would involve stakeholders as well as planning and construction companies. At national and regional levels, to establish platforms for sharing of insights and experiences from water basin management plans with public and private actors in the energy sector would also be a useful tool for minimizing possible conflicts.

2.5 Discussion and conclusion

This chapter has presented a novel yet relatively simple policy-analytical approach to assess policy coherence. It demonstrates how policy coherence can be conceptualized as a problem of policy interaction at multiple levels, and how policy coherence analysis entailing three steps can be performed. Based on existing debates, we have established that policy coherence can be analyzed vertically and horizontally, as well as externally and internally. In principle, therefore the analytical approach can be applied between any two interacting policies, such as two sectoral

Table 2-6: Summary account of policy coherence cases examined

Case	Objectives	Instruments	Implementation
Bioenergy promotion versus greenhouse gas mitigation and land use change	Synergy	Neutral or weak synergy	Neutral or weak conflict
Biomass promotion versus biodiversity	Weak synergy - stated as requirement	Neutral or weak synergy – under development	Range from weak synergy to strong conflict
Renewable electricity promotion versus water quality	Strong synergy	Neutral	Range from neutral to potential strong conflict
Transport technology innovation versus healthy cities and greenhouse gas mitigation	Strong synergy	Strong synergy	Strong synergy
Transport price signals versus air quality	Strong synergy	Strong synergy	Weak synergy (pricing not sufficient to cover social costs)
Agriculture production subsidies versus biodiversity	Neutral	Now neutral but conflict from past practice	Conflict
Rural development support versus climate adaptation and water scarcity	Neutral but probably moving towards weak synergy	Weak synergy – White Paper notes relevance but measures still under development	Data not available
Cohesion policy, environmental protection, growth versus waste prevention, reuse, recycling and recovery	Strong synergy	Neutral to weak conflict	Range from strong synergy to strong conflict
Cohesion policy, innovation, growth versus resource efficiency	Synergy	Neutral	Range from synergy to weak conflict
Cohesion policy versus transport infrastructure and land use	Weak synergy	Weak synergy	Range from strong synergy to weak conflict

policies or two environmental policies at or across levels of governance. Our examples however have focused on horizontal / external coherence, i.e. interactions between environmental and sectoral policies at the EU level. With this focus, we have analyzed coherence at three (related) levels: policy objectives, policy instruments and implementation practices. The consequences of different implementation practices have been considered in the context of a reference framework that enables an estimation of their likely outcomes and impacts on the environment.

The examples found variations in coherence when moving from objectives to instruments and through to implementation practices. The biofuels and land use/biodiversity example showed a neutral to potentially positive interaction in policy objectives and instruments but a conflict in implementation, partly due to the heavy reliance on first-generation biofuels. The cohesion policy and waste example also showed neutral to positive interaction in policy objectives and instruments, but a mixed picture in implementation due to the unwieldy implementation and funding priorities made by MSs. The renewable electricity and water example showed neutral to positive interaction in policy objectives and in policy instruments to reach the objectives but a clear risk of conflict in implementation mainly in relation to hydropower.

Although three cases will not support claims of representativeness, it is worth noting that the cases were highlights among a larger selection of cases in our study (see Table 2-6) that could not be accounted for in this chapter. However, the wider sample confirms the pattern. In most sectors, there is a relatively limited set of conflictual interactions at the level of objectives. For the most part, policy objectives are formulated in line with overarching EU sustainable development priorities and are held at a general level. Conflicts emerge more clearly in the energy and agriculture policy domain than in transport and cohesion policy, but even in these domains they are limited. Also, most instruments in their general form do not signal that there are many conflicts. However, when it comes to implementation either at the EU or at the MS level, potentially strong conflicts come to the fore. Some of these conflicts can be attributed to instrument design and guidelines and some relate to interpretations by MSs because of national priorities.

The growing interest in improving the process of policy making, through impact assessments and strategic environmental assessments, has been the result of a growing concern for better regulation and more evidence-informed decision making. Policy process analysts (such as those concerned with environmental policy integration) have often posed serious critiques on these processes, including, for example, how ex ante impact assessment has been used and even abused (Nilsson et al., 2008). The present study on the other hand suggests that policy processes that have often been criticized for their weak integration mechanisms appear to have still been able to deliver relatively coherent policy objectives. The apparent lack of conflict can in part be attributed to objectives being sufficiently vague to be able to pass in the legislative process.

This shows how important it is to develop analytical concepts that allow an evaluation of policy coherence down to the level of implementation practices and outcomes. However, it still begs questions on whether policy outputs follows linearly from process, as conventional policy-analytical theory would typically assume, and, following this implication, although somewhat uncomfortable for this group of authors, what role policy integration processes really play in shaping policy outputs. There are however more indirect and long-term benefits of policy integration processes such as joint learning and long-term alignment of overarching objectives across sectors (Nilsson, 2005).

In addition to following policies unfolding from objectives to implementation it is necessary to follow how this sequence unfolds across levels of governance from EU to the MS and, where appropriate, local levels. Here, the respective roles of MSs and the EU in instrument design and implementation differ significantly between policy areas. Many EU policy instruments, both environmental and sectoral, are designed to give considerable flexibility to MSs in deciding how to develop regulations and practices at the national level and how to apply the instruments. This is particularly clear in the case of funding instruments within agriculture (rural development pillar) and cohesion policy, but it is similarly applicable to, for example, renewable energy policy, where most instruments and implementation practices still remain a national affair. For cohesion policy, there is a high variability depending on national and regional decisions in implementation. Some instruments are fully designed and implemented at regional or local levels. Thus, whether there is synergy or conflict is often strongly dependent on various choices made, interpretations of how the rules apply at MS and lower levels, and what technologies and mitigation options are applied at the stage of implementation.

Four analytical challenges came to the fore in this first study, and point to further needs for methodology development.

The first concerns the timing of the study and its study objects, and how to address outcomes and impacts in relation to this time frame. Our focus was on current policy objectives, instruments and implementation practices. Still, many EU policies have undergone reform in recent years: for example, the Common Agricultural Policy was revised in 2003 and saw further updates in 2008, while debate is now underway on further reform by 2013. Biodiversity policy has also evolved in recent years; in March 2010, the European Council issued ambitious objectives for 2020 and 2050. Coherence analysis can review such changes relatively easily when looking at objectives and also instruments, for example in policy documents and legislation. However, implementation takes time, and depends crucially on interactions between governments and stakeholders; and tracing outcomes and impacts requires an even longer time scale. Thus, one challenge in developing coherence analysis further – in particular at the level of outcomes and impacts – will be to factor in these time lags.

Second is the need to systematically address system boundaries, not only in time but also from a life-cycle perspective. For instance, a full life-cycle approach to technologies promoted will give different results from a more narrow approach. Similarly, the choice of geographical boundaries will affect the pattern of interaction with other policy areas. Upstream activities in for instance energy production (which may occur in countries far away) often result in pollution and resource degradation.

The third challenge is that the estimation of the outcomes on the behavior of economic actors as well as subsequent environmental impacts requires a reliable reference framework that covers the policy-economy-environment chain. Analytical frameworks such as the DPSIR model help in that endeavor but they need to be coupled with qualitative and quantitative models that describe and analyses current and future linkages between sectors and the environment. All available tools have shortcomings: with regard to input data, conceptual models employed, the parameters investigated, and particularly with analyzing cross-sectoral linkages. Policy coherence analysis needs to build on previously investigated interactions and sometimes work with multiple potential outcomes.

The fourth challenge concerns interactions between multiple policies. This study has looked at the intersections between pairs of policy areas: individual environmental policies and individual non-environmental policies. Several case studies, however, highlighted the importance of interactions between multiple policy areas. For example, the case study on coherence between agricultural and biodiversity policy notes that energy policies that promote biofuels will influence the linkages between agricultural production and biodiversity. Indeed, to determine effects of multiple policies at the level of outcomes has been long recognized as a central challenge in policy analysis more broadly.

It should be noted that the framework applies an admittedly simplistic and instrumental-rationalist view on governance. In reality, efforts towards policy coherence, be it at national, EU or global levels of governance, will be advanced in a political context where multiple actors, with competing interests and ideas, battle to get their views represented in policy decisions. Policy making then becomes not an evidence-based and rationalistic process in pursuit of common goals, which is often implicitly assumed in the integration and coherence tool box, but a political and contested process. From such a perspective, coherence takes on a different complexion – relating to balancing of interest groups and power politics as it is played out between different actors at different levels for political purposes.

The wide embrace of the coherence agenda is of course related to political opportunities as it directly seeks out the possibility of synergies between policy domains which tends to remove or weaken interest conflicts. At the same time, a broader range of governance mechanisms and arrangements to orchestrate the coordination between the public and private spheres are now being called into action to advance coherence and sustainable development, involving a wider set of actors, scales and modes of governance (Paavola et al., 2009). Considering that governance typically denotes not just the policy, but also the polity and the politics, a more comprehensive approach to "coherence governance" can be elaborated. However, broadening the approach would entail trade-offs in terms of analytical clarity.

Further development of the analytical approach is needed. This will surely identify further challenges and shortcomings that could be used to refine the framework to policy coherence analysis, both towards a more complex representation of policy making and (although probably not at the same time) towards a more concrete and formalized tool. Such developments should be made in a transdisciplinary setting, involving with more depth the policy makers and desk officers as the ultimate users of policy coherence analysis.

CHAPTER 3: Mitigating the Adverse Effects of Hydropower Projects: A Comparative Review of River Restoration and Hydropower Regulation in Sweden and the United States

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Abstract:

Hydropower involves two of the most pressing global environmental challenges of modern society–accelerated biodiversity loss and climate change. On one hand, hydropower provides a reliable source of renewable energy. On the other, it contributes to significant biodiversity loss in freshwater ecosystems. Mature hydropower producing countries must increasingly restore habitats damaged by existing hydropower projects while attempting to increase their production of renewable energy. Meanwhile, developing hydropower countries are only beginning to craft regulations for their burgeoning hydropower industries.

This chapter evaluates the application of environmental laws to hydropower projects in Sweden and the United States, comparing the relative contribution of each regulatory program to river restoration. It concludes that the United States has achieved greater ecosystem restoration, primarily due to its hydropower licensing framework. In the United States, regulators issue licenses for a limited term of thirty to fifty years. After the license expires, the operator must obtain a new license compliant with current environmental laws. In Sweden, licenses are perpetual, and only the environmental laws in effect at the time of the original licensing bind dam operators. Countries can strengthen laws governing hydropower operations by learning from the different extent of river restoration in these two similarly situated hydropower-producing countries. To improve hydropower regulation in developed countries and to create effective regulations in developing countries, the following two elements are essential: (1) mandatory, periodic review of licenses to adapt to new laws, changed circumstances, and scientific improvements; and (2) placing the burden of proof on project operators to demonstrate that a given project serves the public interest.

This chapter first discusses the conflict in hydropower regulation: fostering power generating technologies with limited carbon emissions versus protecting river ecosystems. It then compares hydropower productivity and river restoration in Sweden and the United States–two similarly situated hydropower-producing countries. The chapter then compares the differing procedural and substantive laws and regulations in Sweden and the United States before explaining how different environmental laws in the two countries results in different extent of river restoration. Ultimately, the chapter finds that the United States' system affords greater long-term environmental protection, a conclusion that offers suggestions for both developed and developing countries alike to craft and update hydropower policies.

3.1 Introduction

Hydropower is a competitive source of electricity production, comprising more than 16% of the electricity generated worldwide (Moller, 2015; ICOLD, 2015). Hydropower is a renewable source of energy and can be readily dispatched to balance the electric grid by meeting fluctuating demand and supply (IEA, 2012). At the same time, hydropower projects also have negative social and ecological effects (e.g. see Goldsmith and Hildyard, 1995; Rosenberg et al., 1995). Measures to protect and restore the environment can limit the expansion of hydropower despite its positive attributes.

This conflict is particularly acute when building new hydropower projects (Jackson, 2011). The US Department of Energy recently estimated that the capacity for new stream-reach development in the United States is 84.7 GW, with total undeveloped generation estimated at 460 Terawatt hours (TWh) per year (Kao, 2011). However, the estimated capacity falls to 65.5 GW by excluding federally protected areas. This figure is only slightly lower than the combined existing hydropower capacity in the United States (Kao, 2011).

There is also significant potential to increase hydropower capacity by upgrading existing projects within mature hydropower producing countries. In Sweden, upgrading medium- and large-scale facilities would result in an additional 3 TWh per year, representing an increase of almost 5% in hydropower production (Rudberg, 2013). Between 2003 and 2012, upgrades to existing projects resulted in a production increase of 337 Gigawatt hours per year in Sweden (Rudberg, 2013). In the United States, production capacity has increased by 3.51 % from 1986 to 2001 through capacity increases incident to relicensing (FERC, 2001). The US Department of Energy estimates that there is an additional potential 12.1 GW of hydropower capacity at the 54,000 dams in the United States that currently do not produce hydropower (Hadjerioua et al., 2012).

Although there is important potential for expanded production by upgrading existing hydropower facilities across the United States (DEA, 2009), there is increased recognition that the benefits of such expansion must balance the environmental costs. For example, expansion in regions with high fish endemism would become subject to regulations to avoid further harm to imperiled aquatic resources (McDonald et al., 2012).

As of March 2014, there were 3,700 hydropower projects with a capacity of greater than 1 Megawatt (MW) planned (83%) or under construction (17%) globally (Zarfl et al., 2014). If completed, these projects would increase global hydropower capacity from 980 GW in 2011 to 1,700 GW. However, the expansion would result in the fragmentation of 25 of the 120 large river systems currently classified as free flowing, primarily in South America - a loss of 21% of large, free-flowing river systems worldwide (Zarfl et al., 2014).

As shown in mature hydropower producing countries, dam-related habitat fragmentation and altered flow regimes disrupt freshwater ecosystems by, among other things, preventing freshwater species from migrating above and below dams (Nilsson, 2005; Malmquivst and Rundle, 2002; Nilsson, 1997). These effects make hydropower projects one of the biggest causes of freshwater species loss globally (Dudgeon et al., 2005; Vörösmarty et al., 2010). Global species loss occurs at a rate that some consider more alarming than the rate of climate change (Rockström et al., 2009).

A country's regulation of hydropower necessarily strikes a balance between promoting renewable, low-carbon energy and protecting river ecosystems. This chapter evaluates this balancing by comparing the hydropower regulations and river restoration efforts in two countries, the United States and Sweden. It concludes that effective regulation must include: (1) mandatory periodic review of licenses to adapt to changed circumstances and improved science; and (2) placing the burden of proof on project operators to demonstrate that the project is in the public interest.

This chapter looks at Sweden and the United States because both are mature, democratic hydropower producing countries. In 2010, the United States was the fourth-biggest producer of hydropower globally, and Sweden was the tenth-largest producer (IEA, 2012). Sweden is a good case study because it is subject to European Union Directives, represents the European Union more broadly, and is one of Europe's most important hydropower producers. Both Sweden and the United States have environmental regulations established in the 1970s, including those for the protection of threatened and endangered species (US, Endangered Species Act of 1973; EU, 2000; EU, 2009a). Additionally, water regulation and fragmentation from dams impact a similarly high share of the largest river systems in each country (Dynesius and Nilsson, 1994).

This chapter addresses three questions: (1) Are there significant differences in river restoration measures at hydropower projects in Sweden and the United States? (2) If there are significant differences, to what extent can the differences be attributed to differences in procedural laws? (3) To what extent can the differences be attributed to differences in substantive laws?

To answer the first question, the chapter compares specific river restoration measures–dam removal, construction of fish passage facilities and fish screens, and minimum flow releases requirements–because they directly mitigate the flow regime change and habitat fragmentation caused by hydropower projects (Bernhardt et al., 2007). Compared to Sweden, the United States has implemented more of these measures, causing a slight reduction of hydropower productivity. To answer the second question, the chapter reviews and compares the procedural laws of the two countries with a focus on hydropower license review, including the term of granted licenses and the burden of proof in license review and relicensing proceedings. To answer the third question, the chapter reviews and compares substantive laws of the two countries with a focus on standards for biodiversity protection, renewable energy promotion, and climate change mitigation, as well as legal principles such as "polluter pays." While both Sweden and the United States have substantive laws that are similarly protective of aquatic ecosystems, their procedures for licensing hydropower projects differ in key respects, which explains the different extent of restoration. Specifically, the United States requires periodic review of licensed projects (USC, 2015)[8] and puts the burden of demonstrating that the project is in the public interest on the project operator as the license applicant (USC, 1966).[9] Incorporating these procedures into the hydropower regulations of other countries should result in similar environmental results.

3.2 Hydropower production and restoration measures

This section first discusses the prevalence of hydropower and the basics of licensing in Sweden and the United States. It then compares hydropower production and the extent of environmental restoration in each country by quantifying the following: the number of hydropower licenses in each country; the number of licenses reviewed in a twenty-year period; the number of environmental measures implemented as a result of the license reviews; and the reduction in hydropower production resulting from the implementation of the environmental measures.

There are significant differences in river restoration measures between Sweden and the United States–particularly concerning incidents of project decommissioning in the United States, which are sometimes for failure to satisfy new requirements from relicensing or license amendment. For example, in 2009, one of several river restoration projects in the United States began on the Elwha River in Washington (Kober, 2015). The project involved decommissioning and removing two medium-sized, functioning hydropower dams (108 and 210 feet tall) with a total installed capacity of 28 MW (Kober, 2015). Most recently, the Federal Energy Regulatory Commission (FERC) revoked a license and decommissioned a project for failure to

[8] 16 U.S.C. § 808 (2015).
[9] 5 U.S.C. § 556(d) (1966)

construct fish passage facilities required by a license amendment to upgrade capacity (FERC, 2014). Reports and scientific articles from Sweden do not discuss any similar dam removals as a result of a revoked hydropower license. There is only evidence of one recent failed process in court to revoke a granted hydropower license (Harning, 2014).

This chapter empirically evaluates the extent of river restoration activities using reports from relevant administrative and regulatory bodies as well as scientific articles. In Sweden, the analysis focuses on all of the hydropower projects, which are regulated by the Land and Environmental Court (SFS, 1998a).[10] In the United States, the analysis focuses on non-federal hydropower projects licensed by FERC.[11]

3.2.1 Production, Capacity, and Licenses

Sweden and the United States are similarly developed hydropower-producing nations, making them effective for comparing hydropower projects. For example, water regulation and fragmentation from dams impact the large river systems in both countries to a similar extent (Dynesius and Nilsson, 1998). Sweden has approximately 2,100 hydropower projects and the United States approximately 2,400 (Holmgård et al., 2009; Hall and Reeves, 2006)). The total hydropower production capacity is 16 GW in Sweden and 75 GW in the United States (Löv et al., 2013; Hall and Reeves, 2006).

In Sweden, multiple licenses[12] can be issued to regulate different aspects of the same hydropower project (Holmgård et al., 2009). In the United States, a single license regulates all aspects of project construction, operation, and maintenance (USC, 2015).[13] FERC may even regulate multiple dams under a single license if the dams operate as a "complete unit of development." (USC, 2015).[14]

Thus, except for a few differences, Sweden and the United States are equally situated as developed countries with high levels of hydropower development subject to licensing regulation.

[10] 24:1
[11] As under the U.S. Federal Power Act, the term "hydropower project" includes the dam, powerhouse, reservoir, and any other structures, rights, lands, and waters regulated by a license or exemption (See 16 U.S.C. § 797(e) (2015)). Hydropower projects are classified by capacity using the following terminology: "Mini" up to 1.5 MW, "small" up to 5 MW, "medium" up to 30 MW, and "large" more than 30 MW.
[12] The term hydropower license is used with the same meaning as "permit for water operation," the formal legal term in Sweden.
[13] 16 U.S.C. §§ 796(11)-(12), 797(e) (2015).
[14] 16 U.S.C. §§ 796(11)

3.2.2 River Restoration Measures

In Sweden, the Land and Environmental Court decides river restoration measures related to fish and biodiversity through adding new conditions in a license review trial (SFS, 1998a).[15] Between 1990 and 2010, the Court reviewed a total of 90 hydropower licenses, resulting in 132 biodiversity and fish improvement measures (Hedenskog and Monsén, 2012). So far, there is no evidence that the Land and Environmental Court has required any dam removals through a license revocation process (Harning, 2014).

In the United States, FERC issues licenses for periods of thirty to fifty years (USC, 1966).[16] Once a license expires, the project operator must apply for a new license through the relicensing process (USC, 2015).[17] During relicensing, FERC evaluates the project and determines whether continuing to operate the project is in the public interest and, if so, under what conditions (USC, 2015).[18] Prior to approving a license, FERC may require "modification of any project and of the plans and specifications of the project works" to ensure the project is, in FERC's judgment, best adapted to a comprehensive plan of development for the affected waterway (USC, 2015).[19]

Between 1990 and 2010, FERC relicensed 501 hydropower projects.[20] A nationwide study of 363 relicensings between 1987 and 2000 revealed that FERC approved 142 fish passage improvements in 112 projects (FERC, 2004).[21] Another study reported that at least 600 dams were removed in the United States (Pittock and Hartmann, 2011; Pohl, 2012), 19 of which were removed via FERC relicensing decisions from 1996 to 2005 (Pittock and Hartmann, 2011).

In Sweden, between 1990 and 2010, the total loss of hydropower production due to minimum flow requirements added in license reviews of existing hydropower projects was only 0.02% of the total hydropower production in an average year (Hedenskog and Monsén, 2012). By comparison, a 2001 FERC study found that, of the 246 relicensings between 1986 and 2001 in the United States, the average annual generation loss from relicensing was 4.23% (FERC 2001).[22] Assuming the 246 relicensings between 1986 and 2001 are representative of production for all existing

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[15] 24:5
[16] 5 U.S.C. § 556(d) (1966)
[17] 16 U.S.C. § 808(a) (1) (2015).
[18] 16 U.S.C. § 808(a) (2) (2015)
[19] 16 U.S.C. § 808(a) (2) (2015)
[20] For a complete list of licenses issued by FERC, see (FERC, 2015a).
[21] There is no complete national database of river restoration measures resulting from relicensing, so this chapter relies on various studies that provide a reasonable overview of the situation.
[22] This figure includes Seattle City Light (71 FERC ' 61,159), although FERC argues it is atypical.

non-federal hydropower projects, the total estimated production loss from relicensing was approximately 0.5%.[23]

3.2.3 Findings

The data extrapolated from the various reports on license reviews and relicensings demonstrate significant differences in the number of projects reviewed and the number of river restoration measures implemented in two countries.

As shown in Table 3-1, the most striking difference is that, in Sweden, only 2% of total hydropower licenses (90 hydropower licenses in total) were reviewed between 1990 and 2010, while in the United States, 28% of non-federal hydropower licenses were reviewed (501 licenses in total).

The second significant difference between the two countries illustrated by Table 3-1 is that Sweden did not decommission or remove any dams as a result of license revocation, but the United States has done so. Table 3-1 also displays significant differences in the total production loss from hydropower license revisions; with production loss many times higher in the United States over fifteen years of relicensing than in Sweden over twenty years of license reviews.

While both countries are mature hydropower-producing countries that require licenses and have stringent environmental laws, the United States requires more frequent license review. As a result of these mandatory reviews, the United States has implemented more environmental restoration measures than Sweden with a greater cost to hydropower generation.

Table 3-1: Hydropower license and river restoration statistics in Sweden and the US

Hydropower license and river restoration statistics	Sweden	United States
Licensed capacity (GW)	16[24]	75[25]
Hydropower (percentage of electricity production)	42.2%[26]	7.6%[27]
Hydropower produced in 2010 (TWh)	67[28]	328[29]

[23] Two hundred forty-six relicensings out of 1,245 FERC licenses represents 20% of production in Commission-licensed projects. This, in turn, represents 11% of total hydropower production in the United States. In 2010, 1,245 Commission-licensed hydropower projects generated 57% of total hydropower production in the United States. (See Bracmort et al., 2017). Production loss of 4.23% out of 11% equals approximately 0.5% loss of total production.
[24] Löv et al., 2013
[25] Hall and Reeves, 2006
[26] IEA, 2012
[27] IEA, 2012
[28] IEA, 2012
[29] IEA, 2012

Hydropower license and river restoration statistics	Sweden	United States
Approximate number of hydropower projects	2,100[30]	2,370[31]
Licenses and exemptions	3,700[32]	1,700[33]
Licenses reviewed between 1990-2010	90[34]	501[35]
Fish passage measures required after review	29[36]	142/363[37]
Minimum flow measures required after review	64[38]	12/13[39]
Dam removal required after review	0[40]	19[41]
Average hydropower loss from license review (percentage per individual project)	<5%[42]	4.23%[43]
Approximate production loss from license review (percentage of national annual hydropower production)	0.02%[44]	0.5%[45]

3.3 Hydropower Regulation

This section compares the laws in Sweden and the United States that led to the different extent of river restoration described in section 3.2. Section 3.3.1 first examines the procedural and substantive laws governing hydropower production in Sweden. The discussion of substantive laws in Sweden includes both Swedish national laws and mandatory European Union Directives. Section 3.3.2 then highlights the key procedural and substantive laws governing hydropower production in the United States.

The review of substantive laws focuses on standards for biodiversity protection, renewable energy promotion, and climate change mitigation, as well as legal principles such as "polluter pays." The review of procedural laws highlights

[30] Holmgård et al., 2009
[31] Bracmort et al., 2015; Hall and Reeves, 2006
[32] Holmgård et al., 2009
[33] Bracmort et al., 2015
[34] Hedenskog and Monsén, 2012
[35] For a complete list of licenses issued by FERC, see (FERC, 2015a)
[36] Hedenskog and Monsén, 2012
[37] FERC, 2010 (the denominator changes as the number of fish passages were analyzed for the period between 1987 to 2002)
[38] Hedenskog and Monsén, 2012
[39] Moyle et al., 2011
[40] Harning, 2014
[41] Pittock and Hartmann, 2011
[42] Hedenskog and Monsén, 2012
[43] FERC, 2001
[44] Hedenskog and Monsén, 2012
[45] A rough calculation based on the assumption that the relicensed projects between 1986 and 2001 can be treated as representative in terms of energy production for the totality of non-federal hydropower facilities in the United States.

procedures for hydropower license review, including the term of granted licenses and the burden of proof in license review and relicensing proceedings. The comparison between the two countries shows that while substantive laws are similar, there are important differences between the procedural laws.

3.3.1 Sweden

This section outlines the key elements of the procedural and substantive laws that regulate hydropower in Sweden. The substantive law consists of both Swedish national laws, such as the Environmental Code (SFS, 1998a), and European Union Directives, including the Water Framework Directive (EU, 2000) and Renewable Energy Directive (EU, 2009a), which set mandatory targets, or end results, for Sweden (EU, 2012).

Procedural Law

Hydropower licenses are granted in five courts of law that are part of the general court system of Sweden (Swedish Courts, 2012). Chapter 24 of the Swedish Environmental Code regulates the review of licenses (SFS, 1998a).[46] The conditions for operation stipulated in a license are legally enforceable and are granted for an unlimited term (SFS, 1998a).[47] Either the hydropower operator or a public authority with standing must bring a claim in court in order to change any of the operational conditions specified in a license (SFS, 1998a).[48]

As discussed below, license review initiated by a public authority must satisfy similar requirements with a proceeding to obtain a license to construct a new hydropower plant, except that an Environmental Impact Assessment is not required (SFS, 1998a).[49] The responsible public authority, rather than the operator, must provide technical studies and documentation to persuade the court that proposed changes to a license–such as mandatory minimum flow releases and construction of fish passage facilities–are technically feasible, reasonable, and do not lead to the imposition of conditions that significantly interfere with hydropower production (SFS, 1998a).[50] The current application of the procedural laws thereby shifts the burden of proof from the operator of a hydropower project to the responsible public authority pursuing review. The public authority initiating a license review must also pay the

[46] 24
[47] 24:1
[48] 24:5, 24:7
[49] 6: 1
[50] 2:7, 11, 24:5

litigation costs of the opposing parties in a trial, excluding those of the operator (SFS, 1998a).[51] This disincentives public authorities from initiating reviews.

Substantive Law

This section describes the substantive Swedish environmental laws, which inform the license conditions with which a project operator must comply. The Environmental Code is the primary legal authority for regulation of hydropower in Sweden (SFS, 1998a).[52] Chapter 2 of the Code establishes what is generally referred to as "general rules of consideration." It requires operators to demonstrate that they operate in an environmentally acceptable manner in line with the requirements of the Environmental Code. It establishes the "polluter pays" principle: operators that cause an environmental impact must pay for preventive or remedial measures (SFS, 1998a).[53] It also requires using the best possible technology in the operation of an enterprise ((SFS, 1998a).[54] The general rules of consideration are mandatory to the extent they are deemed reasonable, particularly in relation to the costs and benefits (SFS, 1998a).[55]

Chapter 11 of the Environmental Code specifically addresses water operations, including the construction or modification of hydropower facilities and production conditions, and it stipulates that water operations may only be undertaken if the benefits to public and private interests are greater than their environmental impacts (SFS, 1998a).[56] The chapter further requires that operators who intend to carry out water operations that may be detrimental to fish, aquatic mollusks, and crustaceans must, at their own expense, construct and maintain any facilities necessary for the passage of these organisms (SFS, 1998a).[57] If the Court finds that the benefits of such facilities do not justify the expense, it may choose to relieve the operator of this obligation (SFS, 1998a).[58]

Chapter 24 specifies the conditions under which a public authority can initiate a license review for river restoration and other purposes (SFS, 1998a).59 A license review can be initiated for a number of reasons, for example complying with European Union membership obligations or ensuring adequacy of existing measures

[51] 25:3
[52] 11 :9
[53] 2:3
[54] 2:3
[55] 2:7
[56] 11:2; 11:6.
[57] 11:8.
[58] 11:8.
[59] 24:5.

to protect fish (SFS, 1998a).60 The chapter specifies that a license review is not permissible if it leads to intrusive conditions that significantly hamper or stop hydropower (SFS, 1998a).61

The Law of Introduction of the Environmental Code (SFS, 1998b) stipulates that a hydropower operator with a license under the 1918 Water Law or under older legislation–representing just less than 90% of all current licenses in Sweden–must accept only a 5% loss in production value from a license review unless compensated.

In 1998, the Swedish Parliament adopted the SEQO in conjunction with the Swedish Environmental Code (Riksdagen, 1999). The sixteen SEQOs, which Sweden intends to achieve by 2020, form an overarching framework for Swedish environmental policy (Riksdagen, 1999). These non-binding policy goals include “limit[ing] climate change” and ensuring “flourishing lakes and streams,” both relevant to hydropower production (Riksdagen, 1999).

European Union Directives

European Union Directives set mandatory targets for every member state, including Sweden (EU, 2014). There are three primary European Union Directives governing hydropower: the (1) Renewable Energy Directive (EU, 2009a). (2) Water Framework Directive (EU, 2000) and (3) Habitats Directive (EU, 1992).

The Renewable Energy Directive (EU, 2009a)[62] establishes a framework to promote energy from renewable sources. It establishes a European Union-wide target of 20% renewable energy by 2020 as a percentage of gross domestic consumption of energy (EU, 2009a).[63] The directive translates this overall EU target into national targets, and in Sweden’s case, the renewable target requires an increase from a 39.8% renewable share in 2005 to a 49% share in 2020 (EU, 2009a).[64] In Sweden, the Renewable Electricity Certificate System provides subsidies for renewable energy production that are available to certain hydropower projects; these subsidies are the most important tool for implementing the directive and reaching Sweden’s renewable target (SEA, 2011).

[60] 24:5.
[61] 24:5.
[62] Art. 1
[63] Art. 96
[64] Annex I

The Water Framework Directive establishes a framework for the protection of inland surface waters, transitional waters, coastal waters, and groundwater (EU, 2000).[65] This directive ensures that no water body in the European Union experiences a decrease in water quality and that water bodies achieve "Good Chemical and Ecological Status" by 2015 (EU, 2000).[66] The directive also requires the establishment of Environmental Quality Standards for Sweden's water bodies (EU, 2000).[67] Sweden has created five River Basin District Authorities to monitor water quality and to create River Basin Management Plans, including programs to reach "Good Water Status" (RBDA, 2009b). Water bodies designated as "heavily modified water bodies," including some water bodies affected by hydropower, need to reach the less strict Environmental Quality Standard requirement of "Good Ecological Potential" (EU, 2000).[68]

Finally, the Habitats Directive forms the cornerstone of the European Union's nature conservation policy together with the Birds Directive (EU, 2009b). The Habitats Directive is built around the Natura 2000 network of protected sites (EU, 19929,[69] which includes different habitats of European importance and a strict system of species protection for over 1,000 animal and plant species (EU, 1992).[70] For the habitat types and species protected, the directive maintains and restores "Favorable Conservation Status" through sustainable land and water management (EU, 1992).[71] This directive protects various species that depend upon riverine habitats and currently have an imperiled conservation status (Sohlman, 2007). Protecting areas with sustainable land and water management is meant to preserve threatened species and habitats (EU, 1992).[72]

3.3.2 United States

This section discusses the key elements of procedural and substantive laws regulating hydropower in the United States. This discussion forms the basis for the chapter's conclusion that the procedural requirements for licensing and relicensing are the primary reasons for greater implementation of river restoration measures at hydropower projects in the United States as compared to Sweden.

[65] Art. 1
[66] Art. 4(1)(a)(iii)
[67] Art. 7(1), Art. 16(7), Annex V, Annex IX.
[68] Art. 4.1(a), Annex V, tbl.1.2.5.
[69] Annex I and II
[70] 12:1, Annex IV
[71] Art. 2:2
[72] Art. 4:4

Procedural Law

FERC has the authority to regulate non-federal hydropower projects by granting a license or exemption.[73] For non-federal hydropower projects that do not qualify for an exemption, an operator must obtain a license from FERC (FERC, 2015b). FERC grants a license for a term of thirty to fifty years (USC, 2015;[74] USC 2015).[75] Five years before an existing license expires, the operator must notify FERC whether it intends to seek a new license.[76] A competitor may also apply for the new license, in which case FERC will issue the license to the applicant whose proposal provides the greatest public benefits (USC, 2015).[77] During the relicensing process, the hydropower project is subject to all applicable laws at the time of relicensing (USC, 2015).[78] Given the evolution of environmental laws, there is no presumption that a new license will be issued on the same terms as the previous license. The license applicant is required to consult with federal and state resource agencies, Indian tribes, and the public in the course of relicensing (CFR, 2015a).[79]

Under the Federal Power Act, a non-federal hydropower license is a privilege to use public lands and waters (US, 1967). Accordingly, the US Supreme Court has held that, under the Federal Power Act, an applicant must demonstrate that its proposal is in the public interest (US, 1967). Further, under the Administrative Procedures Act, any applicant for a federally issued license has the burden of proof to support its license application (USC, 1966).[80] FERC has four options for its final decision in a relicensing: a new license (USC, 2015),[81] non-power license (USC, 2015),[82] decommissioning (USC, 2015;[83] US GPO, 1995), or federal takeover.

During the relicensing process, FERC must conduct an environmental analysis under the National Environmental Policy Act (NEPA) (USC, 1970;[84] CFR, 2015b).[85] This includes the preparation of an Environmental Assessment or Environmental Impact

[73] The Commission may issue a conduit exemption for a hydroelectric facility up to 40 MW that uses a manmade conduit operated primarily for non-hydroelectric purposes. It can issue a 10 MW exemption for a hydroelectric project of 10 MW or less. Exemptions are granted in perpetuity. For the 40 MW exemption, an environmental assessment is required. *See* 16 U.S.C. § 823a (2015); *see also* 18 C.F.R. §§ 4.30(b)(28), 4.90-4.96 (2015).
[74] 16 U.S.C. § 808(e) (2015).
[75] 16 U.S.C. §§ 799, 808 (2015)
[76] This is true unless the operator wishes to abandon the project.
[77] 16 U.S.C. § 808(a) (2015)
[78] 16 U.S.C. § 808(a)(1)
[79] 18 C.F.R. § 4.38 (2015)
[80] 5 U.S.C. § 556 (1966)
[81] 16 U.S.C. § 808 (a)(2) (2015)
[82] 16 U.S.C. § 808 (f)
[83] 16 U.S.C. § 803(a)(1) (2015)
[84] 42 U.S.C. §§ 4321, et seq.
[85] 18 C.F.R. §§ 2.80 (2015)

Statement, which discloses the environmental impacts of the proposed and alternative license conditions and evaluates measures to mitigate such impacts. The NEPA document includes[86] a study and evaluation of the environmental effects of proposed and alternative actions in a hydropower relicensing (CFR, 2014;[87] USC 1975;[88] CFR 1966).[89]

Substantive Law

FERC regulates non-federal hydropower projects under the Federal Power Act (USC, 1978) which calls for the comprehensive improvement of rivers for energy generation, water supply, recreation, fish and wildlife, and other beneficial uses (USC, 2015).[90] In addition to the Federal Power Act, FERC must comply with other environmental statutes, including the Clean Water Act (USC, 1972) and the Endangered Species Act (USC, 1973), prior to issuing a license (USC, 1972).[91]

Under Federal Power Act section 10(a), FERC must determine that a project is “best adapted to a comprehensive plan of development” of the affected river basin for the beneficial uses of energy generation, water supply, flood control, recreation, fish, and wildlife (USC, 2015).[92]

Under Federal Power Act section 4(e), FERC must give “equal consideration to energy conservation, the protection, mitigation of damage to, and enhancement of, fish and wildlife (including their spawning grounds and habitat), the protection of recreational opportunities, and the preservation of other aspects of environmental quality (USC, 2005a).[93]” Section 4(e) also requires that, for any project located on public lands or reservations, such as a National Forest, FERC must find that the license will not interfere with the original purpose of the reservation, and the federal agency with jurisdiction over the federal reservation, such as the US Forest Service, which administers National Forests, may require any additional conditions it finds necessary to protect the reservation (USC, 2005a).[94]

Under Federal Power Act section 18, the Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) may condition a license on measures to provide fish passage (USC, 2005b). In sum, the Federal Power Act requires that any

[86] Either an Environmental Assessment or an Environmental Impact Statement.
[87] 18 C.F.R. §§ 380.5(b)(6), 380.6(a)(4) (2015)
[88] 42 U.S.C. § 4332(2)(E)(1975)
[89] 40 C.F.R. § 1508.9(b) (1966).
[90] 16 U.S.C. § 803(a)(1) (2015)
[91] 33 U.S.C. § 1356(a)(1) and 16 U.S.C. § 1536(a)
[92] 16 U.S.C. § 803(a)(1)
[93] 16 U.S.C. § 797(e)
[94] 16 U.S.C. § 797(e)

new licensed project achieve a balance of beneficial uses of the affected waters and lands that is in the public interest (USC, 2015e;[95] US, 1967; FERC, 2006).

Under Endangered Species Act section 7(a)(2), FERC must consult with FWS and NMFS to demonstrate that the new license will not jeopardize endangered or threatened species, or habitat designated critical for such species (USC, 1988).[96] FWS and NMFS may require that FERC include certain mitigation measures in the new license to avoid liability under the Endangered Species Act for harming listed species or critical habitat (USC, 1988).[97] Under Endangered Species Act section 7(a)(l), FERC has a more general obligation to contribute to the conservation of all threatened and endangered species affected by its actions (USC, 1988).[98]

Under Clean Water Act section 401, FERC may license a hydropower project only if the state where the project discharge will occur certifies that the project will comply with applicable water quality standards (USC, 1977).[99] States may condition their certification on measures necessary to ensure compliance with water quality standards.[100] For example, the state may require minimum in-stream flows (USSC, 1994) or the installation of aeration devices to enhance dissolved oxygen concentrations (Union, 2007).[101] FERC must incorporate any certification conditions into the license without modification (USCA, 1997). Over the last few decades there have been federal tax credits for the promotion of renewable energy (USEIA, 2005). The US Department of Energy makes funding available for the implementation of renewable technologies, including hydropower (USDE, 2018). As of January 2012, thirty states have adopted mandatory Renewable Portfolio Standards (RPS) or similar policies to increase the generation of renewable electricity (USEIA, 2015). These policies require producers to supply a certain share of their electricity from designated renewable energy sources by a specified date (CPC, 2002).[102] Some RPS programs include hydropower production facilities (ORS, 2015). To date, there is no federal policy similar to state RPS.[103]

[95] 16 U.S.C. § 803(a)(1)
[96] 16 U.S.C. § 1536(a)(2)
[97] 16 U.S.C. § 1536(b)(4)(ii) *see, e.g.,* 50 C.F.R. §§ 402.02 (defining “[r]easonable and prudent measures”), 402. 14(i)(1)(ii) (2015).
[98] 16 U.S.C. § 1536(a)(1)
[99] 33 U.S.C. § 1341(a)
100 Under the Clean Water Act, water quality standards must include designated beneficial uses (e.g., fish and wildlife, recreation, water supply), criteria necessary to protect those uses (e.g., minimum dissolved oxygen and temperature thresholds), and an anti-degradation standard to maintain existing water quality at the time the standards were adopted.
[101] Discussion re-aeration flows under art. 410
[102] § 399.15(b)(2)(B) (West 2015) (requiring 33% renewables by 2020)
[103] The American Clean Energy and Security Act of 2009, H.R. 2454, 111th Cong., was the last failed attempt to establish a federal RPS.

While all hydropower projects in Sweden are subject to the same regulations (SFS, 1998a), different types of dams are subject to different regulations in the United States.[104] FERC's regulation and periodic review does not apply to the small hydropower projects and conduits that qualify for exemptions from licensing (USC, 2013). More importantly, the largest hydropower projects in the United States, federal hydropower dams, are regulated by either the US Army Corps of Engineers (USACE) or the US Bureau of Reclamation, and not by FERC (USC, 1914). USACE and the Bureau of Reclamation have adopted rules and practices for periodic review of operations at dams but do not enforce their requirements as diligently as FERC (Roos-Collins and Gantenbein, 2007). Efforts to enforce these requirements have resulted in limited river restoration measures utilized in federal hydropower projects.

The Federal Power Act, Clean Water Act, and Endangered Species Act are the three primary environmental statutes that regulate hydropower projects in the United States and empower federal and state agencies to enforce their respective mandates.

3.4 Comparison

This section compares the significant differences between the regulation of hydropower in the United States and Sweden that produce disparate differences in river restoration measures (see Table 3-1). The most important distinctions between the countries' measures are the scope and timing of license reviews; the number of dam decommissionings and removals; and the share of total hydropower production redirected to river restoration efforts. By all of these measures, river restoration is significantly more prevalent in the United States than in Sweden (see Table 3-1). Because hydropower production is highly regulated in both countries, these differences likely result from the countries' different approaches to hydropower regulation.

The substantive environmental laws provide a comparable level of protection for non-developmental uses of water, such as water quality, fish, wildlife, endangered species, and recreation. In the United States, the Clean Water Act, Endangered Species Act, Federal Power Act, and NEPA are the primary laws that apply in a relicensing proceeding. In Sweden, there are both national laws (the Swedish Environmental Code and Environmental Quality Objectives) and European Union

[104] *See, e.g.,* USC 2013; CFR 2014 (18 C.F.R. §§ 4.30(b) (29), 4.90-4.96.; see also USC 1975, 43 §§ 372, 373, 383, 391, 392, 411, 416, 419, 421, 431, 432, 434, 439, 461, 491, 498.

Directives (for example, the Habitats Directive and the Water Framework Directive) that apply in a license review (SFS, 1998a).

The term of licenses (thirty- to fifty-year terms in the United States compared to unlimited terms in Sweden) and the procedural laws regulating license review are the biggest differences between the two countries. When a license expires in the United States, the project operator must apply for a new license subject to then-current environmental laws and public comment (USC, 2015;[105] CFR, 2006). By contrast, in Sweden, license reviews are discretionary and must be initiated by a public agency or by the operator (SFS, 1998a).[106] Mandatory license review in the United States means that far more licenses are reviewed than in Sweden (see Table 3-1).

Additionally, under US law, the license applicant must demonstrate that the proposed project is in the public interest for the term of the new license (USC, 2015e).[107] Thus, the burden is on the applicant to show that it should be awarded the privilege to appropriate public waters, and not on the public to show that the project interferes with the public interest. In Sweden, the public agency or a third party must show that additional environmental measures are needed and that these measures will not unreasonably interfere with hydropower production (SFS, 1998).[108]

In Sweden, the Renewable Energy Directive incentivizes the expansion of renewable energy production with hydropower projects (EU 2006).[109] In the United States, there are limited federal incentives (USDE, 2018) and most renewable energy incentives are offered at the state level.[110] The countries' differences may be attributable to greater public acceptance of climate change in Sweden and in the European Union as compared to the United States (Lorenzoni and Pidgeon, 2006). Hydropower is a renewable energy source that can contribute to the reduction of emission of greenhouse gases and is often highlighted in Sweden as combatting climate change (Svensk Energi, 2012). The popularity of hydropower and national incentives may be another factor contributing to the lower rate of river restoration in Sweden, as river restoration often reduces the amount of water available for hydropower production.

Both countries have substantive provisions for protecting endangered species and aquatic ecosystems. In Sweden, however, the country's substantive provisions

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[105] 16 U.S.C. § 808(b)(2)(205).
[106] 24:5
[107] 16 U.S.C. § 803(a)(1) (205).
[108] 24:5
[109] Preamble para. 30, art. 5(3), Annex II
[110] For detailed information about state incentives, see Database of State Incentives for Renewables and Efficiency, DSIREUSA, available at http://www.dsireusa.org. The DSIRE website is managed, in part, by the U.S. Department of Energy and tracks renewable portfolio standards by state.

are more sharply contradicted by incentives to expand renewable energy production to combat climate change. These incentives benefit some hydropower projects in Sweden, but may also limit river restoration measures because they come at a cost to renewable hydropower generation. Sweden's prohibition on excessively costly restoration measures also limits their implementation through license reviews (SFS, 1998a).[111] In contrast, there is no requirement under the Federal Power Act that FERC issue a license on terms economically feasible from the licensee's perspective.

A hydropower license in Sweden is granted with no time limit (SFS, 1998a)[112] and is treated like a property right to use the watercourse in accordance with the conditions specified in the license. In practice, a license review initiated by a public authority is the only means of applying new substantive laws requiring river restoration to the operations of a Swedish hydropower project. A license review that results in additional limitations on the right to use the water is treated as an expropriation of property that requires compensation (SFS, 1998b).

The burden of proof lies with the public authority initiating the license review process in Sweden, causing considerable administrative and legal costs for that agency (CAB, 2008). These costs typically amount to two-thirds of the total cost of a river restoration project (CAB, 2008). In addition, the Environmental Code limits the "polluter pays" principle in two ways. First, new conditions from a license review cannot lead to the imposition of conditions that significantly hamper hydropower production (SFS, 1998a).[113] Second, an operator holding a license granted under the 1918 Water Law, or older legislation–approximately 90% of all licenses in Sweden–must only tolerate a loss of 5% of production value from a license review (SFS, 1998b).[114] After that point, the responsible agency must compensate the operator with public and other funds (SFS, 1998b).[115]

In addition, the public authority initiating a concession review must convince the court that the proposed river restoration efforts are reasonable in light of the costs and benefits of the proposed remedial measures (SFS, 1998a).[116] Benefits from river restoration–for example, ecosystem restoration and fish passage measures–are often more difficult to quantify and prove than the costs of construction and reduced electricity production.

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[111] 24:5
[112] 24:1
[113] 24:5
[114] 39
[115] 39
[116] 2:7

In the United States, by contrast, FERC licenses are granted for a limited term of thirty to fifty years (USC, 2015).[117] When the license period ends, the hydropower project must be relicensed in accordance with existing law at the time of the relicensing procedure (USC, 2015).[118] Thus, many projects that were originally licensed in the first half of the twentieth century, prior to the enactment of environmental laws like the Endangered Species Act and Clean Water Act became compliant with current laws when they underwent the relicensing process. Competing interests are balanced again at the time of the review for relicensing based on evidence in the record, existing laws, and current public values (USC, 2015e).[119] FERC has never issued a new license on the same terms as the previous license. In several instances, FERC relicensing has resulted in decommissioning of hydropower projects and removal of project dams after the licenses expired (Pittock and Hartmann, 2011).

In the United States, hydropower licenses are treated as temporary privileges to use public waters (US, 1967). This explains why, unlike in Sweden, the project operator must demonstrate that the project is in the public interest (US, 1967). Furthermore, resource agencies can prescribe mandatory facilities for fish passage and water quality, thereby providing additional checks on projects that would unreasonably favor power generation over the environment (USC, 2005a).[120] That FERC relicensed 28% of licenses between 1990 and 2010 and required the implementation of river restoration measures in most of them indicates that the system in the United States allows for the adaption of operations to evolving substantive environmental laws.

3.5 Conclusion

There are significant differences in the extent of river restoration efforts in Sweden and the United States, with more river restoration measures in the United States. While only 2% of hydropower licenses were reviewed in Sweden between 1990 and 2010, 28% were reviewed in the United States (see Table 3-1). While there have been several dam removals as a result of a license review in the United States (Pittock and Hartmann, 2011; Kober, 2015), not a single hydropower dam has been removed in Sweden as a result of a license revocation (Harning, 2002). The higher rate of license review and imposition of restoration measures has resulted in a higher level of

[117] 16 U.S.C. §§ 799, 808 (2015).
[118] 16 U.S.C. § 808(a) (2015).
[119] 16 U.S.C. § 803 (2015)
[120] 16 U.S.C. § 811 (2015).

hydropower production loss to restoration in the United States: approximately 0.5% of total production, compared to 0.02% in Sweden (see Table 3-1).

The difference in procedural laws provides the best explanation for the disparate extent of river restoration between Sweden and the United States. A hydropower license in Sweden is granted in perpetuity, which means that a public authority must initiate a license review to implement river restoration measures (SFS, 1998a).[121] In the United States, FERC grants hydropower licenses for non-federal projects with a limited term of thirty to fifty years, after which the operator must apply for a new license (USC, 2015).[122] Furthermore, Sweden places the burden of proof during a license review on the public authorities, while this burden is on the applicant in the United States (USC, 1966[123]).

Substantive environmental legislation must be supported by adequate procedural legislation to be effectively implemented. The EU Water Framework Directive in Sweden provides an example of incomplete implementation, at the time of writing, because Sweden has created limited legal tools or economic incentives to achieve the environmental goals of the Directive. In practice, a license review initiated by a public authority, with the hurdles outlined above, continues to be the only way to implement river restoration measures at hydropower projects in Sweden to meet the environmental objectives of the Directive.

Hydropower regulation with the periodic review of licenses balances the need for security of investment with the need to keep hydropower projects accountable for environmental best practices. The US system of license reviews is closer to this ideal.

[121] 24:5
[122] 16 U.S.C. §§ 799, 808 (2015).
[123] 5 U.S.C. § 556(d) (1966). *see also* CFR 2014

CHAPTER 4: Learning-based intervention for river restoration: analyzing the lack of outcomes in the Ljusnan River basin, Sweden

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Abstract

We focus on a large and sustained stakeholder process for river restoration related to hydropower production that failed to reach any significant natural resource management outcomes. We explore to what extent the stakeholder process can be characterized as a learning-based intervention as well as the reasons for the lack of outcomes. The analysis draws on insights from existing literature of procedural and institutional factors identified to foster and hinder social learning in stakeholder processes. The analysis finds that the stakeholder process featured virtually all fostering procedural factors as well as various fostering institutional factors identified in the literature. The main hindering institutional element consisted of strong pre-existing water rights, granted by the legislation governing hydropower production and river restoration in Sweden. Existing legislation provided a key stakeholder with the power to reach its objective successfully, through the unilateral action of exiting the stakeholder process. Our results demonstrate that various learning outcomes, including knowledge acquisition, trust building, and the creation of networks are possible in stakeholder processes that feature power imbalances. The results also suggest that, ultimately, the power imbalance limited the process from reaching significant natural resource management outcomes, both in the short and longer terms. Based on comparison with international cases, the results reveal the need to focus attention on the national scale to remediate power imbalances in stakeholder processes that arise from a share of stakeholders possessing strong prior rights to the use of natural resources. In such cases, sustainable management of natural resources could be better served by efforts to modify existing legislation, rather than investments in resource-intensive learning-based interventions.

Keywords: *learning intervention, outcomes, hydropower, river restoration, Sweden*

4.1 Introduction

Social learning in stakeholder processes related to natural resource management has emerged as an influential strand of academic research during the last decades (Berkes et al. 2002, Keen et al. 2005, Wals 2007, Gerlak et al. 2018). Social learning can be defined as a process of iterative reflection that occurs from sharing experiences, ideas, and environments with others (Keen et al. 2005). A recent review identified that a majority of analyzed social learning processes in the literature refer to learning-based interventions, which can be defined as a government-led (or participatory action research) process to trigger or support social learning (Rodela 2013, Suškevičs et al. 2018). The literature contains numerous assertions related to the beneficial outcomes of social learning in stakeholder processes, including improved decision-making and problem-solving capacity as well as changes in perceptions, values, and norms (Walters 1986, Dale 1989, Lee 1993, Pinkerton 1994, Daniels and Walker 1996, Buck et al. 2001, Röling 2002, Olsson et al. 2004, Folke et al. 2005, Armitage et al. 2008). Ultimately, there seems to be an expectation that successfully facilitated learning-based interventions lead to desirable collective action and natural resource management outcomes (Schusler et al. 2003, Blackmore 2007, Pahl-Wostl et al. 2007, Muro and Jeffrey 2008, Cundill and Rodela 2012).

However, the relationship between learning-based interventions and natural resource management outcomes represents an area in which further research is warranted. Recent literature on learning and natural resource management increasingly focuses on whether and how natural resource management outcomes are, or can be, connected to learning processes (Siebenhüner et al. 2016, Armitage et al. 2017, de Kraker 2017, Suškevičs et al. 2018). However, Suškevičs et al. (2018) explicitly highlighted a shortage of analysis of 'failed' learning processes in the literature, i.e., processes that did not result in the expected outcomes.

We focus on a case that, as we argue, can be analyzed as a failed learning-based intervention in the Ljusnan River basin (referred to hereafter as the Ljusnan process). The Ljusnan process ran between 2000 and 2007 and focused on river restoration of Sweden's eighth most important basin in terms of hydropower production (Swedish Energy Agency 2014). The vision of public stakeholders, who initiated the process, was to recreate an ecologically sustainable river basin with varied natural and cultural environments in line with national and EU environmental policy. Moreover, the Ljusnan process was initiated with the intention of constituting a model for coordinated hydropower permit reviews for river restoration in Sweden, the largest hydropower producer in the EU (CAB 2008, EC 2018). However, in 2007, after 25 project meetings, with an average of 12 participants per meeting and producing 21 project reports, the main hydropower producer in the basin exited the Ljusnan process, effectively ending it without any river restoration measures.

We aim to explore the relationship between learning-based interventions and natural resource management outcomes. We do so by outlining a research framework based on key factors identified in the literature to foster or hinder social learning and by applying it to the Ljusnan process. In doing so, we are guided by the following questions: (1) to what extent can the Ljusnan process be characterized as a learning-based intervention and (2) how do procedural and institutional factors related to the Ljusnan process explain its lack of natural resource management outcomes?

By answering these questions, we contribute to the knowledge of learning-based interventions that are initiated with the aim of reaching tangible natural resource management outcomes, including environmental policy implementation (Blackmore et al. 2007, Ison et al. 2007, Steyaert and Jiggins 2007, Pahl-Wostl et al. 2008). Such knowledge is increasingly valuable given the current trend toward promoting stakeholder participation, voluntary agreements, and learning to implement environmental policy in the EU (Knill and Lenschow 2000, Jordan et al. 2005, Newig and Koontz 2014). Furthermore, there are few analyzed cases in the literature of extensive and sustained stakeholder processes that have failed to reach any significant natural resource management outcomes. As such, insights from the Ljusnan process can contribute to knowledge of how, when, as well as when not to, initiate learning-based interventions aimed at implementing environmental policy.

4.2 Procedural and institutional factors fostering or hindering social learning

Social learning is the dominant learning conceptualization in the environmental policy and natural resource governance literature (Gerlak et al. 2018, Suškevičs et al. 2018). Most learning-based interventions in the literature are analyzed using social learning as the key learning concept (Suškevičs et al. 2018). Therefore, we focus on insights from the body of literature related to social learning to build our research framework to analyze the Ljusnan process (Table 4-1). The framework is based on insights from three extensive reviews of social learning in natural resource management and governance literature: Muro and Jeffrey (2008), Cundill and Rodela (2012), and Siebenhüner et al. (2016). These three review articles represent authoritative reviews on the state of the social learning literature, as indicated by their extensive citations in subsequent literature (Muro and Jeffrey 2008) and in the robust method used to reach their findings (Cundill and Rodela 2012, Siebenhüner et al. 2016).

Muro and Jeffrey (2008), in a review of the theory and application of social learning, identified a range of procedural factors directly related to the structure and functioning of the stakeholder process, which supports social learning. For Muro and Jeffrey (2008), these included facilitation, repeated meetings, open communication, unrestrained thinking, and diverse stakeholder participation. Cundill and Rodela (2012) found that consensus emerged about similar procedural elements that support social learning, including sustained interaction between stakeholders, ongoing deliberation, and sharing of knowledge in a trusting environment. The two reviews thereby identify similar fostering procedural factors, which in our framework are expressed as: (1) sustained interaction; (2) joint knowledge acquisition, sharing, and deliberation; (3) skilled facilitation; and (4) inclusion of relevant stakeholders. No specific hindering procedural factors are identified in the reviews.

Sibenhüner et al. (2016) found that the most recurring fostering factors identified for the emergence of social learning processes in their sample are informal and formal institutions. Informal institutions are exemplified as social capital and networks in the shape of relationships and trust whereas formal institutions refer to administrative and legislative elements embedding the process. In the papers reviewed by Sibenhüner et al. (2016), it is possible to find examples of fostering institutional factors, e.g., capability of formalizing new practices, arrangements, norms, and values (from Steyaert and Jiggins 2007) and the existence of an organization that fits the relevant ecological unit, such as a basin- wide organization in the case of water management (from Mostert et al. 2007). Reversely, scalar misfits between administrative and ecological units was identified as a hindering institutional factor in the literature included in Sibenhüner et al.'s sample (from Borowski et al. 2008). Muro and Jeffrey (2008) identified a very rigid institutional framework as a condition that limits opportunities for social learning processes. In reviewed papers by Muro and Jeffrey (2008), it is possible to find examples of hindering institutional factors in the shape of authorities that lack experience with multiparty stakeholder approaches or that experience scale and intra-relational difficulties, as well as stakeholders possessing strong pre-existing rights over the natural resource in question (from Mostert et al. 2007). The two reviews thereby identify institutional factors, defined as broader values, administrative and legislative elements embedding the stakeholder process, as fostering the emergence of, or limiting the opportunities for, social learning. In the framework, we express fostering institutional factors identified in the reviews as: (5) social capital and networks; (6) capability of formalizing new practices, arrangements, norms, and values; and (7) an organization that fits the relevant ecological unit. Institutional factors hindering social learning are expressed as: (8) authorities lacking experience, facing spatial misfits, and problems of coordination; and (9) stakeholders possessing strong pre-existing rights over the natural resource.

Table 4-1 shows the research framework, grouping identified factors into fostering and hindering procedural and institutional factors. This presentation allows for the creation of a simple and parsimonious framework, with only two overall categories that cover the most significant factors identified in the three reviews. This framework does not intend to be an exhaustive list of factors fostering or hindering social learning in stakeholder processes, but instead to provide a concise framework to analyze learning- based interventions based on authoritative reviews of critical factors. Appendix 1 exhibits all the identified factors in each of the three review publications and illustrates how we arrived at the final grouping and expression of factors.

Table 4-1: Research framework - procedural and institutional fostering and hindering factors of social learning to be applied to the Ljusnan process

	Fostering	Hindering
Procedural factors	• Sustained interaction (1) • Joint knowledge acquisition, sharing and deliberation (2) • Skilled facilitation (3) • Inclusion of relevant stakeholders (4)	
Institutional factors	• Social capital and networks (5) • Capability of formalizing new practices, arrangements, norms and values (6) • An organization that fits the relevant ecological unit (7)	• Authorities lacking experience, facing spatial misfits and problems of coordination (8) • stakeholders possessing strong pre-existing rights over the natural resource (9)

Having outlined this framework, we emphasize that we are conscious of the fact that stakeholder processes featuring social learning are not guaranteed, nor can they always be expected to lead to natural resource outcomes (Reed et al. 2010). Our focus is however on learning-based interventions applied purposefully by stakeholders (e.g., researchers or governmental bodies) to implement environmental policy and yield natural research management outcomes. Although learning-based interventions that lead to, for example, changed mental models of a natural resource situation can be highly valuable to analyze social learning as a social process, they are of less value to implement environmental policy if they cannot be related to any natural resource management outcomes.

4.3 The Ljusnan River Basin and Process

Sweden is the biggest hydropower producing EU member state and the Ljusnan River basin is, in turn, Sweden's eighth most significant hydropower producing basin (Swedish Energy Agency 2014). There are just over 40 hydropower stations in the basin, as well as an additional 50 hydropower dams, with a total production capacity of 829 MW and an average yearly production of 3.9 TWh (CAB 2003, Swedish Energy Agency 2014). One hydropower company is dominant in the Ljusnan River basin with 95% of the total production capacity (Fortum 2017).

Hydropower dams and stations in the Ljusnan River basin are predominantly regulated with permits granted according to the Swedish Water Law of 1918, which was in force until 1984 (CAB 2003). These hydropower permits were granted with no time limit and specify the operating conditions of the stations and dams, including maximum and minimum head of dams as well as water flow into turbines. Requirements of environmental protection, such as passage facilities and minimum flow, are minimal because the permits were primarily crafted to maximize energy production (CAB 2003). To modify a hydropower permit to allow for river restoration, proposed reviews must be brought to the Swedish Land and Environmental Court and processed, as well as decided, separately by the court for each individual hydropower station or dam (Rudberg et al. 2015). These permit reviews are generally initiated by public authorities and Swedish legislation specifies requirements and limitations regarding the permitted extent and scope of environmental measures as part of a permit review. One significant limit is what could be called the “compensation free” limit for river restoration measures. This limit establishes that proposed environmental measures are not allowed to cause a reduction of more than 5% of the production value of a hydropower station or dam holding a permit according to the Swedish Water Law from 1918 (SFS 1998, 39 §). If more environmental measures are implemented as part of a permit review at such a station or dam, the public authority pursuing the permit review must provide monetary compensation to the hydropower producer for losses exceeding the limit of 5% of its production value.

The Ljusnan process included representatives from two county administrative boards, five municipalities and five hydropower companies in the basin. The process was initiated by Gävleborg and Jämtland Country Administrative Boards (CAB) and the five municipalities Söderhamn, Ljusdal, Bollnäs, Ovanåker and Härjedalen situated in the Ljusnan River basin (CAB, 2003). The process was divided into two phases: phase one with only public stakeholders – CAB and municipality representatives – that ran between the years 2000 and 2003, and phase two that included industry stakeholders and ran between 2003 and 2007.

The vision and goals of the Ljusnan process were formulated by the public actors in phase one of the Ljusnan process based on national and EU environmental policy (CAB, 2003). The vision was to recreate an ecologically sustainable river basin with varied natural and cultural environments. The project goals were formulated as: continue hydropower production with regards to 21st century values; increase biodiversity; recreate aquatic habitats in dry reaches of the river; ensure fish passage at artificial barriers; improve natural reproduction; increase the social and touristic values of the basin; work in cooperation with concerned actors. The type of river restoration measures contemplated to achieve these goals were the creation of passage facilities, establishment of mandatory minimum flows, as well as the removal of small hydropower stations in the basin.

The core idea behind the Ljusnan process was to transcend the legislated compensation free limit for environmental measures of each station or dam by transforming it into an overall river basin scale compensation free limit. Such a basin-wide limit would be calculated by adding the individual limit of 5% for each station and dam in the Ljusnan River basin. The overall basin scale limit could then be used more focused and effectively because some stations, with potentially high environmental benefits from restoration measures, could benefit from measures that would result in production losses exceeding 5% of its production value. The overall basin-wide limit of production loss from measures would not be surpassed because other stations and dams, with less environmental potential from measures, would be left unmodified in the basin. The production loss from environmental measures, at a basin scale, would thereby be kept below 5% of the total hydropower production value of the basin.

An overall basin-wide limit would be relatively simple to operationalize in the Ljusnan River basin because of the presence of one single dominant hydropower producer. Cooperation between public representatives and operators would serve to jointly identify and agree on objectives and measures with the highest potential for environmental benefits within the overall river basin compensation free limit of environmental measures. The most appropriate shape, focus, and distribution of compensation free environmental measures in the river basin was thereby an open-ended question that was to be answered through joint investigation and deliberation between public and private representatives.

4.4 Methodology

We focus on a single case, the Ljusnan process, as a revelatory case study of a learning-based intervention aimed at implementing environmental policy. The relevance of the case is underlined by the strong political interest in the process from the Swedish Association of Municipalities because the Ljusnan process was intended to constitute a model for coordinated hydropower permit reviews for river restoration in Sweden (CAB 2008).

The empirical material consisted of the meeting minutes from 25 stakeholder meetings of the Ljusnan process, semi-structured interviews with 5 key participants in the Ljusnan process, and 21 project reports, including reports on existing hydropower permits in the basin, biotope and fish mappings, and trial water release accounts. The empirical material was analyzed and presented using framework synthesis (Barnett-

Page and Thomas 2009) through a search of evidence of procedural and institutional fostering and hindering factors of social learning in the Ljusnan process, as identified in the research framework (Table 4-1). The triangulation of meeting notes, interview replies from key participants, and project reports ensures a high level of internal validity of the insights and conclusions.

Project documentation formally identified 22 representatives as part of the Ljusnan process. Five key participants were selected for an interview by asking the coordinator of the process, i.e., the first interviewee, who the most active and relevant participants to interview were (snowball sampling). Based on this initial list, interviewees were chosen to ensure that representatives from the dominant hydropower producer (industry representatives A and B), the two CABs (the coordinator, who represented CAB A, and a representative from CAB B) as well as a municipal representative from the biggest and most active municipality in the basin were included.

Open interview questions were developed in which the interviewees were asked for their experiences of the process, identification of project outcomes, and their explanations of these outcomes. The questions were sent out prior to the interview and summary notes were taken during the interviews. The interviews lasted for about one hour and were conducted by phone between December 2016 and February 2017. They were not recorded to ensure as earnest answers and open communication as possible. The two industry interviewees were sent the summary notes and provided their approval of the documented replies.

Carrying out interviews ten years after the finalization of the Ljusnan process represents a potential source of error because interviewees may have forgotten important aspects of the process. Various measures were taken to limit this risk. Interview questions were sent out prior to the interviews to give the respondents time to think and remember relevant aspects of the process. Replies were also extensively validated by referring to the detailed meeting minutes from 25 stakeholder meetings. Some advantages of the delayed interviews include that sufficient time has elapsed for possible time-lagged outcomes from the process to materialize. Furthermore, because most interviewees were retired and had no formal obligations towards their former employers, it provided conditions for more open and earnest answers.

4.5 Analyzing the Ljusnan Process

We use the research framework from Table 4-1 to analyze procedural and institutional elements related to the Ljusnan process. The numbers in the headings refer to the factors in the table.

4.5.1 Fostering procedural elements

Sustained interaction (1)

In the Ljusnan process there is ample evidence of sustained interaction between all stakeholders from the end of 2003 to the end of 2007, four years in total. There are meeting notes from 18 project meetings featuring representatives from CABs, municipalities, and industry stakeholders. Three meetings were two-day meetings that included excursions, dinners, and ample time for interaction between the stakeholders.

Joint knowledge acquisition, sharing and deliberation (2)

The Ljusnan process can be characterized as containing both separated and joint knowledge acquisition, sharing, and deliberation. A large portion of the knowledge acquisition of the project took place during the first phase of the project in which only public actors, i.e., CAB and municipality representatives, participated. Four project summary reports, two biotope mapping reports, and one trial water release account were developed and published prior to the formal inclusion of industry representatives in the Ljusnan process. A significant portion of the knowledge acquisition of the project was thereby not carried out jointly with industry representatives.

During the second phase of the project, in which industry representatives participated, there are several important examples of joint knowledge acquisition as well. There are reports of 4 jointly conducted trial water releases, and there was an active working group during the second phase that met 10 times, which can be identified as a forum for joint knowledge acquisition. Interviewees described the working group as a forum where problems were raised, examined, and discussed. As industry representative B recalls: “The work largely consisted in knowledge acquisition and sharing between different interest groups and participants.” Industry interviewee A also explained how he informed the public stakeholders of problems of nutrient limitation and salmon disease that led to trials of release of salmon fry as an alternative option for salmon reintroduction in Ljusnan. Meeting notes from meetings 13, 16, and 19 support industry representative A’s account and thus provides evidence of joint knowledge acquisition, sharing, and deliberation in the Ljusnan process related to salmon reintroduction.

Skilled facilitation (3)

The Ljusnan process appears to have been skillfully facilitated until the end of 2006 when the coordinator of the process, CAB representative A, retired. Industry representative A praised the work of the coordinator of the project who managed the project until 2006: "The coordinator managed the project in an excellent way. You could trust his word and he made sure there was speed and direction in the work." CAB representative B expressed equally positive sentiments toward the coordinator's facilitation skills. The retirement of the coordinator therefore did, in the view of industry representative A, as well as the coordinator himself, influence the process negatively. However, CAB representative B and the municipality representatives, even when asked specifically, did not experience the retirement of the coordinator as a decisive shift in the Ljusnan process nor decisive for the outcome of the project, as recalled by the municipal representative: "My recollection is that the retirement of the coordinator did not influence the project noticeably."

Inclusion of relevant stakeholders (4)

The inclusion of representatives from the two county administrative boards, five municipalities, and five hydropower organizations in the Ljusnan River basin ensured the inclusion of relevant stakeholders in the Ljusnan process. However, the Legal, Financial and Administrative Services Agency (LFASA), the main national agency in Sweden initiating permit reviews for river restoration related to hydropower production, was a key stakeholder that was missing from the Ljusnan process. Representatives from LFASA were invited to participate but chose not to, because, as recalled by CAB interviewee B, they did not think that the Ljusnan process was feasible given the existing legislation governing hydropower production and river restoration: "They [LFASA] said that [the Ljusnan process] was a completely impracticable way forward."

There are various NGOs in Sweden that have an interest in river restoration, including in the Ljusnan River basin that did not participate directly in the process. As the municipal representative explained on the nonparticipation of NGOs: "[NGOs did not participate] but I continuously informed the local fishing associations and the Swedish Society for Nature Conservation." There are, however, no indications that the lack of inclusion of NGO stakeholders had any significant negative influences on the Ljusnan process.

4.5.2 Fostering and hindering institutional elements

Social capital and networks (5)

The interview responses indicate that the Ljusnan process was permeated by mostly positive relationships and trust among stakeholders. All interviewees stated that there was a respectful environment in the project and that the collaboration went well. Industry representative A mentioned that he felt trust toward the coordinator of the project and CAB representative B said that he was trusting toward the industry representatives. The municipal representative stated that there was a positive spirit in the process because it felt like they were all working toward the same goal. Or, in the words of industry representative B: “[The cooperation] worked very well. We became very close, there was understanding and respect.”

The Ljusnan process also appears to have contributed to the creation of positive relationships and networks among the participants as recalled by the coordinator: “Municipality, CAB, and industry representatives met and rubbed off on each other... indirectly it created networks...we got to know each other and each side’s arguments.” Industry representative B’s opinion coincides with this evaluation of the process: “The positive part is that we gained a larger network, an increased understanding of the values of the basin as well as what the public authorities prioritize. The knowledge exchange of the project was beneficial”.

Capability of formalizing new practices, arrangements, norms and values (6)

The first phase of the Ljusnan process, which included representatives from the two CAB and five municipalities in the Ljusnan River basin, shows evidence of institutional capability to formalize new practices and arrangements. The Ljusnan process was an attempt to develop a model for combined permit reviews in river basins affected by hydropower production and as such departed from previous practices of river restoration in Sweden (CAB 2008). In interviews, the coordinator explained how the participants from each CAB and municipality in the Ljusnan process managed to cooperate, reach agreement, and embed the decisions taken in the Ljusnan process formally among politicians and civil servants of each municipality and CAB in the Ljusnan River basin: “The working group compiled [the work] and the civil servants in each municipality embedded it in their respective organization. I embedded the work at the CAB as well as politically.” Although it is more difficult to say something about formalizing new norms and values, our findings do not reveal any evidence that points toward a lack of such a capability among the authorities that participated in the Ljusnan process.

An organization that fits the relevant ecological unit (7)

No basin-wide institution existed nor was created to cover the whole Ljusnan River basin. However, the public authorities present in the Ljusnan process, both at the county and municipal levels, covered the Ljusnan River basin almost entirely. The first phase of the Ljusnan process was, in addition, dedicated to the cooperation and agreement among the participating public authorities. This allowed them to act in a coordinated and similar way to one basin-wide institution in phase two of the Ljusnan process. This was confirmed by the coordinator who mentioned that there were no problems of cooperation between public actors: "It worked well. We were all on the same side which made it simpler despite some differences in the angle of incidence."

Authorities lacking experience, facing spatial misfits and problems of coordination (8)

In phase one of the Ljusnan process, public authorities at county and municipal levels in the Ljusnan River basin had the opportunity to coordinate the positions and mode of cooperation. Although there is evidence from the interviews that there was a difference in opinion and style between the public representatives in the Ljusnan process, there is no evidence that participants faced difficulties in terms of coordination and lack of experience from stakeholder processes. The CAB and municipalities present in the Ljusnan process also effectively covered the whole of the Ljusnan River basin, which meant that there was a good fit between the administrative and biophysical units.

Stakeholders possessing strong pre-existing rights over the natural resource (9)

The hydropower producers that participated in the Ljusnan process were in possession of strong water rights for hydropower production. Permits for hydropower production are unlimited in time in Sweden and very difficult to modify against the wishes of the operator. Apart from staying within the legislated compensation free limit for river restoration measures, the public agency proposing a permit review must provide technical studies and documentation to persuade the court that the proposed changes, such as mandatory minimum flow releases and construction of passage facilities, are technically feasible, reasonable, and do not lead to the imposition of conditions that significantly interfere with hydropower production (Rudberg et al. 2015).

Interviewees agreed that most public representatives in the Ljusnan process underestimated the important hurdles facing public authorities pursuing a hydropower permit review. Interviewed participants further concurred that one of the main reasons for the lack of outcomes from the Ljusnan process was that the dominant hydropower producer in the basin did not agree with the public stakeholders' basic idea that there existed a compensation free limit for river restoration measures. The legislated compensation free limit for river restoration measures is rather only one of several limitations established by Swedish legislation restricting the opportunities and scope for river restoration measures. Other notable limitations include that the public authorities initiating a review bear the burden of proof and must convince the court that proposed river restoration measures are reasonable considering its costs and benefits. In the words of industry representative A: "From [the public side] there was a general and unrealistic faith in the opportunities for permit reviews ... the legislation also contains a clause requiring that the costs of measures should match the benefits."

Industry interviewee B explained that the objective of the main hydropower producer in the basin was to limit the production loss of the envisioned environmental measures. They therefore attempted to focus the work of the Ljusnan process on tributaries, with smaller hydropower stations than the main river, in which river restauration measures would lead to minimal production losses. Project reports from phase two also revealed that industry representatives introduced the idea of hydropower expansion by constructing new installations in the Ljusnan River basin to compensate for the production loss of envisioned river restoration measures. This suggestion did not prosper and in 2007, toward the end of the Ljusnan process, the public side made an offer of proposed measures that included the creation of 16 passage facilities, the increased minimum flow at 19, and the removal of an additional 4 hydropower stations and dams in the Ljusnan River basin (CAB 2007). The public side calculated that this offer would create a cumulative production loss, because of environmental measures, of just over 2% of the basin's total hydropower production value.

The response of the main hydropower producer to the public side's formal offer was to exit the Ljusnan process because, in the words of industry representative B: "According to their [the public actors'] opinion the public could demand 5% of [production] value without compensating. They placed their offer at half that sum and believed it to be a good compromise. We were, at the time, unable to continue working on those terms and it all stopped." In the formal reply, the dominant hydropower producer in the basin justified the decision to exit the Ljusnan process by reference to global warming as the dominant environmental threat and arguing that hydropower production should not be reduced because of its key role in mitigating climate change.

4.6 Discussion

4.6.1 Can the Ljusnan process be characterized as a learning-based intervention?

Judging from the in-depth analysis of the process goals, documents, and interviews with key stakeholders, the Ljusnan process fits our definition of social learning as a process of iterative reflection that occurs from sharing experiences, ideas, and environments with others. It can also be considered a learning-based intervention because government-led participation was meant to trigger or support social learning. In addition, the empirical material demonstrates the presence of various significant procedural factors identified to support social learning, such as sustained interaction and joint knowledge acquisition, sharing, and deliberation.

There are however different strands of thinking and numerous definitions of social learning in the literature (Dyball et al. 2007, de Kraker 2017). Indeed, some more stringent definitions of social learning include requirements to demonstrate changes in understanding that go beyond the individual and occur through interaction in a social network (Reed et al. 2010), the creation of a common vision and priorities (Dyball et al. 2007), or at least evidence of convergence of ideas among stakeholders regarding both goals and means to deal with a problem (Van Bommel et al. 2009). The application of one of these more stringent definitions of social learning would question whether the Ljusnan process was a social learning process at all. The vision and goals of the Ljusnan process were, for example, formulated among public stakeholders and the hydropower operators intended, and failed, to include hydropower expansion as a goal in the process to compensate for envisioned production losses from environmental measures.

Although the preceding paragraph illustrates that there is scope for valid disagreement, we still argue that overall there are sufficient arguments to characterize, and meaningfully analyze, the Ljusnan process in terms of a learning-based intervention.

4.6.2 Outcomes from the Ljusnan process

Suškevičs et al. (2018) proposed a list of five types of possible learning outcomes from learning processes related to natural resource management. Analyzed as a learning-based intervention, the empirical material presented from the Ljusnan process shows evidence of changes that fits into various of these defined learning outcomes, including knowledge acquisition, changes in individuals’ feelings toward each other, and changes in networks. A different methodology, including participant observation and prior and post process interviews, would have shed additional insight into some of the cognitive and relational processes at work during the Ljusnan process.

Our primary focus is, however, on learning-based interventions to implement environmental policy, which require natural resource management outcomes. There were no such outcomes as a direct result of the Ljusnan process. Ten years after the finalization of the process, it is not possible to find much evidence that the knowledge acquisition, trust building, and network creation that did occur in the process, even in a longer term, has resulted in significant natural resource management outcomes in the basin. From the interviews and available documentation, it was only possible to relate two natural resource management outcomes in the basin to the Ljusnan process: one permit review in 2015 to increase the minimum flow of one hydropower station and a loach restoration project during 2009-2012 in the upper reaches of the basin. Given the time and resources spent on the Ljusnan process and compared to the public side’s proposed restoration measures, even these long-term natural resource management outcomes can be considered insignificant.

4.6.3 Critical role of legislation

The in-depth analysis of the Ljusnan process shows that it featured a significant number of procedural and institutional elements identified to foster social learning. The Ljusnan process featured sustained interaction, joint knowledge acquisition, sharing, and deliberation in a trusting environment. Until the end of 2006 there is evidence of skilled facilitation of the process and all stakeholders present in the process were relevant. The public authorities leading the Ljusnan process exhibited the capability of formalizing new practices related to river restoration as well as the capacity to coordinate and lead the stakeholder process. The fit between the biophysical scale of the Ljusnan River basin and the administrative scale of the public authorities participating in the Ljusnan process was also appropriate. Despite exhibiting all these fostering procedural and institutional factors, the Ljusnan process has resulted in insignificant natural resource management outcomes, even 10 years after its finalization. The main hindering institutional factor identified in the Ljusnan process, i.e., strong pre-existing water rights among a share of stakeholders, provides a compelling explanation for this result.

Institutions can be analyzed as expressions of power to protect interests of certain groups, and legislation as formally sanctioned rules to regulate conflict in situations in which interests cannot be harmonized (Vatn 2005). A learning-based intervention that includes negotiation of incompatible interests and zero-sum interactions, as was the case with the Ljusnan process, can therefore be expected to be heavily influenced by the legislation embedding the process. The underlying assumption from the public side in the negotiations was that a lack of agreement in the Ljusnan process would result in extensive, case by case, permit reviews of various hydropower stations in the basin that, in the end, would result in higher production losses and costs for the operators (CAB 2007). The strong pre-existing water rights among the hydropower operators, granted by legislation governing hydropower production and river restoration in Sweden, undermined this assumption. Existing legislation granted the hydropower producers the power to successfully reach its objective, i.e., limiting production loss, through the unilateral action of exiting the Ljusnan process.

Power is repeatedly brought up in the literature of participation and social learning (van den Hove 2006, Reed 2008, Crona and Parker 2012). Some authors even identify power or power imbalances as determinant of social learning (Ison et al. 2007, Rodela 2013, de Kraker 2017). The Ljusnan process sheds light on the role of legislation in determining stakeholder interdependence in a learning-based intervention because it ultimately granted one stakeholder the power to successfully take unilateral action. Although our results from the Ljusnan process show that various learning outcomes are possible in stakeholder processes that feature important power imbalances, including knowledge acquisition, trust building, and creation of networks; they also suggest that the power imbalance limited the process from reaching significant natural resource management outcomes. In other words, the conflict originating from zero-sum interactions between river restoration and hydropower production could not be overcome through the learning-based intervention given the existing legislation, despite the process' excellent procedural elements.

It is, however, also possible to interpret some actions of the public stakeholders as displays of power that limited the scope of possible solutions and thereby contributed to the lack of outcomes (Van Bommel et al. 2009). In particular, by defining the vision and goals of the Ljusnan process in line with EU and national environmental policy, public stakeholders reserved the prerogative of problem definition and structuring, and thereby limited the range of politically acceptable arguments and solutions (Hisschemöller and Hoppe 1995). This is illustrated in the Ljusnan process by the failure of hydropower producers to introduce the goal of hydropower expansion as a compensation for possible production losses from environmental measures. The suitability of these actions by public authorities ultimately boils down to a discussion of whether public stakeholders, guided by environmental policy, possess higher legitimacy to define environmental problems compared to other stakeholders, guided by private or corporate considerations.

4.6.4 Comparing the Ljusnan process with learning-based interventions for river restoration related to hydropower production in the EU and US

To put our findings into perspective and to allow for additional material to explore the role of the legislation embedding a learning-based intervention, we compared the findings from the Ljusnan process with two well-documented cases harboring very different outcomes. The first case is a learning-based intervention in the form of a stakeholder process conducted between 1992 and 2004 in the Dordogne basin in the south of France (Barraqué et al. 2004). This case is similar both in terms of scale of hydropower production, 58 dams and 28 hydropower stations with a production capacity of 1550 MW (EDF 2015), and the two major issues at stake in the process, i.e., (1) the impact of hydropower discharges on water quality and levels, and (2) the management of the aquatic environment (Barraqué et al. 2004, Mostert et al. 2007). The reported outcome from the Dordogne stakeholder process, in terms of river restoration measures related to hydropower production, were limited to an agreement to increase the minimum flow downstream one hydropower dam in the basin. The authors identified the governance structure and the pre- existing distribution of water rights as the main obstacles to allow for social learning in the stakeholder process (Barraqué et al. 2004, Mostert et al. 2007). Hydropower concessions in France are granted for 75 years and in the Dordogne basin the first ones would come to an end after 2010.

The second case, in the Penobscot basin in the USA, is a learning- based intervention in the form of a stakeholder process to relicense various hydropower projects according to the US Integrated Licensing Process. This hydropower licensing process, developed in 2003, aims to increase public participation and find ways for stakeholders to reach agreements outside of the courtroom (FERC 2011, Opperman et al. 2011a). This stakeholder process concerned hydropower stations and dams, producing on average 0.3 TWh/year, and led to an agreement that included various river restoration measures, including the removal of the two most seaward dams and new, or improved, passage facilities at five dams in the basin (Opperman et al. 2011a). The measures drastically improved access for various migrant species in the river and, through capacity and operational changes of existing stations, maintained the total basin energy generation at previous levels. Opperman et al. (2011b) identified three factors that facilitated the comprehensive approach in the stakeholder process: previous conflicts and expenses that had accompanied the relicensing of individual nonfederal hydropower dams, single ownership of the hydropower facilities, and the legal battle over the status and rights of the Penobscot Indian Nation in hydropower licensing decisions.

Similar to the Ljusnan process, these two cases suggest that the legislation embedding a learning-based intervention conditions the possibility of reaching significant natural resource management outcomes. In the Ljusnan River basin, the legislation, in the form of indefinite permits for hydropower production that are very hard to modify, allowed the main hydropower operator to reach its objective of limiting production losses through unilateral action. The public stakeholders in the Ljusnan River basin, on the other hand, almost completely failed to meet any of their objectives in the basin. Similarly, in the Dordogne basin, there was a very limited river restoration outcome reported from the stakeholder process, which in part can be related to the fact that the hydropower producers in the process were in possession of strong pre-existing water rights for hydropower that, at the time of the study, were still many years from expiring.

By contrast, in the Penobscot basin, it can be argued that two identified legislative features, hydropower licenses that expire regularly and the granting of special rights to Native Americans of natural resources on their tribal lands, are factors that create a level of interdependency of stakeholders that facilitated the reaching of a comprehensive hydropower licensing agreement. The legal arrangements in the USA related to river restoration and hydropower production provided stakeholders in the Penobscot basin with tools to effectively challenge and thwart the possibilities for the hydropower operator to reach its objectives through unilateral action. The combination of river restoration measures with capacity and operational changes of existing stations, to maintain the total basin energy generation, also evidences the possibility, in some cases, of escaping zero-sum interactions through adopting a basin-scale approach. Besides the Penobscot case, there are other examples of river basins in the USA that exhibit similar legislative arrangements, i.e., river basins on Native American tribal land and the relicensing of hydropower projects, in which stakeholders have agreed on collaboratively negotiated proposals that include significant river restoration outcomes (Birge et al. 2014, Chaffin et al. 2016).

4.7 Conclusion

We explored the relationship between learning-based interventions and natural resource management outcomes by focusing on the Ljusnan process. This stakeholder process represents an important and sustained effort for river restoration associated with hydropower production, which failed to reach any significant natural management outcomes. We discussed to what extent the Ljusnan process can be characterized as a learning- based intervention, and developed a research framework to analyze how related procedural and institutional factors can explain the lack of natural resource management outcomes.

We concluded that the Ljusnan process can be meaningfully analyzed as a learning-based intervention and that it featured virtually all procedural and institutional factors understood to foster social learning. The main hindering institutional element consisted of hydropower producers possessing strong pre-existing water rights, granted by Swedish legislation governing hydropower production and river restoration. This situation gave the dominant hydropower producer the power to reach its objective successfully, i.e., limiting production loss, through the unilateral action of exiting the Ljusnan process. The Ljusnan process does show that various learning outcomes, such as knowledge acquisition, trust building, and creation of networks, are possible in stakeholder processes that feature significant power imbalances. The same power imbalances were, however, crucial in stopping the learning-based intervention from reaching significant natural resource management outcomes.

The analysis of the Ljusnan process, as well as a comparison with cases in the EU and the USA, therefore highlight the paramount role that the legislation surrounding a learning-based intervention has on the prospect of reaching significant natural resource management outcomes. As such, future research, as well as policy initiatives, could further investigate the possibility of initiating learning interventions in combination with hydropower relicensing in various mature hydropower producing countries. This includes various EU member states and nonfederal hydropower projects in the USA that have systems of granting hydropower production rights that are limited in time and periodically renegotiated. Sweden is excluded from such research efforts until the end of 2018 because hydropower permits, until that time, have no time limit. Important legislative adjustments have however been passed in the Swedish parliament, and will enter into force in January 2019, including a general limit to the term of hydropower permits of 40 years and shifting the burden of proof in permit review trials to hydropower operators. These changes constitute significant modifications to the legal arrangements surrounding river restoration and hydropower production and could provide a unique research, as well as policy, opportunity in Sweden to revisit learning-based interventions for environmental policy implementation in this area.

More generally, our research findings highlight the importance of assessing the legislative setting of a natural resource management situation prior to engaging in a sustained learning- based intervention. In many parts of the world, various stakeholders have prior rights to the use of natural resources and existing legislation can make it virtually impossible to modify such rights against these stakeholders' wishes. In such circumstances, sustainable management of natural resources could be better served by efforts to modify existing legislation to increase stakeholder interdependency, rather than in resource-intensive, learning-based interventions with a high risk of insignificant outcomes.

CHAPTER 5: Beyond generic adaptive capacity: exploring the adaptation space of the water supply and wastewater sector of the Stockholm region, Sweden

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Abstract

This chapter examines the processes by which the generic adaptive capacity of a system is translated into adaptation to climate change, what form it takes, and what factors facilitate or restrain such processes. This is done by an in-depth analysis of climate change adaptation in the Water supply and Wastewater (WW) sector of the Stockholm region. Observed adaptations are categorized in terms of building adaptive capacity and implementing adaptive decisions, and these measures are analyzed using a model of the adaptation process based on organizational learning theories. In particular, the concept of an organization's actual adaptation space is defined and used as a means to understand the adaptation options that different WW organizations can pursue, as well as why such options might be pursued. The chapter finds that most adaptation measures in the WW sector of the Stockholm region are aimed at building the adaptive capacity of the sector. It also finds that the extent to which adaptation measures can be pursued by the WW organizations is determined principally by how able the organization is to justify the additional resources required for adaptation. The analysis shows that there are two main routes to address this: use of climate knowledge to argue that adaptation is needed, and reference to rules and regulations to show that it is required.

Keywords: *adaptive capacity, adaptation space, organizational learning, water supply and wastewater*

5.1 Introduction

As the climate changes, the conditions for water management will alter, in many cases leading to increased vulnerability of the current water infrastructure (Milly et al., 2008). Adaptation of the water sector to climate change impacts is necessary to reduce vulnerabilities arising from climate change and to take advantage of possible opportunities in the future (Bates et al., 2008). This chapter examines the process by which a system's generic adaptive capacity is translated, or not, into actual adaptation to climate change by focusing on the main organizations of the WW sector of the Stockholm region. The chapter identifies and analyzes the factors that influence the feasibility and attractiveness of the adaptation options available to those organizations.

The WW sector of the Stockholm region is both sensitive to the anticipated effects of climate change and has a critical function in society (Holgerson et al., 2007; Tyréns, 2009). It also appears that the region and its WW sector possess sufficient generic adaptive capacity to adapt, according to the indicators suggested by Smit et al. (2001). This assumption is based on an international comparison in which Sweden has been identified as a country with very limited vulnerability to climate change due to its high adaptive capacity (Yohe et al., 2006b; Yohe et al., 2006a). The Stockholm region, and by extension its WW sector, can be expected to possess similar levels of adaptive capacity as the country as a whole, if not more, since the levels of wealth, education, and management resources are higher than the national average (RTK, 2009).

There are cases of systems possessing high adaptive capacity but only implementing a limited number of adaptive measures. Recent research in the field has tried to understand this issue by focusing on both the real and potential barriers to adaptation. These barriers include perception of risk (Weber, 2006; Baron, 2006); complacency (O'Brien et al., 2004); institutional obstacles (Næss et al., 2005); and social, financial and cultural constraints (Ford et al., 2006; Thomas and Twyman, 2005; Smit and Skinner, 2002). Against this background, the framework presented by Berkhout et al. (2006) on the process of adaptation in business organizations is of particular interest. With this perspective, some of the perceived lack of adaptation measures can be explained by the fact that climate change is only one of several drivers and pressures that organizations have to relate and adapt to.

In light of the above, the Stockholm WW sector is a highly appropriate case to examine since it represents a system with high generic adaptive capacity where there is an identified need to adapt to anticipated effects of climate change. As such it can offer insights into the process by which a system’s generic adaptive capacity is translated, or not, into actual adaptation to climate change, the form that the adaptation takes, and what facilitates or limits such processes. Such insights can further the understanding of how organizations and society in general adapt to climate change, and be of particular interest to other regions and systems with high generic adaptive capacity.

The following section explores the concept of adaptive capacity, suggests a division of adaptation measures in terms of building adaptive capacity and implementing adaptive decisions and presents the model of organizational adaptation used for analysis. Sections 5.3 to 5.5 present the methodology of the empirical research, case study context and possible impacts from climate change. Sections 5.6 and 5.7 analyze the adaptation measures of the Stockholm WW sector and use the model of organizational adaptation to identify and analyze the factors that influence the ability of the WW organizations to adapt to climate change. The final section draws out the key conclusions of the chapter where the findings are discussed in relation to the broader literature on adaptation to climate change.

5.2 The adaptation process and space

Vulnerability is one of the key analytical concepts in the literature on adaptation (Adger, 2006; O'Brien et al., 2004; Yohe, 2000), and it is generally understood as a function of exposure, sensitivity and adaptive capacity (Schneider et al., 2001). Adaptive capacity can be defined as "the ability of a system to adjust to climate change…to moderate potential damage, take advantage of opportunities or to cope with the consequences" (IPCC, 2007a, p. 869). On an aggregate level, adaptive capacity has been identified as dependent on factors such as wealth, technology, education, information, skills, infrastructure, access to resources, stability and management resources. Smit et al. (2001, p. 879) argue that "[an] enhancement of adaptive capacity reduces vulnerabilities"

Developments over the last decade have however shown that possessing high adaptive capacity based on these metrics may not in itself necessarily lead to a reduction of vulnerability to the kind of extreme weather events that, very likely, will become more frequent in a changing climate (IPCC, 2007b). For example, France has high adaptive capacity according to the factors identified by Smit et al. (2001). Despite this, the country experienced higher than average death rates from the heat wave in 2003. The reasons for this were, among others, an overall lack of reactivity of the population, poor knowledge of health problems related to heat, and lack of prevention recommendation (Fouillet et al., 2008).

These experiences suggest that the link between high adaptive capacity and reduced vulnerability is not direct. In an effort to enrich the understanding of adaptation processes and their role in reducing vulnerability it has been argued that measures, in principle, can be divided into two dimensions: *building adaptive capacity* and *implementing adaptive decisions* (Adger et al., 2005; Füssel and Klein, 2006). This division reflects the fact that adaptive capacity can exist and be built without this capacity necessarily reducing vulnerability. In this chapter, measures such as commissioning research and writing reports on the exposure and sensitivity of the WW system are characterized as building adaptive capacity. Measures such as raising minimum connection levels to the sewer of new buildings or investing in new water purification technologies are understood as implementing adaptive decisions.

Table 5-1 gives an overview of this division of adaptation measures which we argue can be applied generally to WW systems.

Table 5-1: Examples of adaptation measures in the WW sector, by concepts of building adaptive capacity and implementing adaptive decisions

Building adaptive capacity	Implementing adaptive decisions
• Research and reports on exposure and sensitivity of the WW sector • Enhancing cooperation regionally, nationally and internationally between WW organizations • Raising awareness of climate change among decision makers and the public • Increasing the organization's human capacity in key areas such as research, planning and environmental scanning	• Investments to change the technology used to carry out WW services, for example water purification and wastewater treatment processes • Changes in standards, such as raising the minimum connection level to the sewer • Changes in planning of new urban areas to increase the capacity for storm-water drainage • Changes in investment programs to speed up sewer system renovation and increase the speed of replacement of combined sewer into separated sanitary and storm-water sewer

5.2.1 Model of adaptation and actual adaptation space

In the model of adaptation suggested by Berkhout et al. (2006), adaptation to climate change is conceptualized as a process of organizational learning (Nelson and Winter, 1982; Cyert and March, 1992) which leads to a change of the routines of the organization. "Routines" are in this framework broadly interpreted as the rules, procedures and knowledge that guide the behavior of the organization (Levitt and March, 1988). The learning process is based on *awareness and interpretation of climate change*, *search for and articulation of possible solutions* and *feedback from adaptations undertaken* (Berkhout et al., 2006). In order for the organization to consider changing its routines and adapt, it needs to be aware of climate change signals and interpret these as significant and in need of a response (Daft and Weick, 2000). This awareness opens up a search for possible changes which are articulated and evaluated under the assumption that they should not have negative performance implications for the organization (Zollo and Winter, 2002). A change creates feedback that could come in the form of performance improvements or from outside actors that give positive or negative feedback on the changed routines (March, 1991).

Berkhout et al. (2006) identify a wide range of available adaptation options defined as an organization's "adaptation space". "Available" in this context means "not concerned with costs and benefits in any given option, but with technical and organizational practicability in principle" (Berkhout et al., 2006, p. 148). The authors acknowledge that not all options are equally feasible and attractive and that contextual factors, such as the market and regulatory context, can restrict the adaptation space. However, Berkhout et al. (2006) do little analysis of how and why options within the adaptation space become more or less feasible and attractive and how this influences the adaptation that is pursued. In this case study we explicitly focus on the factors that influence the feasibility and attractiveness of the different adaptation options available to the WW organizations. This provides an understanding of the *actual adaptation space* of an organization which helps explain how and when the generic adaptive capacity of a system is translated into adaptation measures.

5.3 Method

It is not straightforward to separate adaptation measures related to climatic change from those that are carried out in response to other social, demographic and economic changes (Adger et al., 2005). Modifications of a system in response to non-climatic stimuli may unintentionally serve as an adaptation to climate change (Smit et al., 2000), and it has been shown that intentional adaptation measures generally occur due to a combination of factors (Smit and Wandel, 2006). The challenge of separating climate change adaptation from adaptations to other types of stressors holds for the WW sector of the Stockholm region as well.

To gain relevant empirical data, 21 semi structured interviews were conducted during 2009 with representatives from the management group and operational staff in four of the five regional WW organizations in the Stockholm region. An interview guide was developed based on Berkhout et al.'s (2006) model of organizational learning which was used in all interviews. The qualitative data analysis followed an analytical approach based on meaning categorization as suggested by Kvale (1996, p. 196). More information on the method can be found in Rudberg (2010a)

The four regional WW organizations studied – Norrvatten, Stockholm Vatten, Roslagsvatten, Käppalaförbundet – represent a clear majority of the WW services carried out in the Stockholm region as shown in Table 5-2. Conclusions are therefore relevant for the WW sector of the Stockholm region as a whole. In-depth interviews with key stakeholders in the region provided a comprehensive picture of the measures adopted in the organizations that are related to climate change based on what the intentions and outcomes of the measures were. The relevant measures were then separated in accordance with the division set out in Table 5-1.

The interviews were complemented with an analysis of official documents from the four organizations and the regional Stockholm Water and Sewage Cooperation Council in which the studied organizations participate. Three additional interviews were also conducted with the Swedish Water and Wastewater Association (SWWA).

Table 5-2: Information on the Stockholm Region WW organizations analyzed in this study

	Services	Customers		Turnover (MEUR** in 2008)
		Municipalities	Inhabitants*	
Norrvatten	Water supply	11	500 000	14
Roslagsvatten	Sewer	4	80 000	22***
	Wastewater	4	56 000	
Käppala	Wastewater	11	410 000	23
Stockholm Vatten	Water supply	11	1200000	121
	Sewer	2	900 000	
	Wastewater	6	980 000	

* The Stockholm Region has 2 million inhabitants living in 26 municipalities
** Million Euros
***Turnover is for 2007

5.4 Case study context

The population of the Stockholm region is growing, and is expected to expand to between 2.3 and 2.5 million inhabitants by 2030, an increase of between 15 and 25 % compared to today (RUFS, 2010). One of the region's main strategies to accommodate this population growth is to build denser residential areas in the urban centers of the region (RUFS, 2010). In terms of water supply there is a move towards increased efficiency by taking advantage of economies of scale (SWC, 2010), and an increasing number of municipalities in the Stockholm region, and beyond, are connected to Norrvatten and Stockholm Vatten. These suppliers draw their water from Lake Mälaren which serves approximately 1.7 million of the region's inhabitants. The Baltic Sea is the main recipient of the region's wastewater. The municipalities of the Stockholm region are responsible for the provision of WW services, which include planning, construction and operation of facilities for water provision and wastewater treatment.

SWWA is the national trade association of WW organizations in Sweden. SWWA recommends that the sewer system should be built in such a way that it can drain a ‘10-year rainfall event’ – a heavy rainfall that statistically appears once every 10 years (SWWA, 2004). This recommendation can be seen as similar to a regulation because it is used by the Swedish Water Supply and Sewage Tribunal which arbitrates in disputes between WW organizations and individuals that have experienced flooding from sewers (VA, 1993).

Stricter environmental regulation is likely with the ongoing implementation of the EU WFD in Sweden. To reach the WFD targets a 35% and 50% reduction in anthropogenic phosphorus and nitrogen release is necessary. This increases the requirements for wastewater treatment (RBDA, 2009a).

When comparing the WW organizations it should be acknowledged that there are differences in the level an type of risk associated with different water services. In this chapter a standard conceptualization of risk is used where it is defined as the combination of the probability of an incident occurring multiplied by the consequences such an incident would have (NFA, 2007). In the case of water supply there are large scale, high impact societal consequences associated with a failure to provide adequate water for the population of the Stockholm region (Tyréns, 2009). Problems associated with storm water discharge and the sewer could be significant, but are generally more local in scale and mainly have economic consequences due to flooding of properties. Wastewater treatment failure mainly has environmental consequences and primarily occurs in the water body where the wastewater is released.

5.5 Possible climate change impacts in the region

The possible impacts described below are expected during the course of this century. One of the major potential impacts from climate change in the region is a change in the precipitation pattern, manifested in an increase in the total volume of precipitation of 10 % per year (SMHI, 2009b). There could be an increase of precipitation during winter of around 40 % while summer months could experience a decrease of 20 %. The probability of extreme precipitation events is envisaged to increase over the whole year. Increasingly there are signs that the projected increase of sea level will have to be revised to account for loss of Arctic and Antarctic ice sheet mass (van den Broeke et al., 2009; Chen et al., 2009), which could lead to a raise of

Table 5-3: Summary of climatic and other drivers in the Stockholm region, on a decadal time scale, impacting the WW services

<table>
<tr><th colspan="2" rowspan="2">Driver</th><th colspan="3">Impacts</th></tr>
<tr><th>Water supply (Lake Mälaren)</th><th>Sewer system</th><th>Wastewater treatment</th></tr>
<tr><td rowspan="6">Climatic</td><td>Increasing average temperatures</td><td colspan="2" rowspan="4">Increasing probability deteriorated water quality (turbidity, pathogens, pollution, eutrophication)</td><td rowspan="5"></td></tr>
<tr><td>Decreasing time of snow and ice cover</td></tr>
<tr><td>Increasing precipitation</td></tr>
<tr><td>Changing precipitation pattern</td></tr>
<tr><td>Rising sea level</td><td>Increasing probability of salt-water intrusion from Baltic Sea</td><td rowspan="4">Increasing probability of local flooding from sewer system</td></tr>
<tr><td>Increasing frequency of extreme precipitation events</td><td rowspan="3"></td><td rowspan="2">Increasing probability of overflow discharge</td></tr>
<tr><td rowspan="5">Other</td><td>Increasing impermeable surface area</td></tr>
<tr><td>Increasing attractiveness of
building on unsuitable land</td><td></td></tr>
<tr><td>Stricter environmental regulations and water protection (WFD)</td><td>Increasing probability of improved water quality</td><td rowspan="3"></td><td>Increasing probability WW operations in conflict with environmental rules</td></tr>
<tr><td>Upscaling water supply</td><td rowspan="2">Increasing consequences in case of water supply problem</td><td rowspan="2"></td></tr>
<tr><td>Increasing population density</td></tr>
</table>

sea level of up to roughly 1 meter by the end of this century (Rummukainen and Källén, 2009). One important geological characteristic of the region is an approximate 52 cm land elevation per century following the latest glacial period (Hammarklint, 2011) which moderates the expected increase of sea level in the region. A probable increase of average temperature during this century is around 3–4 °C (SMHI, 2009a).

More frequent heavy precipitation events, increased precipitation during winter and fewer days of ice coverage in Lake Mälaren lead to increased run-off from land and increased frequency of overflow discharges from wastewater treatment plants. Together these changes could lead to increased turbidity of the water of Lake Mälaren and increase the concentration of pathogens and pollution (Rudberg, 2010b). Decreased precipitation during summer months and higher temperatures increase the probability of low water tables and eutrophication of the lake. No absolute shortage of water is envisaged in the region but Lake Mälaren is connected to the Baltic Sea, separated by locks which means that a sea level rise greater than the land rise increase the probability of salt water intrusion. In the long term this could make the water in the lake undrinkable with the present water purification technology (Rudberg, 2010b).

Some of the changes occurring in the Stockholm region unrelated to climate change (see the previous section) could combine with and aggravate the effects of climate change during this century. Table 5-3 gives an overview of the climatic and other drivers in the region and how they influence the Stockholm WW sector.

5.6 Characterization of observed adaptation measures

Measures related to climate adaptation could be observed in all organizations. Generally speaking, the measures focused on expected impacts of climate change in longer term strategic areas of the organizations' activities. The observed measures were mainly aimed at building adaptive capacity of the organizations such as strengthening in-house expertise and analyzing threats to water supply quality. There were examples of implementations of adaptive decisions, the most prominent of these the increase in minimum connection levels to the sewer for new urban developments in two organizations and changes to purification techniques in the water supply in one organization. Table 5-4 provides a summary and characterization of the observed adaptation measures for each organization. For a more extensive analysis see Rudberg (2010a).

Table 5-4: Summary and characterization of observed climate change adaptation measures in the WW sector of the Stockholm region

	Building adaptive capacity	Implementing adaptive decisions
Norrvatten	• Strengthened in-house expertise • Increased focus and research on impacts affecting water quality • Risks communicated to political steering committee and included in annual report	• Improved water purification techniques
Stockholm Vatten	• Strengthened in-house expertise	• Raising minimum connection level to sewer system with 0.6 meters
Käppala		• Change in fee structure to incentivize refurbishment of sewer[124]
Roslagsvatten	• Increased human capacity for storm-water discharge planning and coordination	• Raising minimum connection level to sewer system with 0.5 meters • Higher safety levels for storm-water drainage in new areas
Stockholm Water and Sewage Cooperation Council	• Reports on threats to water supply quality of Lake Mälaren	
Swedish Water and Wastewater Association	• Prioritization of funds for research on water supply and storm-water discharge in relation to climate change	

[124] Not specifically implemented due to climate change but decreases the in-leakage which reduces the sensitivity to precipitation

5.7 Exploring the actual adaptation space

This section focuses on understanding the key issues that influence the feasibility and attractiveness of the available adaptation options, which creates the *actual adaptation space* available to the WW organizations. To do this the three steps of the model of the adaptation process suggested by Berkhout et al. (2006) were applied as explained in section 5.2.1. The most recurrent factors were identified and quantified by carrying out meaning categorization (Kvale, 1996, p. 196). The main part of this section is dedicated to the second step of the model – search for and articulation of possible solutions – since this is where the majority of relevant findings were made. For a more extensive analysis and quantitative presentation of responses see Rudberg (2010a).

5.7.1 Awareness and interpretation of climate change signals

The majority of respondents clearly stated that their organization was not yet experiencing impacts of climate change directly. Most argued that any variability experienced recently had been seen before, or did not mention any observations that could be connected to climate change: “We have not really seen anything if we look at Stockholm…if you look back in time this [extreme weather events] has occurred earlier as well” (respondent T). Interviews showed that most of their information on climate change came from the media, scientific publications and conferences. In terms of interpreting the mainly indirect signals of climate change most respondents expressed the view that it will affect their organization and gave relevant examples of how this would occur. Other respondents either recognized that there may be impacts but stressed the uncertainties related to climate change, or that they had not yet formed a full opinion about climate change, and therefore found it hard to comment on possible impacts: “I am trying to form an opinion [about climate change]…it is therefore hard to relate it to my professional activity” (respondent Q).

5.7.2 Search for and articulation of possible solutions

Most respondents were aware of how climate change may affect their business and felt that their organization ought to take measures to adapt. The respondents were also able to identify different adaptation options that would reduce the sensitivity and exposure of the WW system to climate change. These included changes to the water purification technology, changes to the planning of new areas and physical changes to the WW infrastructure. In the search for possible adaptation options a number of issues were raised by the respondents that influence the feasibility and attractiveness of the different options. The most recurrent were economic factors, knowledge, and rules and regulations which are discussed below.

Economic factors appeared as the most recurring issue, raised by 10 out of 21 interviewees. They were seen as either important or the most important factor influencing the possibility to adapt. However, it was evident that it is not a lack of economic resources in absolute terms. Rather, there were concerns about how increased spending to fund adaptation would be received by the politicians of the municipalities that set the WW fee: "it is not price sensitivity because people lack money, it is rather price sensitive politics" (respondent H)

Assessing possible impacts from climate change on the organization's activities and implementing adaptation measures may also be an awkward task. It means diverging from the standard way of working, and it requires time, energy and money both to work out what adaptation measures to implement and to convince the relevant politician and public in general of its necessity: "It is always hard to push through when it deviates from the standard… climate adaptation always requires much more money" (respondent K)

There are also significant signals from the market to construct new residential areas close to the sea and in centrally located areas where the land has a high economic value, but is less suitable for construction from a WW perspective: "Everybody wants to live close to the sea. A new area in our municipality is built basically below sea level" (respondent L)

Knowledge – and its limitations due to the scientific uncertainties – was brought up by seven respondents as a critical determinant of the ability to adapt to climate change. Most interviewees agreed that a solid knowledge base would enable necessary investment decisions. It was however argued that such knowledge is usually hard to provide due to the uncertainties related to climate change information. The knowledge base is also closely related to economic factors since it is the basis on which decisions and priorities on investments are made: "We need to be confident enough on the state of knowledge [on climate change] to make changes and new investments" (respondent H)

Few respondents questioned climate change directly as an issue. Many interviewees had however participated in or listened to discussions where the whole concept of climate change had been questioned. There was therefore uncertainty not only about how severe the impacts will be and when they will appear but on a more fundamental level about whether climate change is actually a real phenomenon that poses a threat to the organization. Arguing for substantial resources for adaptation may in this atmosphere be very difficult: "If I were to come to the steering board today and say that we need to rebuild the water plants for almost a billion [100 MEUR], they would say "no, investigate the question further". Then maybe a debate would emerge if climate change really exists" (respondent F)

Rules and regulations were brought up by seven respondents as key determinants of adaptation. They were also linked to economic factors since regulations requiring adaptation are a way of justifying the extra expenditure necessary for adaptation. Regulations would come from national organizations or government agencies. The SWWA recommendations on the required capacity of the sewer system to handle a 10-year rainfall event were particularly important. Most interviewees in Roslagsvatten argued that SWWA should include a "climate factor" to the intensity of rain that is considered a 10-year rainfall event. This would make it possible to refer to the SWWA recommendations to justify increasing the capacity of the pipes of the sewer system. This issue was also brought up by interviewees in the other organizations with a similar message "If we had a requirement on us from the National Food Administration…then we would not have a choice" (respondent F)

In interviews with SWWA it became obvious that changing the intensity of what is considered a 10-year rainfall event it is not a straightforward task since no dramatic changes had been measured in the intensity of rainfall (Dahlström, 2006). SWWA aims to develop a "climate factor" to account for future changes in rain intensity but still has as their main recommendation that new areas should always be built on land where the possibility for surface drainage exists in case of extreme precipitation.

5.7.3 Feedback from adaptation undertaken

There were few measures significant enough and that have been in place long enough to result in feedback from outside actors or performance improvements. One exception to this was the 0.6 m increase in minimum connection level to the sewer implemented by Stockholm Vatten in 2006. The first reaction of real estate developers on this adaptation was very negative although with time the decision was perceived to have been accepted.

Several respondents also raised the problem of insufficient feedback, in terms of performance improvements, if different adaptation options were to be implemented. In one company there was a strong requirement for cost-benefit analysis based on 'facts' to be able to argue for investments to be made: "You have to be able to show that it is profitable for the organization or society at large" (respondent U). It was deemed as very challenging to show performance improvements from adaptation based on the current knowledge of climate change.

5.7.4 Differences between the organizations

When analyzing the four organizations separately some differences appear. Norrvatten had been dedicating a considerable amount of resources to building adaptive capacity to climate change and had implemented an adaptive decision which increased the fees of the organization. Roslagsvatten had to some degree both built its adaptive capacity and implemented adaptive decisions where climate change was one of many factors leading to such measures. Stockholm Vatten had implemented an adaptive decision that does not affect their fees since it results in increased expenditure for real estate developers in the region. In Käppala there had been few measures related to concerns over climate change.

These differences in adaptive measures correlate well with the findings of Berkhout et al. (2006), who found evidence of various adaptation strategies followed by organizations, such as “wait and see”, “risk assessment and options appraisal”, and “bearing and managing risks”. Käppala appeared to follow a wait and see strategy, while Roslagsvatten had started to assess and to some extent manage risks associated to climate change. Norrvatten had come furthest in its risk assessments and had started to bear and manage climate risks. Stockholm Vatten had begun assessing and managing risks in some areas, while in other areas showed evidence of a wait and see approach.

There are several factors that can explain the observed variations in adaptation strategies. One is the different levels of risk associated with the various WW services, another presence of key individuals that have managed to raise the issue of climate change in their organization. The low level of risk associated with wastewater treatment and the limited exposure of the facilities to climate change impacts provide a plausible explanation for the low level of awareness of climate change and the wait and see strategy of Käppalaförbundet. In Norrvatten all respondents referred to one expert within the organization as their main source of information on climate change. This shows how one key individual in an organization can foster ambition and measures toward climate change adaptation.

The literature on organizational learning also provides some possible explanations to the observed differences between the organizations. Daft and Weick (2000) draw attention to the importance of the internal perspective of the organization, referred to as “frame of reference”, that can explain differences in perception, strategy and decision making between organizations that are faced with similar changes that are diffuse and contested. Zollo and Winter (2002) also show how possible adaptation options are subject to an internal selection process based on their performance implications for the organization. Depending on the priorities of the organizations, different adaptation options should therefore be selected or discarded.

Because economic issues emerged as the most important factor influencing the actual adaptation space of the studied organizations, they should also determine some of the observed differences in behavior between them. Stockholm Vatten has adopted a management style with an explicit emphasis and priority on the company's core competences and cost reduction efforts (Stockholm, 2007). In interviews, Stockholm Vatten officials insisted the most on the uncertainties related to climate change – which in their view made it hard to make investments based on climate change information. They also stressed that it was necessary to show "facts" before decisions on adaptation measures could be taken since such measures require large amount of resources. This contrasted with Norrvatten – with an apparently less strict focus on cost efficiency – where the respondents argued that showing negative "trends" from climate change would be sufficient to argue for important investments to implement changes. The change of purification technique implemented in Norrvatten in 2003 – which led to an increase of the municipal fees to the organization – is a case in point since the initiative was based on negative trends of water quality in Lake Mälaren that, at least partially, are climate related. The results therefore indicate that, in an organization with a strong focus on cost reduction, the requirements on the knowledge base of climate change increase in order to justify costly adaptation measures.

5.8 Discussion

This chapter uses a case study approach to examine the processes by which the generic adaptive capacity of a system is translated into adaptation to climate change, what form it takes, and what factors facilitate or restrain such processes. We have argued that the generic adaptive capacity of the WW sector of the Stockholm region has been translated primarily into measures aimed at building the adaptive capacity of the system. There are few examples of expensive implementations of adaptive decisions taken in response to expected climate change impacts. In the studied organizations, it was widely contended that the companies have the capacity to adapt to a range of negative impacts from climate change. Many respondents were readily able to suggest several possible adaptation options that their organizations could pursue. Accordingly, the number of potential adaptation options available to them is quite extensive. However, our analysis illustrates that there are multiple factors that decrease the attractiveness and feasibility of various potential adaptation options. Hence the options that an organization can realistically pursue – the *actual adaptation space* of the organization – may in fact be smaller than one expects.

One of the key questions that influenced the range of adaptation options available to the investigated organizations was the ability to *justify the additional resources required*. In absolute terms, the water and wastewater charges that Swedish households pay are relatively modest in comparison with fees for electricity or heating (Fastigheten, 2009). Several respondents argued that large investments in the WW system would lead to relatively small increases in the charges per capita. At the political level though, tradeoffs are made between the needs of the WW sector and other municipal responsibilities, such as childcare and schools. Our interviews showed a strong demand to keep the combined level of taxes and fees of the municipalities at the lowest level possible while maintaining the required quality of services. Our findings indicate that there are two principal avenues available to motivate important investments for adaptation.

First, by making use of *knowledge* on climate change and its impacts, adaptation measures can be justified by showing that adaptation is necessary. The imprecise and uncertain information about future climate however makes it difficult to show if and when operations will be affected by climate change impacts, and thus if and when adaptation will be necessary. It can be argued that other projected changes in the region that the organization has to adapt to, such as population growth, exhibit similar uncertainties. Our research however shows that the skepticism that to some extent exists in the organizations regarding the very existence of climate change sets it apart from knowledge and projections of other changes in the region. The questioning of climate change on a more fundamental level makes it challenging to use the available knowledge on climate change to argue for investments.

Second, by referring to *rules and regulations,* adaptation measures can be implemented if they are a requirement, regardless of the costs involved. Our results do, however, point towards a lack of clear rules and regulations regarding adaptation at the national level. This void means that the companies are largely left to their own devices in deciding the appropriate level of adaptation. However, interviews with the trade association SWWA suggest that the same problem of uncertainty in relation to climate change and adaptation to its impacts is prevalent also on a national scale. Hence, setting national standards through rules and regulations may not be more feasible than addressing the problem on a case-by-case basis locally.

Building adaptive capacity is in many ways a necessary first step in order to evaluate and understand what adaptation measures should be implemented. In the WW sector, research and measures that build adaptive capacity are however also generally less resource intensive than implementations of adaptive decisions that often entail investments in the range of 10 MEUR and beyond. In a situation where there is a reluctance to increase the WW charges, knowledge on climate change is diffuse and disputed and there are few rules and regulations requiring adaptation, building adaptive capacity becomes an attractive option due to the low costs associated with such activities. The cost difference between building adaptive capacity and implementing adaptive decisions therefore partially explains why a large share of adaptation measures in the region to date are aimed at building the adaptive capacity of the WW organizations.

In systems with high generic adaptive capacity, one of the key questions seems to be the timing of adaptation in relation to the risk of unacceptable negative impacts from climate change. Brooks (2003, p. 10) points this out: “we must ask ourselves whether a system is likely to implement the necessary adaptation measures in the time available to it in order to reduce risk to a subjectively defined acceptable level.” Will climate change be interpreted as significant enough for the organizations to be able to justify important and expensive adaptations before we see serious unacceptable negative impacts on the WW sector? This study indicates that a strong focus on cost efficiency can lead to higher requirements for certainty in climate change knowledge to justify expensive adaptation measures. This could push necessary investments into the future and bring them closer to possible serious negative impacts from climate change.

If such negative impacts emerge relatively slowly and linearly – which most respondents believed – the organizations should indeed be able to limit unacceptable disturbances on the WW services through incremental adaptation. There is however mounting evidence that the effects of climate change may be increasingly abrupt and non-linear. The rapid and unexpected melting of the Greenland Sea ice in 2007 is a clear example of a system reaching a tipping point as it experienced an important acceleration of melting that exceeded the IPCC projections (Zhang et al., 2008; Lenton et al., 2008). Ecosystems under stress are driven by similar dynamics which can lead to unexpected and rapid changes (Scheffer et al., 2001; Folke et al., 2004). The probability that the studied organizations will have to adapt to rapid and unforeseen changing climate conditions thereby increases, and with this the probability of serious negative impacts on the WW sector.

The WW operations depend on long lived infrastructure. Investment decisions made today will have an influence far into the future, when impacts from climate change could be significant. In the literature, it has been argued that planning practices and decision-making frameworks should put more emphasis on making infrastructure decisions robust to a wide array of possible climate futures (Hallegatte, 2009), instead of aiming at optimizing investments based on historical records (Milly et al., 2008). However, Dessai and Hulme (2007) point out that robust solutions usually entail higher costs, which raises questions over whether robust adaptation options are socially and economically acceptable. Our findings indicate that, at the time of our study in the WW sector of the Stockholm region, the ability to implement robust and more expensive adaptation measures solely on the basis of possible impacts from climate change was limited.

There is no single best way to analyze responses or non-responses to climate change. In our study, we have found the model of adaptation as organizational learning suggested by Berkhout et al. (2006) to be a powerful framework with which to further the understanding of how organizations address climate change adaptation. In our view, the literature has so far given too little attention to the factors that determine whether different adaptation options are attractive and feasible or not among decision makers. By explicitly analyzing issues that make different adaptation options more or less feasible we are able to gain a more comprehensive understanding of the actual adaptation space and thereby the adaptation options truly available to an organization. This in turn allows us to move beyond analyzing the underlying capacity of a system to adapt and provides a greater understanding of the shape, form and timing of adaptation to climate change in societies and systems with a high level of generic adaptive capacity. Further research is needed to provide deeper understanding of to what extent and how these results are applicable in other regional contexts and sectors with relatively high adaptive capacity to climate change. It would be equally interesting to investigate if these outcomes are of the same value in regions with lower generic adaptive capacity where organizations and society in general possess less basic capacity to respond and adapt to climate change.

CHAPTER 6: Conclusion

6.1 Introduction

Urgent environmental challenges, such as biodiversity loss and climate change, risk creating new global climatic and environmental conditions that will be less favorable for human development and prosperity. Despite the successful progress in environmental policy formulation, aimed at tackling these challenges from the global to the local level, environmental policy goal fulfillment remains low. The limited goal-fulfillment of environmental policy has been related to the perceived limitations in using coercive-based implementation to solve wicked and uncertain environmental problems. Complex environmental problems, such as those cited above, are outside of definitive prediction, optimal solutions and the application of standard coercive remedies. Rather, participatory and learning approaches are gaining prominence in dealing with inherent environmental uncertainty and for improving environmental policy goal-fulfillment.

Given this background, this thesis aimed to conduct a critical analysis of learning as an implementation mode, by analyzing the empirical insights provided by several new and understudied cases. In this way, the thesis aims to contribute to the literature on learning in environmental policy and governance.

Chapter 1 framed learning as an implementation mode and conceptualized it as one of three ideal-type implementation modes, the others being coercion and market. It introduced conflict as a crucial context for policy implementation and hypothesized that there are three facets of conflict, which are particularly relevant to environmental policy implementation: conflicts of interest between stakeholders, conflicts in environmental policy goals, and finally legislation. The chapter proposed assessing policy outcomes in terms of their effectiveness and coherence. Furthermore, it identified variables and concepts which it combined into a conceptual model that treated change in target group behavior as the outcome of policy and the dependent variable in environmental policy implementation. Chapters 2-4 comprised several cases involving high conflict across different governance scales; those of environmental policy implementation in river restoration affecting hydropower production. One of these cases, in Chapter 4, featured an analysis of learning as an implementation mode in a subnational case, in Sweden. Chapter 5 detailed another Swedish subnational case concerning learning as an implementation mode in the implementation of adaptations in urban water service related to climate change. This case contained low conflict.

The thesis was guided by the following research questions:

1. ***How do stakeholder conflicts of interest and legislation influence the effectiveness of learning as an implementation mode?***
2. ***How are conflicts in environmental policy goals manifested, and what role can a learning-based implementation mode play in increasing policy coherence?***

The remainder of this concluding chapter answers the research questions, discusses theoretical and methodological issues, and highlights pertinent policy and research implications.

The following section uses the empirical findings to draw conclusions on how stakeholder conflicts of interest and legislation influence the effectiveness of learning as an implementation mode, and how environmental policy goal conflict is manifested. It further reflects on what role a learning-based implementation mode can play in policy coherence.

Section 6.3 highlights the findings' links to broader research undertakings, particularly research on adaptive governance, and discusses the policy implications of the research. Section 6.4 ponders the methodological questions concerning the framing and conceptualizations made in the research. It also discusses the advantages, and limitations, of the research approach. Section 6.5 discusses the findings' research and policy implications.

6.2 Key research findings

6.2.1 Level of conflict, legislation and effectiveness of learning

Chapters 3-5 provided the main empirical material and analysis needed to answer the first research question of the thesis, namely, how stakeholder conflicts of interest and legislation influence the effectiveness of learning as an implementation mode. These results show that legislation constitutes a key determining element that influences the effectiveness of learning in situations that exhibit high levels of stakeholder conflicts of interest. The results also indicate that the reverse applies; that legislation is less determinant of the effectiveness of learning in situations that exhibit low levels of stakeholder conflicts of interest. These findings are elaborated in more detail below.

Using a Swedish case study, Chapter 4 demonstrated how the effectiveness of learning was limited by existing legislation, which gave the main hydropower producer the power to reach its objectives by unilaterally withdrawing from the Ljusnan process. Given the existing policy goals of river restoration, at the time of the process (CAB, 2010), it can be concluded that learning demonstrated limited signs of effectiveness. As described in section 1.7.2, and illustrated in Chapters 3 and 4, river restoration affecting hydropower production features high levels of stakeholder conflict and is a highly legislated environmental domain. There are multiple stakeholders in river basins with hydropower production, whose interactions exhibit high interdependence, incompatible goals and zero-sum elements. The explanation from Chapter 4 for the limited effectiveness of the implementation of environmental policy, resulting from learning in the Ljusnan River Basin, is that existing legislation in Sweden favors the status quo in hydropower production. This finding is similar to that of Barraqué et al. (2004) and Mostert et al. (2007) who identified pre-existing distribution of water rights as one of the main obstacles behind the limited outcomes of a learning process that was focused on mitigating the negative impacts of hydropower production in the Dordogne and Muga basins, in France and Spain respectively.

In contrast to Chapter 4, Chapter 5 showed how learning can produce effective policy outcomes, despite limited legislation, in situations of low stakeholder conflicts of interest. Despite the absence of coercion; rules and regulations requiring climate change adaptation, at a national level, the urban water service organizations in the Stockholm Region demonstrated significant behavioral changes geared towards climate change adaptation. When we take the existing policy goals of climate change adaptation at the time of the study into account (Holgerson et al., 2007), these observed behavioral changes can be interpreted as indications of an effective implementation of climate change policy, resulting from learning. The work of the broad committee of inquiry on climate change adaptation, "Sweden Facing Climate Change - Threats and Opportunities" (Holgerson et al., 2007) can be identified as a learning-based implementation mode that contributed to climate change adaptation in the urban water services in Stockholm. This thesis was able to identify the observed behavioral changes as a policy outcome because of various key experts on climate change in the studied urban water organizations participated in this committee of inquiry. Notably, in Norvatten, the organization that had implemented the most advanced adaptive decisions at the time of the study, the identified key expert was also a prominent member of the broad committee of inquiry on climate change adaptation (Holgerson et al., 2007).

The findings of other scholars concerning the adaptation of water services in various urban areas also exhibited similarities with those of the Stockholm Region. One example was from a learning process to improve urban storm water management in a district of Sydney, Australia. This led to significant behavioral changes in the shape of new management plans and groups, as well as the hiring of new technical staff (Bos and Brown, 2012). The authors of that study identified the critical factors for the experienced transformation as including champions, science and bridging organizations, while legislation and regulation were not deemed critical. Lenhart et al. (2014) analyzed municipal adaptation, including storm water management, in Malmö, Sweden, and identified leaders, dialogue, communication and participation as the crucial drivers of adaptation, while making limited reference to legislative and regulatory requirements.

There are, however, examples from the water sector that are not in line with the findings from the Stockholm Region. Notably, Arnell and Delaney's study (2006) analyzed climate change adaptation among private sector water supply organizations in England and Wales. They found that the company's adaptation strategies were largely determined by regulatory requirements. Possible reasons for these differences might be the fact that water provisioning is a service that, in England and Wales, is managed by private companies. Their operations are in line with the regulatory directives set by public agencies and this emphasizes the high importance of regulation in informing company strategies across the board.

6.2.2 Environmental policy goal conflict and role of learning for policy coherence

Chapters 2-4 provided the main empirical material and analysis required to answer the second research question of the thesis: how are conflicts in environmental policy goals manifested, and what role can a learning-based implementation mode play in increasing policy coherence? The results illustrate how environmental policy goal conflict is mainly materialized and manifested during the implementation of environmental policy. The results also point towards the potential pitfalls and possibilities in the role that learning can play in policy coherence, largely depending upon legislation. These findings are elaborated in more detail below.

Chapter 2 concludes that, despite limited evidence of conflictual interactions at the level of policy goals and instruments, potentially strong conflicts emerge when it comes to policy implementation at both EU and member state level. Chapters 2-4 further highlight the potential for environmental policy goal conflict, between the implementation of biodiversity conservation and water policy through river restoration and the renewable energy development through hydropower production. This potential policy goal conflict exists at the supranational (EU), national (Sweden) and subnational (Ljusnan River basin) levels. Notwithstanding having pointed out the potential for environmental policy goal conflict, the thesis' results also highlighted a potential for the refurbishment of existing hydropower stations that would allow for improvements to the aquatic environment, while maintaining hydropower production in mature hydropower producing countries.[125] The results suggest that learning can play an important role in realizing this potential, which would increase policy coherence. However, it also risks engendering serious pitfalls, in the form of inaction.

Chapter 4 provided a stark illustration of how learning risks provoking serious pitfalls. The Ljusnan process was an example of an important investment in time, money and energy being made into a learning-based intervention that did not lead to any significant change in behavior of the target group. However, Chapter 4 also included an example of a subnational learning-based intervention in the Penobscot basin, in the United States. Here, the refurbishment of existing hydropower stations was used to maintain the total basin energy generation, at previous levels, while drastically improving access for the various migrant species in the river.[126] Differences in legislation between Sweden and the United States, as well as in the experiences in the Ljusnan River and Penobscot basins, provides a basis on which to contend that legislation plays a significant role in determining the coherence of policy outcomes from learning.

The learning-based interventions in both the Ljusnan River and Penobscot basins were similar in terms of the level of stakeholder conflicts of interest and policy goals conflicts. Both were also learning-based interventions on a basin scale, with one dominant hydropower producer. However, the two processes developed within two different legislative contexts. Chapter 3 demonstrated that whereas hydropower production in Sweden is regulated by perpetual, property-like permits, in the United States, non-federal facilities are regulated by temporal licenses granting a time-bound privilege to use public lands and waters. Therefore, the target group of the policies – the hydropower producers in the two basins –faced two distinctively different situations.

Legislation in Sweden gave the hydropower producer in the Ljusnan River basin the opportunity to opt out of the learning-based intervention, without any significant consequences. On the other hand, in the Penobscot basin, if the hydropower producer had refused to participate in the learning-based intervention, this would most likely have resulted in river restoration measures through coercive means, i.e. traditional relicensing of existing hydropower permits. Thus, given the existing

[125] Chapter 2 estimates that there is a potential for around five per cent growth in hydropower production in the EU, from refurbishing existing facilities, which is confirmed for Sweden in Chapter 3. Chapter 3 also provides data on a materialized increase in production capacity of three-and-a-half per cent, in the United States, during 1986-2001, as part of capacity increases resulting from relicensing.

[126] The experience from the Penobscot basin, although not a case study in this thesis, represents a well-researched case in the literature, that, given its outcome, merits comparative analysis with the Ljusnan process (Opperman et al. 2011a; Opperman et al. 2011b).

legislation in the United States, it was only through participation in the learning-based intervention that the hydropower producer was able to limit production loss, while allowing for the implementation of significant river restoration measures. This process also allowed increased policy coherence between the environmental policy goals, related to biodiversity conservation and renewable energy development. There is evidence to suggest that the Penobscot case, with its significant and coherent outcomes, is not unique in the United States. There are several other examples of similar processes, triggered by hydropower relicensing requirements, where stakeholders have agreed on collaboratively negotiated proposals, which include significant river restoration outcomes, with a view to maintaining hydropower production as far as possible (Chaffin et al., 2016; Birge et al., 2014).

Furthermore, there are relevant examples of cases from other environmental domains, such as fisheries and agriculture that feature important similarities to the Penobscot case, in terms of the significant and coherent outcomes from learning despite high stakeholder interdependence, incompatible goals and zero-sum interactions (Puente-Rodríguez et al., 2015; Jiggins et al., 2007). In the Dutch Wadden Sea, all the stakeholders experimented jointly, to develop sustainable practices that ensured the protection and development of the Wadden Sea as a natural area, while guaranteeing commercial mussel fishing in the long-term (Puente-Rodríguez et al., 2015). In the Benelux middle area, stakeholders agreed on a shift in agricultural practices to conserve groundwater for the benefit of users and nature areas (Jiggins et al., 2007).

The Wadden Sea and the Benelux middle area cases exhibit similarities with the cases of hydropower relicensing in the United States, highlighted in this thesis, in that the fishing and agricultural stakeholders met a similar situation as the hydropower producers; opting out of the learning process would most likely have resulted in the implementation of environmental conservation measures through coercive means. Thus, the most viable method for the target group to determine measures to limit production loss, while allowing for the implementation of significant environmental conservation measures, was to participate in a learning process. As a result, stakeholders in the Wadden Sea and the Benelux middle area are jointly developing measures that will increase policy coherence between environmental and fishing, and agricultural, policies.

The following section draws on these key insights to contribute to broader theoretical discussions in the environmental policy and governance field.

6.3 Theoretical reflection

6.3.1 Limits to and requirements for learning

An overarching interest of this thesis is to question and explore the extent to which, and under what circumstances, learning constitutes the most appropriate mode for implementing environmental policy. The results of this thesis, combined with findings from the broader literature, indicate that in low conflict contexts, learning can lead to effective implementation, on its own. Conversely, in high conflict contexts, the results show that the shape and formulation of existing legislation can be a determinant factor in influencing the effectiveness and coherence of learning. Therefore, the shape and formulation of legislation constitutes a significant variable in determining the appropriateness of learning, in high conflict situations.

Furthermore, this thesis's observations suggest a connection between the effectiveness of coercion and learning, in relation to legislation in high conflict situations. This finding implies that shifting an implementation mode from coercion to learning is unlikely to improve the fulfilment of environmental policy goals in high conflict situations, if the legislation remains unchanged. These arguments are discussed below and reference the broader academic literature.

Chapters 3 and 4 illustrate the limited effectiveness of implementation of river restoration measures through predominantly coercion, on a national scale in Sweden, and through learning, on the subnational scale, in the Ljusnan River basin. On the other hand, the same chapters provide evidence for the effective implementation of river restoration measures using predominantly coercion, on a national scale in the United States, and from learning on the subnational scale, in the Penobscot basin. Scharpf (1997) and Héritier and colleagues (Héritier and Eckert 2008, Héritier and Lehmkuhl 2008) explained this observation, positing that successful voluntary agreements among stakeholders can produce effective policy. However, for this to materialize it requires that the process occurs in the "shadow of the state", where there is credible potential for regulatory intervention, if agreement is not reached. Conversely, if existing legislation does not allow for the effective implementation of environmental policy through coercion, there is a limited potential for regulatory intervention and, thus, a limited "shadow of the state" connected to the stakeholder learning process.

In other words, the results highlight the importance of legislation, to the effectiveness of environmental policy goal fulfillment in high conflict situations, using both learning and coercion as implementation modes. This insight fine-tunes the view that the limitations of a coercive mode of implementation, in solving complex environmental problems, are the fundamental reason behind restricted environmental policy goal-fulfillment (Newig and Koontz 2014; Jordan et al., 2005; Knill and Lenschow 2000; Bäckstrand et al., 2010). An important element of the ineffective implementation of environmental policy can, therefore, be attributed to limitations in legislation to use coercion to overcome a share of stakeholders' prior rights to the use of natural resources.

6.3.2 Learning and legislation in complex and conflictual environmental governance

The analysis made in this thesis suggests that learning, together with favorable legislation, could be a viable way of attaining the benefits of learning to deal with complexity, while preventing inaction because of stakeholder conflicts of interest. The following paragraphs explain how these insights are relevant to the broader debate on environmental governance, and particularly adaptive governance.

Adaptive governance has been identified as one strand of a new approach to environmental governance that captures emergent, collaborative and learning-based types of environmental governance (Cosens et al., 2018). While adaptive governance stresses broader policy processes, for stakeholders and institutions to solve environmental problem (Armitage et al., 2012) it still acknowledges the importance of the governmental aspects of governance (Cosens et al., 2017).

The analysis and insights of this thesis, related to the requirements of legislation and learning to deal with conflict and complexity, are in line with existing explorations into legislation and adaptive governance (Craig et al., 2017; DeCaro et al., 2017; Cosens et al., 2017). Although these authors use different words, the empirical basis, analysis and insights are very similar to those of this thesis. DeCaro et al. (2017) argued for state-reinforced self-governance as a way of facilitating adaptive governance, which enables flexible decision-making without jeopardizing stability. This argument is similar to the suggestion of this thesis; that learning processes in the shadow of the state are a way of dealing with conflict and complexity successfully. Furthermore, Craig et al. (2017) found that procedural requirements, notably legal sunset clauses, were vital in allowing for the calibration of the existing stability-flexibility balance of the governance structure. This is in line with the findings of this thesis; that temporal hydropower licenses (which grant a time-bound right to use public lands and waters) explain the significant activity in the United States, in terms of river restoration, compared to Sweden. DeCaro et al. (2017), drew on the example of the Platte River, in the US, as an example of a reorganization towards a more adaptive governance processes in the basin, which was triggered by the relicensing of a hydroelectric dam. This example is very similar to one highlighted in this thesis; that of the Penobscot basin, where a learning-based intervention, triggered by hydropower relicensing, set the stage for stakeholder learning and cooperation which in turn reduced the zero-sum interactions between stakeholders and increased policy coherence in the basin.

The above analysis provides corroborating evidence to suggest that the current legislation surrounding non-federal hydropower projects in the United States, crucially its legal sunset clauses that require mandatory periodic reviews of hydropower licenses, provides favorable legislative conditions for learning and adaptive governance, including collaboration and agreement among stakeholders. Scharpf (1997, 200–206), points towards the value of collaboration and agreement among stakeholders. This is because it allows for the full use of situational conditions, preferences, and potential solutions, which are known and developed among the actors concerned, but difficult for central government to obtain. Given the situation of increasingly urgent and interconnected environmental challenges, it is imperative to understand the situational conditions, in order to make full use of the potential solutions that limit trade-offs, zero-sum interactions and increase coherence between different environmental policies. The results of this thesis indicate that learning can play an important role in increasing policy coherence, compared to government led coercion, precisely by providing solutions based on situational conditions which are focused on reducing zero-sum interactions between stakeholders.

Learning plays an important part in new approaches to environmental governance, including adaptive governance. One of the expectations of applying these new approaches is that it will increase policy effectiveness through broad participation by public and private actors in collective decision-making (Bäckstrand et al., 2010). The insights provided in this thesis suggest that, rather than increased effectiveness, learning's promise, with favorable legislation, lies in increased policy coherence between increasingly urgent and interconnected environmental challenges.

6.4 Methodological reflection

Section 1.7.6. described the expected internal and external validity of this thesis. The following paragraphs will critically deliberate how the current thesis meets these requirements of validity.

6.4.1 Internal validity

Chapter 1 stated that the creation and strength of the causal narrative represents an important challenge to the internal validity of this thesis' research. This section will discuss two parts to the causal narrative of this thesis: the use and configuration of the research model and the strength of evidence in the empirical cases related to observed behavioral changes in the policy of interest.

Figure 1-1 on page 22 combined the various concepts and variables that were introduced in this thesis, in order to suggest a direction of causation, from environmental policy goals to policy outcomes, which is understood as change in the target group's behavior. The model highlights conflict, within a policy context, as an independent variable that is able to explain the change, or no change, in target group behavior. Multi-layer problems (Hill and Hupe, 2003), were not a particularly important aspect of the research. This is because policies on biodiversity conservation and water protection, in Sweden and the rest of the EU, exhibit similar, but potentially conflictual, goal interactions across layers, in relation to renewable energy. Policy on climate change adaptation also exhibits similar characteristics, across layers, in terms of the limited risk of conflictual policy goal interactions, in Sweden and the rest of the EU (see Sections 1.7.2 and 1.7.3). Furthermore, in the US, river restoration in non-federal hydropower projects is primarily unitary in character, i.e. the hydropower relicensing process is directed from a national level, and not by individual states. Therefore, this empirical area of enquiry presents relatively limited implementation challenges to the federal system (Stoker, 1991).

The thesis used its empirical cases to provide evidence and arguments that relate observed behavioral changes to the policy of interest, to varying degrees. Where the domain of river restoration affecting hydropower production is concerned, there are clear and longstanding policies in the field of biodiversity conservation and water protection, and renewable energy development, which serve to substantiate causation between the relevant policies and the observed behavioral change of the target group.

Chapter 3 illustrated an example of a suggestion being made for causation, using a counterfactual approach. The chapter compared Sweden and the United States, as "most similar worlds", where the target group of policy and hydropower producers, exhibited significantly different behavioral changes, as concerns river restoration. The study argued that the dense legislation, which regulates hydropower production in the two countries, could provide a plausible explanation for the observed differences. While the chapter found that environmental policy and substantive legislation were similar in the two countries, it remarked large differences in procedural legislation between the two nations. Additionally, Chapter 4 also used a mechanism and capacities approach, to establish a causal narrative that will help to understand the lack of behavioral change among the target group of a policy, despite a sustained learning-based intervention that was initiated to implement environmental policy.

As concerns the domain of climate change adaptation in urban water services, there is scope for more detailed empirical material to be gathered, and analysis to be made, in order to substantiate causation between relevant policies and any observed behavioral change in the target group. Chapter 5 used a mechanism and capacities approach to establish a causal narrative in order to understand any observed behavioral change from organizational learning, resulting from climate change stimuli. However, the research method and the focus of Chapter 5, did not allow for a more detailed identification of policy-related behavioral changes, which could be documented as a policy outcome, when compared to non-policy related signals of climate change, such as extreme weather events and climate change research in general. The empirical material only provided a basis to suggest that one of the climate change stimuli, for organizations, is policy-related and that the observed behavioral change was only a policy outcome, in part.

On a more general note, the internal validity of the research findings was improved using an iterative process with stakeholders over several years. This thesis' main research results were widely circulated to the key stakeholders in Sweden and the EU (municipal water utilities, hydropower producers, public agencies and environmental NGOs) and were the subject of extensive discussions and feedback. Feedback was given both verbally, in various seminars with key stakeholders, and in written form (Vattenfall, 2013). The peer-review process that was part of the publication process, for the articles included as chapters in this thesis, also provided further arenas for ensuring the internal validity of the research and the findings.

6.4.2 External validity

Chapter 1 suggested that the thesis could produce insights of external validity to the studied environmental domains as well as insights into learning in environmental policy and governance that have a wider validity. This section discusses how the research on the empirical material from the studied environmental domains – climate adaptation in urban water services and river restoration affecting hydropower production – produced insights and conclusions that have wider validity in these domains. The section also discusses how an analysis of conflict as a crucial contextual factor for environmental policy implementation, and a comparison of it across environmental domains, offers insights into learning in environmental policy and governance that have a wider validity.

Authors have used and referred to this thesis' findings to understand communities' adaptive capacity to hurricanes and wildfires in Florida, (Newman et al., 2013; Newman et al., 2014). In the same way, authors referred to this thesis' findings, related to the importance of technical standards and guidelines for adaptation measures, to understand adaptation of the railway system in Germany and France (Rotter et al., 2016; Dépoues, 2017). These two uses of thesis generated insights suggest that thesis insights concerning adaptation in urban water services in the Stockholm Region have some validity for, and application to, adaptation processes more generally, as well as specifically related to large-scale infrastructure.

Thesis cases point towards the relevance of analyzing procedural and substantive legislation in a country, in order to understand the extent of river restoration affecting hydropower production. A key insight gained from the comparison of Sweden and the United States is that the use of time-bound and indefinite hydropower permits largely explains the significant differences in the extent of river restoration between the two countries. Hydropower production is heavily regulated across the EU (Glachant et al., 2014), which denotes that it should be possible to analyze and understand the scope and extent of river restoration affecting hydropower production with a similar analysis in these countries, as well.

This thesis generated insights related to the importance of limited terms for hydropower permits in ensuring that hydropower installations comply with the latest environmental legislations. These thesis insights have been used and referred to by authors in general discussions related to renewable energy and biodiversity protection, as well as adaptive approaches to water governance (Gasparatos et al., 2017; Woodhouse and Muller, 2017). Other authors' use of insights generated from this thesis; to discuss potentially conflictual interactions between renewable energy development and biodiversity protection, as well as adaptive approaches to water governance; suggest that insights from the domain of river restoration affecting hydropower production would also have some validity for other mature and important hydropower producing countries globally.

More general thesis insights into how learning can produce policy outcomes effectively, despite limited legislation, in situations of low stakeholder conflicts of interest, does appear to possess external validity to numerous cases. Such cases include learning processes that have produced significant behavioral change, with limited legislative and regulatory requirements, including the restoration of flooded meadows in Sweden (Hahn et al., 2006), river weir restoration in the UK (Maynard, 2015), adjustments to recreational fishing practices in Sweden (Olsson et al., 2004) and the United States (Van Assche et al., 2013) and adjustments in farming practices to save water in Thailand (Sinclair et al., 2008).

This thesis' insight, that legislation has a pivotal role in both the effectiveness and the coherence of policy outcomes, from learning in high conflict situations, also appears to have a broader external validity. There are cases where the reported outcomes from learning processes, to implement environmental policy, are limited, and this is partially because of material conflicts of interest and a lack of a complementary coercion-based implementation of environmental policy. This insight offers some explanation as to why learning processes have reported limited outcomes in the Vecht River and Drentsche Aa (Jiggins et al., 2007; Van Bommel et al., 2009).

Furthermore, there is an empirical basis to support the suggestion that that the findings of this thesis have some external validity to environmental policy implementation affecting industrial use and extraction of natural resources, across the board. Successful learning processes in environmental policy implementation affecting fisheries in the Dutch Wadden Sea, (Puente-Rodríguez et al., 2015), and agriculture in the Benelux middle area, (Jiggins et al., 2007), have had a history of high material conflict among the stakeholders, as well as controversy and an element, or potential, of coercion-based implementation by authorities. As such they share important similarities with the examined learning processes of this thesis, related to river restoration and hydropower production in the United States, which have produced significant and coherent outcomes. These similarities suggest that the thesis' finding, that legislation has a pivotal role in both the effectiveness and the coherence of policy outcomes from learning, extends to situations of environmental policy implementation that affect industrial use and the extraction of natural resources more broadly.

6.5 Research and policy implications

This thesis arrived at two conclusions concerning learning in environmental policy and governance. The first is that learning can engender effective environmental policy implementation, relatively independently of legislation, in low conflict contexts. The second is that the shape and formulation of legislation can be a determinant factor of the effectiveness and coherence of learning in high conflict contexts.

The discussion on external validity highlighted various cases of natural resource management and suggested that these conclusions have an external validity beyond the empirical domains of this thesis. That being said, there is still scope for future research to test the validity of these conclusions further, in different contextual settings.

Relevant future research could include an exploration of the extent to which learning leads to significant behavioral changes in the target group to implement environmental policy in situations where there are low material conflicts between the stakeholders. Even in situations of low material conflict there are a range of different types of conflict that can prevent behavioral change in the target group. This thesis hypothesized that stakeholder conflicts of interest, conflicts of environmental policy goals and legislation were particularly relevant areas to explore. This focus provided a relevant basis from which to analyze the thesis' empirical cases, but it also excluded other significant sources of conflict such as cognitive, cultural and gender, inter-personal and procedural conflicts. Therefore, future research could explore the relationship and impact of other facets of conflict, and their relationship to environmental governance and policy implementation.

Further research could explore to what extent market, combined with learning, constitutes an appropriate mode for implementing environmental policy. Market is given limited attention in this thesis, compared to learning and coercion, as it is less present and relevant in the empirical cases. Voluntary certification schemes for hydropower production and river restoration are still marginal in terms of the share of hydropower production certified in both Sweden and the United States. Furthermore, the calibration of taxes and charges for water services are slow to develop in most EU member states (Liefferink et al., 2011). However, cases do exist in the natural resource management literature that suggest that market-based incentives can play a significant role, together with learning, to reduce stakeholder conflicts of interest and can produce desired changes in a target group's behavior (Gianotti and Duane 2016; Nykvist 2014; Sims and Sinclair, 2008).

Given population growth, resource consumption and environmental degradation, it is increasingly urgent to ensure policy coherence and to limit trade-offs between interconnected environmental domains. One research endeavor that merits further attention is the area of understanding, assessing and formulating legislation, which is conducive for learning, even in high conflict situations. There are ample opportunities to explore different legislative settings, and the effectiveness and coherence of learning and environmental policy implementation, in relation to industrial use and the extraction of natural resources.

Finally, further research could identify different national legislative settings where learning does, or could, prosper. There are various mature and significant hydropower-producing countries in the EU which could be relevant to investigate. Sweden, although the primary empirical focus of this thesis, would also be an interesting case to revisit after January 2019. Sweden has introduced important legislative changes that will enter into force in January 2019. They include a general limit on the term of hydropower permits to forty years and a shift of the burden of proof, in permit review trials, to the hydropower operators. Using a counterfactual approach, existing legislation and extent of river restoration in Sweden until 2018 and after 2019 would constitute an almost perfect comparison of two "most similar worlds" where possible modifications to the extent and speed of river restoration affecting hydropower production after 2019 could convincingly be related to introduced legislative modifications. Such an analysis should be of interest with regards to environmental policy implementation affecting industrial use and extraction of natural resources in various countries as well as to distill more general insights related to legislation and learning in environmental policy and governance.

6.5.1 Policy implications

The results of this thesis suggest that policymakers, who are faced with ineffective implementations of environmental policy, should recognize the requirements and limits of learning, participation and dialogue, particularly in high conflict situations. The results suggest that it is uncertain that learning will increase implementation effectiveness, in situations where there are high stakeholder conflicts of interest. Instead, it might be required to modify existing legislation. Such modifications to legislation could increase implementation effectiveness and, in the long term, could possibly create the appropriate conditions for learning to increase policy coherence between the various societal and environmental priorities.

The legislation surrounding non-federal hydropower relicensing in the United States could serve as an interesting example for policymakers, to explore how much of it could be transferrable to their countries and other environmental policy domains, since it shows clear signs of allowing for effective implementation of environmental policy as well as creating conditions for learning to increase policy coherence between various environmental policy priorities.

However, legislative modifications, to increase the implementation effectiveness of environmental policy in high conflict domains, are likely to meet with significant challenges and delays. Sweden serves as an illustrative example of this phenomenon. In 1999, it introduced the national environmental policy objective of securing flourishing lakes and streams by 2020; in 2000, it became bound by the WFDs general goal of achieving good chemical and ecological status in its water bodies by, at the latest, 2027; and it is not until 2019 that environmental legislation will be in place that appears to grant the possibility to effectively reach these environmental policy goals, at least when it comes to water bodies impacted by hydropower production.

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Appendices

Appendix 1: Inventory of Environmental Policy for Chapter 2

Overarching objectives	Objectives	References
Climate Change		
"… the long term objective of stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." ". a long term objective of a maximum global temperature increase of 2 °Celsius over pre-industrial levels and a CO2 concentration below 550 ppm …" (both objectives from 6EAP, DECISION No 1600/2002/EC, Article 2 § 2) "…supporting an EU objective to reduce emissions by 80-95% by 2050 compared to 1990 levels…" (COUNCIL OF THE EUROPEAN UNION Climate change: Follow-up to the Copenhagen Conference (7-19 December 2009) - Council conclusions, Brussels, 15 March 2010) "…an EU Framework for Adaptation should be developed in order to improve the EU's resilience to deal with the impacts of climate change; in an initial phase up to 2012…" (Council Conclusions on Climate change: Towards a	The "20-20-20" CARE targets: "A reduction in EU greenhouse gas emissions of at least 20% below 1990 levels" (CARE) "20% of EU energy consumption to come from renewable resources" "A 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency" The binding legislation and the targets therein: "… makes a firm independent commitment to achieve at least a 20 % reduction of greenhouse gas emissions by 2020 compared to 1990." (Decision No 406/209/EC and preamble 4 Council decision) "… a Community objective of a 30 30% reduction of greenhouse gas emissions by 2020 compared to 1990 as its contribution to a global and comprehensive agreement for the period after 2012, provided that other developed countries commit themselves to com parable…" (preamble 3, Council decision) "…objective to reduce energy consumption by 20 % by 2020 compared to projections for 2020 as outlined in the Action Plan for Energy Efficiency which was set out in the Commission	*6EAP*: Decision No 1600/2002/EC laying down the Sixth Community Environment Action Programme *CARE*: http://ec.europa.eu/environment/climat/ climate_action.htm Decision No 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020. Council of the European Union 7224/1/07 Brussels European Council 8/9March 2007. § 32 Decision No 406/2009/EC, (see above), Article 4, §1, Action Plan for Energy Efficiency in the objective refer to COM (206)545.

Overarching objectives	Objectives	References
comprehensive EU adaptation strategy 2953rd ENVIRONMENT Council meeting, Luxembourg 25 June 2009)	Communication of 19 October 2006."' (Decision No 406/2009/EC) "…mandatory national overall targets are consistent with a target of at least a 20 % share of energy from renewable sources in the Community's gross final consumption of energy in 2020." Directive 2009/28/EC. Adaptation "… improve the EU's resilience to deal with the impact of climate change." (COM(2009)147)	Directive 2009/28/EC of 23 April 2009. (Article 3, § 1) COM(2009)147 White Paper: Adapting to climate change: Towards a European framework for action
Nature and biodiversity		
"… long-term vision that by 2050 European Union biodiversity and the ecosystem services it provides – its natural capital – are protected, valued and appropriately restored for biodiversity's intrinsic value and for their essential contribution to human wellbeing and economic prosperity…"(Council conclusions on biodiversity post-2010 3002nd ENVIRONMENT Council meeting Brussels, 15 March 2010) "… a headline target of halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020 and restoring them in so far as feasible, while stepping up	Establish Natura 2000 "A coherent European ecological network of special areas of conservation shall be set up under the title Natura 2000. This network ... shall enable the natural habitat types and the species' habitats concerned to be maintained or, where appropriate, restored at a favorable conservation status in their natural range." (Habitats Directive, Council Directive 92/43/EEC) "limit emissions of … eutrophying pollutants … in order to improve the protection in the Community of the environment and human health against risks of adverse effects from … soil eutrophication … and to move towards the long-term objectives of not exceeding critical levels and loads…" (NECD,	Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants. Article 1.

Overarching objectives	Objectives	References
the EU contribution to averting global biodiversity loss.” (Council conclusions on biodiversity post-2010 3002nd ENVIRONMENT Council meeting Brussels, 15 March 2010)	Directive 2001/81/EC) To reverse negative species abundance trends (6th EAP-BAP) “…halting biodiversity decline with the aim to reach this objective by 2010, including prevention and mitigation of impacts of invasive alien species and genotypes” (6EAP, Article 6 § 1) “…protecting, conserving, restoring and developing the functioning of natural systems, natural habitats, wild flora and fauna with the aim of halting desertification and the loss of biodiversity, including diversity of genetic resources…” (6EAP, DECISION No 1600/2002/EC, Article 2 § 2) To keep fishing within safe limits, restoring marine trophic levels (6th EAP-BAP)	BAP (Biodiversity Action Plan): Commission Communication: Halting the loss of biodiversity by 2010 - and beyond. Sustaining ecosystem services for human well–being COM (2006)216 Final and Annexes to SEC(2006) 621 {}
Natural resources and waste		
“... better resource efficiency and resource and waste management to bring about more sustainable production and consumption patterns...” (6EAP; similar language in the Waste Framework Directive, Art. 1)	“... ensuring that the consumption of resources and their associated impacts do not exceed the carrying capacity of the environment...” (6EAP) “...breaking the linkages between economic growth and resource use...” (6EAP) Achieve “...a significant overall reduction in the volumes of waste generated...” (6EAP) Encouraging re-use, recycling and recovery (6EAP); Hierarchy of waste management:	Sixth Environmental Action Programme; Directive 2008/98/EC on waste and repealing certain Directives (not yet fully in effect)

Overarching objectives	Objectives	References
	"prevention, re-use, recycling, energy and other recovery, disposal" (Waste Framework Directive)	
Environment and health		
"... providing an environment where the level of pollution does not give rise to harmful effects on human health and the environment..." (6EAP) provide the EU with the scientifically grounded information needed to help Member States reduce the adverse health impacts of certain environmental factors and, on the other hand, to step up cooperation between stakeholders in the environment, health and research fields (Environment and Health Action Plan)	To attain "levels of air quality that do not give rise to negative health impacts" (6EAP) To achieve good ecological and chemical status of water bodies (WFD and related legislation) "... protect the environment from the adverse effects of ... waste water discharges" (UWWT Directive) "... improve the quality of the urban environment by making cities more attractive and healthier places in which to live, work and invest and by reducing their adverse environmental impact." (TS Urban Env.) "..improve indoor air quality" (Environment and Health Action Plan) "... chemicals are only produced and used in ways that do not lead to a significant negative impact on health and the environment..." (6EAP) "... reduce the impact of pesticides on human health and on the environment consistent with the necessary protection of crops." (TS Pesticides)	Thematic Strategy on air pollution, COM(2005) 446 final; Directive 2008/50/EC on ambient air quality and cleaner air for Europe Communication of 9 June 2004 from the Commission: "The European Environment & Health Action Plan 2004-2010" [COM(2004) 416 - Official Journal C 49, 28.02.2006] Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants Directive 2000/60/EC establishing a framework for the Community action in the field of water policy; (related directives, e.g. Nitrates Directive, Bathing Water Directive) Directive 91/271/EEC concerning urban waste water treatment Thematic Strategy on the Urban Environment, COM(2005) 718 final REACH (EC 1907/2006) Thematic Strategy on Pesticides, COM(2006) 372 final; Directives on Plant Protection Products (91/414/EEC) and Biocidal Products (98/8/EC) Directive 2008/1/EC concerning integrated pollution prevention and control (Codified version) Directive 2002/49/EC relating to the assessment and management of

Overarching objectives	Objectives	References
	"... prevent or, where that is not practicable, to reduce emissions in the air, water and land from.." industrial facilities (IPPC Directive) "... avoid, prevent or reduce on a prioritized basis the harmful effects, including annoyance, due to exposure to environmental noise" (Noise Directive)	environmental noise

Appendix 2: Inventory of Energy Policy for Chapter 2

Overarching objective	Objectives	Instruments	Reference
1. Supply Security			
to ensure, for the well-being of its citizens and for the proper functioning of the economy, the uninterrupted physical availability of energy products on the market at an affordable price for all consumers	1.1 To secure gas supply	A common framework within which Member States can define general security-of-supply policies that are transparent, solidarity-based, non-discriminatory and consistent with the requirements of a single market in gas.	Directive 2004/67/EC of 26 April 2004 concerning measures to safeguard security of natural gas supply.
		Access to natural gas transmission networks	
		Rules for natural gas transmission networks, gas storage and liquefied natural gas (LNG) facilities.	Regulation (EC) No 715/2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 1775/2005
	1.2 To maintain minimum stocks of crude oil and petroleum products	Securing oil supply	
		Rules aimed at making oil supply in the Community more secure based on solidarity amongst Member States; maintaining minimum stocks of crude oil and/or petroleum products; putting in place emergency procedures to be used in the event of a shortage.	Directive 2009/119/EC imposing an obligation on Member States to maintain minimum stocks of crude oil and/or petroleum products.
	1.3 To secure the supply of electricity	Obligation to secure electricity supply	
		To establish obligations to safeguard security of electricity supply and undertake significant investment in electricity networks.	Directive 2005/89/EC concerning measures to safeguard security of electricity supply and infrastructure investment.
2. Internal market and integration and competitiveness			
To achieve a competitive internal energy market to give European consumers a	2.1 Grid Investments and infrastructure	Guidelines for Trans-European Energy Networks	
		New guidelines for trans-European energy networks (TEN-E) list and rank, according to the objectives and priorities laid down, projects	Decision No 1364/2006/EC laying down guidelines for trans-European energy networks and repealing Decision 96/391/EC

Overarching objective	Objectives	Instruments	Reference
choice between different companies supplying gas and electricity at reasonable prices and of making the market accessible for all suppliers, especially the smallest and those investing in renewable forms of energy.		eligible for Community assistance and the concept of 'project of European interest'.	and Decision No 1229/2003/EC.
	2.2 Common rules	Access of third parties to LNG	
		A Directive to lay down the right of third parties to non-discriminatory access to transmission and distribution systems and to liquefied natural gas (LNG) facilities.	Directive 2003/55/EC concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC.
		Minimum taxation of energy	
		Sets the minimum rates of taxation applicable to energy products, to improve the operation of the internal market by reducing distortions of competition between mineral oils and other energy products.	Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity
		Common rules for electricity supply	
		Rules relating to the Organisation and functioning of the electricity sector, access to the market, the criteria and procedures applicable to calls for tenders and the granting of authorizations and the operation of systems.	Directive 2003/54/EC concerning common rules for the internal market in electricity and repealing Directive 96/92/EC.
		Cross-border exchange in electricity	
		National regulatory authorities shall send the European Commission notification of decisions concerning the certification of a transmission system operator. National TSOs form the European Network of Transmission System Operators (ENTSO) for electricity.	Regulation (EC) No 714/2009 on conditions for access to the network for cross-border exchanges in electricity and repealing Regulation (EC) No 1228/2003
		Common rules on prospection, exploration and production of hydrocarbons	
		Rules to ensure non-discriminatory access to the activities of prospection, exploration and	Directive 94/22/EC on the conditions for granting and using authorizations for the

Overarching objective	Objectives	Instruments	Reference
		production of hydrocarbons to help to reinforce the integration of the internal energy market, encourage greater competition within it and improve security of supply.	prospection, exploration and production of hydrocarbons.
		Increasing transparency in market operations	
		To have transparent and competitive energy markets which contribute to the creation and smooth operation of the internal energy market. "Third market package" together with Directives 714 and 715 about networks and exchange mentioned above.	Directive 90/377/EEC concerning a Community procedure to improve the transparency of gas and electricity prices charged to industrial end-users [See amending acts Directive 2009/73/EC concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC Directive 2009/72/EC concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC
		Greenhouse gas emission trading scheme	
		A trading scheme for cost-effective reduction of GHG emissions to enable the Community and the Member States to meet the commitments to reduce GHG emissions made in the context of the Kyoto Protocol. Installations operating in the energy sector, iron and steel production and processing, the mineral industry and the paper and board industry are subject to the emission trading scheme.	Directive 2009/29/EC establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC [See amending acts].

Overarching objective	Objectives	Instruments	Reference
3. Promoting sustainable and renewable sources of energy			
To reach the target of a 20% share of energy from renewable sources in the overall EU energy mix	3.1 Biofuels	Promotion and use of energy from renewable sources	
		A common framework for the use of energy from renewable sources in order to limit GHG emissions and to promote cleaner transport.	Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Text with EEA relevance).
		SET plan	
		A strategic plan to accelerate the development and deployment of cost-effective low carbon technologies, including measures relating to planning, implementation, resources and international cooperation in the field of energy technology	A European strategic energy technology plan (SET-plan) - 'Towards a low carbon future' (SEC(2007) 1508) (SEC(2007) 1509) (SEC(2007) 1510) (SEC(2007) 1511)
		Biofuel strategy	
		To further promote biofuels in the EU and in developing countries, to prepare for the large-scale use of biofuels and to heighten cooperation with developing countries in the sustainable production of biofuels.	Commission Communication of 8 February 2006 entitled "An EU Strategy for Biofuels" [COM(2006) 34 final - Official Journal C 67 of 18 March 2006].
	3.2 Offshore Energy	Promotion of offshore energy	
		To promote the development of maritime and offshore wind energy in the European Union	'Offshore Wind Energy: Action needed to deliver on the Energy Policy Objectives for 2020 and beyond' [COM(2008) 768 final – Not published in the Official Journal].
	3.3 Biomass	Biomass action plan	
		Actions aimed at increasing the demand for biomass, improving supply, overcoming technical barriers and developing research	Communication from the Commission of 7 December 2005 - Biomass Action Plan [COM(2005) 628 final - Official Journal C 49 of 28.02.2005].

Overarching objective	Objectives	Instruments	Reference
	3.4 Emissions abatement	Industrial emissions directive (IED)	
		IED replaces the IPPC directive and entails the large combustion facilities, including coal and waste incineration. It has procedural and substantive requirements for industrial facilities, including in permitting as well as operations. Best available technology harmonization.	The draft directive on industrial emissions (second reading as of May 2010)
	3.5 Renewable energy general	Renewable energy road map	
		The Renewable Energy Road Map aims to enable the EU to meet the twin objectives of increasing security of energy supply and reducing GHG emissions.	"Renewable Energy Road Map. Renewable energies in the 21st century: building a more sustainable future" [COM(2006) 848 final - Not published in the Official Journal].
		A Competitiveness and Innovation Framework Programme (CIP) 2007-2013	
		Supports measures to strengthen competitiveness and innovation capacity in the EU. It encourages the use of information technologies, environmental technologies and renewable energy sources.	Decision 1639/2006/EC establishing a Competitiveness and Innovation Framework Programme(2007-2013).
4. Energy efficiency			
To reducing energy consumption and to eliminate energy wastage and to support improving energy efficiency for	4.1 Building efficiency and energy consumption	Energy performance of buildings	
		Minimum requirements regarding the energy performance of new and existing buildings ensure the certification of their energy performance and require the regular inspection of boilers and air conditioning systems in buildings.	Directive 2002/91/EC on the energy performance of buildings. The directive has been recast: Reference: COM(2008)780
		Intelligent Energy Europe	

Overarching objective	Objectives	Instruments	Reference
competitiveness, security of supply and for meeting the commitments on climate change made under the Kyoto Protocol.		EU's tool for funding action to improve these opportunities to save energy and encourage the use of renewable energy sources in Europe	Decision No 1230/2003/EC adopting a multiannual programme for action in the field of energy: "Intelligent Energy – Europe" (2003 – 20)
		Action plan to reduce energy consumption	
		Aimed at achieving a 20% reduction in energy consumption by 2020. Measures to improve the energy performance of products, buildings and services, to improve the yield of energy production and distribution, to reduce the impact of transport on energy consumption, to facilitate financing and investments in the sector, etc.	Commission Communication on the Action Plan for Energy Efficiency: Realizing the Potential [COM(2006) 545 – Not published in the Official Journal].
	4.2 Co-Generation	Co-generation	
		The purpose of this Directive is to facilitate the installation and operation of electrical cogeneration plants (a technology allowing the production in one process of heat and electricity) in order to save energy and combat climate change.	Directive 2004/8/EC on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC.
	4.3 Products and Services efficiency	A framework for energy end-use efficiency and energy services	
		Framework includes an indicative energy savings target for the Member States, obligations on national public authorities as regards energy savings and efficient procurement and measures to promote efficiency and energy services.	Directive 2006/32/EC on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.
		Overarching efficiency target	
		A commitment to reducing consumption of primary energy by 20% by 2020. (i.e.'20-20-20' goal)	Commission Communication - Energy efficiency: delivering the 20% target [COM(2008) 772 - Not published in the Official

Overarching objective	Objectives	Instruments	Reference
			Journal].
		Ecodesign	
		EU-wide rules for improving the environmental performance of energy related products (the use of which has an impact on energy consumption) and include: energy-using products (EUPs) and other energy related products (ERPs)	Directive 2009/125/EC establishing a framework for the setting of ecodesign requirements for energy-related products

Appendix 3: Background and development of the research framework - Chapter 4

List of identified factors in the three reviews, recapitulation of factors for the framework and reasons behind exclusion of a limited number of identified factors.

Review 1: Muro, M. and P. Jeffrey. 2008. “A Critical Review of the Theory and Application of Social Learning in Participatory Natural Resource Management Processes.” *Journal of Environmental Planning and Management* 51 (3): 325–344.

This review identifies various “process features that foster social learning”, as well as “conditions that limit opportunities for social learning processes” based on a review of an unspecified number of papers of social learning in participatory natural resource management processes. The identified features and conditions are presented in the table below:

Table A3-1 Process Features and Conditions

“Process features that foster social learning”	“Conditions that limit opportunities for social learning processes”
Facilitation	Nature of problem at hand
Small group work	Very rigid institutional framework
Egalitarian atmosphere	
Repeated meetings	
Opportunities to influence the process	
Open communication	
Diverse participation	
Unrestrained thinking	
Multiple sources of knowledge	

Review 2: Cundill, G. and R. Rodela. 2012. “A Review of Assertions about the Processes and Outcomes of Social Learning in Natural Resource Management.” *Journal of Environmental Management* 113: 7–14.

This review identifies “emerging assertions about processes that support social learning” based on a review of definitions of social learning extracted from a sample of 54 articles. These emerging assertions are presented in in the following table:

Table A3-2 Assertions about processes

"Emerging assertions about processes that support social learning"
Deliberate experimentation
On-going monitoring
Joint actions
Reflective practice
Knowledge sharing
Deliberation
Sustained interaction
Exposure of values
Trust building
Long term-self organizing process
Experience of crisis
Iterative reflection

Review 3: Siebenhüner, B., R. Rodela and F. Ecker. 2016. "Social Learning Research in Ecological Economics: A Survey." Environmental Science & Policy 55 (Part 1): 116–26.

This review identifies "causal factors for the emergence of social learning processes" based on a review of 45 articles treating social learning studies. The identified causal factors are presented in the following table:

Table A3-3 Identified causal factors

"Identified causal factors for the emergence of social learning processes"
Social capital and networks (identified in 35 articles)
Institutional make-up (identified in 24 articles)
Environmental crisis (identified in 12 articles)
Monitoring and evaluation (identified in 7 articles)
Incentives (identified in 7 articles)
Internal drivers (identified in 5 articles)
Technology (identified in 1 article)

Recapitulation of identified factors in the three reviews

Based on the identified factors in the reviews we contend that most factors can meaningfully be grouped into the two overarching groups of "procedural" and "institutional" factors. Using terms and examples from the reviews and the reviewed literature, the identified factors in the three reviews are recapitulated as a total of nine factors that are included in the framework of the paper (Table 4-1). The following tables illustrate how different identified procedural and institutional factors from the three reviews have been groped together and recapitulated for inclusion in the framework of the paper.

Table A3-4 Procedural Factors

Factors recapitulated as: / Review	Sustained interaction	Joint knowledge acquisition, sharing and deliberation	Skilled facilitation	Inclusion of relevant stakeholders
Muro and Jeffrey 2008	- Repeated meetings	- Opportunities to influence the process - Multiple sources of knowledge	- Facilitation - Small group work - Open communication - Unrestrained thinking	- Diverse participation
Cundill and Rodela 2012	- Sustained interaction - Iterative reflection	- Deliberate experimentation - On-going monitoring - Joint actions - Knowledge sharing - Reflective practice - Deliberation	- Exposure of values	
Sibenhüner et al. 2016		- Monitoring and evaluation - Technology		

Table A3-5 Institutional factors

Factors recapitulated as: / Review	Social capital and networks	Capability of formalizing new practices, arrangements, norms and values	An organization that fits the relevant ecological unit	Authorities lacking experience, facing special misfits and problems of coordination	Stakeholders possessing strong pre-existing rights over the natural resource
Muro and Jeffrey 2008	- Egalitarian atmosphere			-Very rigid institutional framework*	-Very rigid institutional framework*
Cundill and Rodela 2012	- Trust building				
Sibenhüner et al. 2016	- Social capital and networks	- Institutional make-up*	- Institutional make-up*	- Institutional make-up*	- Institutional make-up*

*Section 4.2 explains that the reviews provide examples of these factors that fit into the grouping and recapitulation made in the chapter.

Reasons behind excluding a limited number of factors identified in the three reviews

There are a limited number of factors identified in the three reviews that do not fit the framework of the paper. These are “Nature of problem at hand”; “Long term self-organizing process”; “Experience of crisis”; “Environmental crisis”; “Incentives” and “Internal drivers”.

The reasons for this are that the identified factor is either too vague to use - “Nature of problem at hand” – or is not relevant to the focus of this article on learning-based interventions: “Long term self-organizing process”. The factors “Incentives”, “internal drivers”, “experience of crisis” and “environmental crisis” were not included in the framework since the factors do not fit well into either of the two overall groups procedural and institutional factors. The value of creating a simple and parsimonious framework, with only two overall groupings that together cover the most significant identified factors, was deemed higher than the value of adding additional groups of factors to the framework to be able to include these four factors.

Appendix 4: Interview Framework for Chapter 4

Interview framework for chapter 4: Learning-based intervention for river restoration: Analyzing the lack of outcomes in the Ljusnan River basin, Sweden

1.* Why did you divide the project into two phases with, to some extent, different participants?

2.* Could you describe the work in phase 1?

Sub-questions: Who met and how often?

How did you proceed with knowledge gathering, discussions, prioritization, decisions?

How was the collaboration?

3. Could you describe the work in phase 2?

Sub-questions: How often did the steering and the working group meet?

How did you proceed in the groups with knowledge gathering, discussions, prioritization, decisions?

What participants took part in the different parts of the work?

How was the collaboration?

4.* Did representatives from the Sports Fishing Association, Riversavers, the Swedish Society for Nature Conservation or other environmental NGOs participate in any way in the project?

Sub-question: Why?

5. What were the outcomes of the project in terms of physical restoration measures, realized environmental care etc.?

Sub-questions: In the case of Österforsen, Voxnan

In the case of Arbråströmmarna

In the case of Bollnäsströmmarna

In the case of Ljusnans mynning

In the case of other initiatives in the project?

6. What other, in your view, positive or negative outcomes came about from the project?

7. How would you explain the outcomes of the project?

8. As far as your know, has the project in any way influences the ongoing permit review of Dönje hydropower station and the Grundsjö project in favor of the Grundsjö loach (or any other ongoing project or restauration activity in the Ljusnan basin)?

9. What was the relationship of the project to the research project ”hydropower – environmental effects, measures and costs in regulated water”?

10. Is there anything else that you perceive as important and that needs to be brought up that I have not asked?

* Interviewees from the CABs and municipalities were asked all the questions while industry interviewees were asked questions 3 and 5-10 since questions 1,2 and 4 were deemed irrelevant to ask industry representatives.

Appendix 5: Interview Framework for Chapter 5

Interview framework for chapter 5: Beyond generic adaptive capacity exploring the adaptation space of the water supply and wastewater sector of the Stockholm region, Sweden

1. What questions are you working with right now?

2. In what ways have you become aware of climate change and the effects it has/might have on your company?

3. How do you perceive the information and signs of climate change in relation to your business activity?

    Subquestion: How is it perceived within your company?

4. Does your company at present work with the climate change issue and its possible effects?

    Subquestions: Do you collect and evaluate information about climate change and the effects it could have on your business?

    Have you implemented any changes within the company taking this into account?

5. Have you implemented any actual measures/changes within your systems or standards as a reaction on experienced or expected effects of climate change?

6. Have you encountered any problems in the implementation?

    Subquestions: What type?

    Are there measures that you have considered and not carried out? (Why?)

    Do you think the implementation is enough?

7. Are possible adaptation measures evaluated in relation to company goals and performance objectives?

8. What factors, according to you, influence the company's adaptation possibilities?

9. Do you perceive to be getting any feedback from adopted adaptation measure?

10. Is there anything else that you want to include or bring up?

Appendix 6: List of interviewees for Chapter 4

List of interviewees for chapter 4: Learning-based intervention for river restoration: Analyzing the lack of outcomes in the Ljusnan River basin, Sweden

Organization and stakeholder position	Questions	Date and logistics of interview
Gävleborg CAB, “CAB representative A”, Coordinator of the Ljusnan process until the end of 2006	Interview framework for chapter 4	2016.12.16 By phone
Jämtland CAB, “CAB representative B”, Steering and working group representative	Interview framework for chapter 4	2017.01.19 By phone
Bollnäs municipality, Working group representative	Interview framework for chapter 4	2017.01.20 By phone
Main hydropower producer in Ljusnan, “Industry representative A” Working group representative	Interview framework for chapter 4	2017.01.12 By phone
Main hydropower producer in Ljusnan, “Industry representative B” Working group representative (referred to by company steering group representative)	Interview framework for chapter 4	2017.02.02 By phone

Appendix 7: List of interviewees for Chapter 5

List of interviewees for chapter 5: Beyond generic adaptive capacity exploring the adaptation space of the water supply and wastewater sector of the Stockholm region, Sweden

Organization and stakeholder position	Questions	Date and logistics of interview
Käppala (wastewater treatment)		
Head of operations	Interview framework for chapter 5	2009.02.03 Face-to-face
Head technician	Interview framework for chapter 5	2009.02.03 Face-to-face
Head of analysis	Interview framework for chapter 5	2009.02.09 Face-to-face
Head of maintenance	Interview framework for chapter 5	2009.02.09 Face-to-face
CEO	Interview framework for chapter 5	2009.02.12 Face-to-face
Norrvatten (water purification and distribution)		
Engineer distribution	Interview framework for chapter 5	2009.01.13 Face-to-face
Head of administration	Interview framework for chapter 5	2009.01.14 Face-to-face
Head of development	Interview framework for chapter 5	2009.01.19 Face-to-face
Head of production	Interview framework for chapter 5	2009.01.19 Face-to-face
CEO	Interview framework for chapter 5	2009.01.21 Face-to-face
Head of laboratory	Interview framework for chapter 5	2009.01.21 Face-to-face
Head of projects	Interview framework for chapter 5	2009.01.22 Face-to-face
Roslagsvatten (sewer and wastewater treatment)		
Engineer	Interview framework for chapter 5	2008.12.09 Face-to-face
CEO	Interview framework for chapter 5	2008.12.10 Face-to-face

Organization and stakeholder position	Questions	Date and logistics of interview
Engineer	Interview framework for chapter 5	2008.12.10 Face-to-face
Head of development	Interview framework for chapter 5	2008.12.11 Face-to-face
Head of projects	Interview framework for chapter 5	2008.12.15 Face-to-face
Head technician	Interview framework for chapter 5	2008.12.15 Face-to-face
Head of production	Interview framework for chapter 5	2008.12.18 Face-to-face
Head of economy	Interview framework for chapter 5	2009.01.08 Face-to-face
Stockholm Vatten (water purification and supply, sewer and wastewater treatment)		
Head of quality and environmental management	Interview framework for chapter 5	2009.02.02 Face-to-face
Engineer responsible for climate adaptation	Interview framework for chapter 5	2009.02.03 Face-to-face
Svenskt Vatten (Swedish water and wastewater association)		
CEO	Interview framework for chapter 5	2009.03.05 Face-to-face
Head of development	Interview framework for chapter 5	2009.03.05 Face-to-face
Head of mains and sewer system	Interview framework for chapter 5	2009.03.05 Face-to-face

Summary

The last three decades of environmental policymaking have generated some very ambitious and comprehensively formulated policies, ranging from the local to the global level. These policies often have the explicit aim of addressing and reversing some of the most significant trends of environmental degradation, including biodiversity loss and climate change. However, despite evidence of successful progress in the formulation of environmental policies, their implementation and goal fulfillment are generally low. The inadequate fulfillment of environmental policy goals has partially been linked to the perceived limitations of using coercive-based implementation to solve complex environmental problems. Meanwhile, participation and learning are gaining prominence, since they are expected to cope better with complex and unpredictable environmental systems and thereby contribute to the implementation of environmental policy. However, complexity is only one of several decisive contextual factors, which affect environmental policy implementation and governance. For this reason, this thesis questioned and explored the extent to which learning constitutes the most appropriate mode for environmental policy implementation, and under what circumstances.

The introductory chapter frames learning as an implementation mode and conceptualizes it as one of three ideal-type implementation modes; the others being coercion and market. It introduces conflict as a crucial context for environmental policy implementation and hypothesizes that there are three facets of conflict, which are particularly relevant: conflicts of interest between stakeholders, conflicts in environmental policy goals, and legislation. Furthermore, it combines identified variables and concepts into a conceptual model that treats change in target group behavior as the outcome of policy and a dependent variable in environmental policy implementation. Policy outcomes are assessed in terms of their effectiveness and coherence.

The thesis was guided by the following research questions:

1. ***How do stakeholder conflicts of interest and legislation influence the effectiveness of learning as an implementation mode?***
2. ***How are conflicts in environmental policy goals manifested, and what role can a learning-based implementation mode play in increasing policy coherence?***

A multi-case study approach was chosen for this thesis since it allows for a detailed examination of the relevant contextual factors and an exploration of the possible causal mechanisms. As the thesis hypothesizes that conflict is a crucial context for environmental policy implementation, the case studies were selected in two environmental policy domains with different levels of conflict. Chapters 2-4

comprise several cases of environmental policy implementation that involve high conflict, concerning river restoration that affects hydropower production. These cases span different governance scales in Sweden, the United States and the European Union. Chapter 5 details another case, containing low conflict, concerning learning as an implementation mode in adaptations of urban water services related to climate change in the Stockholm Region, Sweden.

The thesis uses a variety of data collection strategies; including document analysis, semi-structured interviews, and participant observation. This allows for a strong contextual understanding and for triangulations of the insights gathered from the various data sources. The main paths for establishing the claims of causation, between policy initiatives, implementation modes and policy outcomes in the examined cases, are the counterfactual as well as the mechanism and capacities approaches.

A number of key findings emerge from the preceding chapters, related to the two thesis research questions. As concerns the first question; the thesis finds that legislation is a key determining element that influences the effectiveness of learning in situations that exhibit high levels of stakeholder conflicts of interest. Chapter 4, a case study of a failed learning-based intervention in the Ljusnan River basin, Sweden, demonstrates how the effectiveness of learning was limited by existing legislation since it gave the target group of policy the option to reach its objectives unilaterally. In contrast to Chapter 4, Chapter 5 shows how learning can produce effective policy outcomes, despite limited legislation, in situations of low stakeholder conflicts of interest. In this case, despite the absence of rules and regulations requiring climate change adaptation, the urban water service organizations in the Stockholm Region have enacted significant behavioral changes geared towards climate change adaptation through organizational learning.

As concerns the second research question; the results illustrate how environmental policy goal conflict is mainly materialized and manifested during the implementation of environmental policy. Chapter 2 concludes that, despite limited evidence of conflictual interactions at the level of policy goals and instruments, potentially strong conflicts emerge when it comes to policy implementation at both EU and member state level. The results also point towards the potential pitfalls and possibilities of the role that learning can play in policy coherence, largely depending upon legislation. Chapter 3 illustrates the differences, between Sweden and the United States, in the legislative settings of hydropower production as it concerns river restoration. Whereas hydropower production in Sweden is regulated by perpetual, property-like permits; in the United States, non-federal facilities are regulated by temporal licenses granting a time-bound privilege to use public lands and waters. Chapter 4 concludes that the perpetual hydropower permits in Sweden were an important reason behind the failed learning-based intervention in the Ljusnan River basin. The same chapter, however, also introduces the example of the Penobscot Basin, in the United States, where a learning-based intervention has produced significant river restoration outcomes while preserving hydropower generation at previous levels. Chapter 4 identifies the legal arrangements surrounding non-federal hydropower facilities in the United States, notably time-bound permits, as an important reason as to why the learning-based intervention in the Penobscot Basin produced results that increased policy coherence between different environmental policy goals.

Based on these answers to the two research questions, an overarching insight from the thesis is that the shape and formulation of legislation constitutes a significant variable, in determining the appropriateness of learning in environmental policy implementation that contains high conflict. The thesis' analysis suggests that learning, together with favorable legislation, could be a viable way of dealing with complexity, while preventing the inaction that may arise from stakeholder conflicts of interest.

Through its empirical cases, this thesis provides evidence and arguments that relate observed behavioral changes to the policy of interest, in varying degrees. Moreover, the examples, in the discussion of environmental policy implementation affecting fisheries and agriculture, show that the findings are also relevant to situations of environmental policy implementation that affect the industrial use and extraction of natural resources more broadly. The thesis ends by offering a suggestion to policymakers who are faced with ineffective implementations of environmental policy: that they recognize the requirements and limits of learning, particularly in high conflict situations.

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