

**Formal structure and culture:
Organizational influence on adaptive capacity to
climate change in quasi-public network sectors**

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Preface and Acknowledgements

Most of the work for this dissertation has been conducted on historical grounds. I have had the good fortune to be able to carry out my research at Polhøgda, the home of Fridtjof Nansen, arguably Norway's most famous scientist, expeditionary, politician, artist and humanist (not necessarily in that order). These historical premises are now the base of the Fridtjof Nansen Institute (FNI). I feel both humbled and privileged to be able to work on these grounds.

This thesis grew out of my interest in regulatory and policy processes. As I began as a student of international relations and foreign policy, the transition to organizational theory and processes was not easy, but it led to experiences I today would not be without. The introduction to what is in many ways a rather complex theoretical field with infinite possibilities, along with a whole new empirical terrain, made for a very steep learning curve.

I am deeply grateful to many people without whom this thesis would either not have existed at all, or would at least have been far less enjoyable to write. My family has always been there for support, and if they ever have lost faith in me along the way they have been very good at hiding it. My closest academic ally has been my supervisor Tom Christensen who, with his sharp analytical eye, precise feedback, swift email responses and dry sense of humour, has made sure I was not led too far astray. Others have also read parts of this PhD and contributed with valuable comments. Anna Korppoo read the framework chapter with a keen eye, as have (in alphabetical order and for other parts of the thesis along the way): Elin Lerum Boasson, Per Ove Eikeland, Eric Glaas, Leif Christian Jensen, Karen O'Brien, Lynn Rosentrater, Svein Vigeland Rottem, Jon Birger Skjærseth and Jørgen Wettestad. Susan Høivik has in her usual effective manner provided invaluable language help, as has Maryanne Rygg with her formatting. Thank you for being so flexible and utterly helpful.

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has been a marvellous adventure. I will certainly miss the project and the participants, but do hope to work with you again. Perhaps this thesis ran the risk of being diluted by the PLAN project workshops in various spa hotels in the Oslo area, but the process itself was very inspiring and the workshops were highly valuable for the end result.

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While it could be tempting to make further use of all my helpers as culprits for any errors or weaknesses in the final product, I presume it is only fair that I bear full responsibility for the occurrence of any such.

Polhøgda, 2012

Tor Håkon Inderberg

Articles in the Thesis

1. Inderberg, Tor Håkon (2011). Institutional constraints to adaptive capacity: adaptability to climate change in the Norwegian electricity Sector. *Local Environment*, 16(04), pp. 303–317.
2. Inderberg, Tor Håkon (2012). Governance for adaptive capacity in the Swedish electricity industry: Do changes in structure and culture matter? *Accepted for publication in Public Management Review*.
3. Inderberg, Tor Håkon (forthcoming 2012). Changes in organizational culture, changes in adaptive capacity? Examples from the Norwegian and Swedish electricity sectors. In *Adapting to Change: Integral Approaches to Climate Change Responses in Norway*. K. O'Brien and E. Selboe. Cambridge University Press. *For review*.
4. Inderberg, Tor Håkon and Liv Arntzen Løchen (2012). Adaptation to climate change among electricity distribution companies in Norway and Sweden: Lessons from the field. *Local Environment*, 1–16, *iFirst Article*.

1 Introduction

The climate is changing – and rapidly (IPCC 2007). While the issue of mitigating greenhouse gas emissions has dominated political and scientific attention for some years (Schipper 2008), it is now widely acknowledged that these mitigating efforts are not going to be enough, nor will they happen quickly enough (O'Brien et al. 2006; IEA 2011b). We must also try to find out how we can adapt to meet the challenges of the changing climate. Climate change adaptation (CCA) can be undertaken by individuals, but is often conducted by organizations, or at least within an organizational setting (Næss et al. 2005; Berkhout, Hertin, and Gann 2006). CCA may take place in the private or public sectors, or as an interrelation between the two, and is usually a relevant matter for state regulation.

For this reason it is important to examine what enables or disables organizational CCA. This PhD thesis does this by analysing organizational capacity to adapt to climate change. It asks what types of barriers and dimensions of CCA prevail in the quasi-public sectors in developed countries, using the electricity grid sectors in Norway and in Sweden as cases for comparison. Since most CCA research has focused on developing countries, it is important to widen the scope and look into the mechanisms that influence the CCA capacity of quasi-public network sectors within developed states, in order to identify other types of barriers and dimensions.

This thesis explains organizational capacity for CCA through four articles that compare the Norwegian and the Swedish electricity sectors on the general sector-level, and also investigates adaptations made ‘on the ground’ by individual grid companies. ‘Adaptive capacity’ is generally understood as the ability to change by reducing vulnerability or enhancing resilience in response to observed or expected changes in climate or associated extreme events (Adger et al. 2007:720). This ability, or the potential to adapt, is equated with adaptive capacity.

CCA refers to how we react to climate change and prepare for its expected impacts, as regards both utilizing the benefits and lessening the vulnerabilities produced. The term encompasses many different practices, depending on who is adapting, to what, and how. Such practices may be as practical and diverse as building flood-

walls, moving houses or villages, or strengthening the electricity grid. Less directly practical measures like mapping potential future changes and vulnerabilities also count as CCA (Pelling 2011). Indeed, CCA can be even more than this. Adaptation can also bring social transformation and change to the framing of climate change in general: changes in ideas, in attitudes, and of values (Hulme 2009).

For these reasons, we cannot study CCA solely from the perspective of ‘formal’ adaptation, looking only at technical change. We also need to analyse the barriers and the facilitators of adaptation at the societal level, where norms and values are brought in, as influential factors or sometimes even as dependent variables (Adger, Lorenzoni, and O’Brien 2009b). And when we consider the adapting entities’ capacity to adapt, the analysis becomes more complex than merely looking at the practices of adaptation behaviour.

Beginning with the recognition that substantial parts of CCA-related processes take place within the realm of organizations, this thesis studies how organizational factors may influence the capacity to adapt to a changing climate. CCA in complex systems in developed countries has been an understudied field (Ford and Berrang-Ford 2011). While there have been studies focusing on aspects such as the role of values for adaptation (O’Brien 2009), the role of governance at different levels (Keskitalo 2009; Glaas et al. 2010) and resource management and urban planning (Finan and Nelson 2009; Winswold et al. 2009), there is a clear need to develop frameworks for comparing adaptive capacity between sectors and countries in different organizational settings (Berkhout, Hertin, and Gann 2006). Here it is likely that other types of barriers to CCA will become evident, which can help our understanding and also propel further research. This PhD work aims to fill some of these gaps.

The Norwegian and Swedish electricity grid sectors are apposite objects for studying adaptive capacity because they are similar in important organizational respects, while also differing in several ways. They have both undergone similar market reforms: Norway in 1991 and Sweden five years later (Midttun 1996). The natural monopolies of the electricity grid sector are today consistent in the two countries. Furthermore, both electricity grid systems are spatially exposed to similar

changes in climate, although the Norwegian grid is arguably more exposed in some places. While there are differences in the organizational structures, regulatory models, historical and cultural contexts, these differences are arguably smaller than the similarities. Such a comparative approach can make it easier to shed light on the mechanisms that lead to differences in adaptive capacity, providing good grounds for comparison (Mill 1911). Norway and Sweden also present good cases of adapting sectors within complex systems in developed countries.

Lively scholarly discussion regarding the study of CCA is underway and the field is evolving rapidly. It has seen major developments from a rather simple formal understanding of adaptive capacity and a focus on ‘determinants’ (Yohe and Tol 2002; Smit and Pilifosova 2003), with the complexity now expanding to include important socio-cultural factors like values and norms. However, there are still developments to make. The application of integrative perspectives and in particular how to apply socio-cultural factors represents a gap. This thesis applies organization theory to fill some of these gaps in theory (Greenwood et al. 2008). The perspectives include an organizational-instrumental and an institutional-cultural perspective (Christensen and Peters 1999). Together these complementary perspectives shed light on very different aspects of organizational decision-making and structure (Scott 2008). Through this combination of perspectives, the thesis sheds new light on CCA, as well as exploring the dynamics between the formal structure and organizational culture of the sectors in question.¹ The four articles that make up this study offer analyses of CCA capacity of the two national sectors individually, a comparison between the two sectors, and comparisons on the company level in both countries. Such a comparative study of CCA capacity between analytical levels and sectors in different countries has, to the author’s knowledge, not been done before.

The thesis is structured as follows. Chapter 1, mapping and discussing the thesis as a full project, starts by posing and interpreting the research question. Then the object of study, the electricity grid sectors of Norway and Sweden, is described. Next, in the theory section (Chapter 2), CCA theory is briefly mapped and reviewed, along

¹ See Theory Framework for elaboration on formal structure and organizational culture.

with a discussion of how organization theory can contribute to the development of CCA. Two theoretical perspectives for CCA capacity are presented. The theoretical contributions are presented with basic assumptions before expectations about the adaptive capacity are developed and made operational against the empirical universe. Chapter 3 gives a description of the research design, methodological issues and discussions of the caveats and trade-offs inherent in the research design. Chapter 4 offers a discussion of the main findings based on the article collection, before Chapter 5 summarises and offers conclusions. These discussions and mappings are followed by the four articles, with empirical data and analysis of the individual cases. Three of the articles have been published or accepted in peer review journals, and the fourth is in the final stage its review process.

1.1 Research question

From the motivation for studying CCA capacity presented in the introduction above the overarching research question in focus for the thesis is reached as follows:

What changes in organizational dimensions such as formal structure and organizational culture can be found over time in nationally regulated quasi-public network industries and how do these changes influence CCA capacity?

This question invites an investigation into what factors influence adaptive capacity to climate change. While the processes showing how CCA capacity evolves and changes are to some extent suggested in the thesis, the primary aim here is to contribute to the understanding of climate change adaptive capacity. This entails an inquiry into what constitutes and influences CCA capacity, as explained by the theoretical perspectives in the thesis. While the term ‘CCA’ also covers reaping the benefits of climate change (Adger et al. 2007), the expected changes in climate, population developments and in requirements for expanding the share of renewable electricity generation will inevitably mean stresses and challenges for the electricity system.

The research question relates to several research programmes. First it relates to organization theory in general, and to institutional theory in particular (Greenwood et al. 2008). An important focus in this literature has been how organizations – or institutionalized organizations – are resistant to change. Institutions are widely understood to be ‘more or less taken-for-granted repetitive social behaviour that is underpinned by normative systems and cognitive understandings that give meaning to social exchange and thus enable self-reproducing social order’ (Greenwood et al. 2008:4-5). The functioning of the sectors is determined by regulatory frameworks, relatively unified governance structures with congruent and consistent patterns of domination and subordination (Scott 2001). Over time, shared values, norms and conventions can be expected to develop, with the potential to influence behaviour.

Next the study relates to the literature on adaptation to climate change. Adaptation within this school has focused mostly on formal factors although this is now changing to include other types of barriers to adaptation on various levels of governance (Adger, Lorenzoni, and O’Brien 2009a). One goal of the present study is to use some of the insights from organization theory to illuminate aspects of adaptive capacity to climate change less evident from these more formal or ‘rational’ paradigms. This is done by asking how and to what extent a high adaptive capacity to climate change requires a favourable (organizational) culture together with a formal structure that encourages and facilitates goals such as security of delivery, as opposed to the electricity reforms’ incursion of the more one-dimensional goal of economic efficiency (Nilsen and Thue 2006). The mutual influence of these two dimensions is also analysed in the study.

1.2 Quasi-public network services: the electricity grid sectors in Norway and Sweden

The Norwegian and the Swedish electricity grid sectors have been selected for analysis. These systems are good representatives of public or quasi-public network services (Statskontoret 2004; Claes and Mydske 2011). Although these services – other representatives being railroad, postal, telecommunication and road – have not been privatized in Norway or Sweden, we find a mix of private and public ownership. The majority of the companies are directly or indirectly publicly owned, in both

countries. Common to all companies in the sector is that they work under the same regulation and provide important public services: in this case the provision of electricity. As a quasi-public network service, the electricity grid industry (in contrast to the generating part of the system) represents natural monopolies under strict public regulation. As such the electricity grid sectors in Norway and Sweden provide good cases for shedding light on the general research question of the thesis. Historically, generating electricity and transporting it were carried out by the same companies as vertically integrated units. Today, we can define the electricity grid sector as consisting of grid utilities, subsidiaries, interest organizations, regulatory authorities and responsible ministries, along with related companies that provide relevant services. The grid utilities in both countries are responsible for security of supply. Changing weather patterns may bring vulnerabilities for the sector and it is important to investigate if today's organizational CCA capacity is adequate for coping with future climate change. This is why the emphasis in the thesis will be on reducing the possible malign effects of climate change on the electricity grid in the future – and the capacity of the sector to do so.

Moreover, in both Norway and Sweden the electricity sectors are identified as 'critical infrastructure' that require high adaptive capacity in order to sustain vital functions in society (NOU 2010:10 ; SOU 2007:60). Energy, as the 'grease' for the running of societal machinery, involves huge ramifications (Homer-Dixon 2006). Life and the economy can be threatened by a power failure of large magnitude. Indeed, after terrorism, blackouts are 'routinely cited as key examples demonstrating the criticality of modern infrastructure', and electric power networks are among the most critical of all critical infrastructure (Van der Vleuten and Lagendijk 2010:2042).

This dependency and vulnerability make the electricity grid sector an important and policy-relevant object of study for CCA capacity. The electricity system is normally analysed as one system, perhaps reflecting the pre-reform traditional organization of the sector where the same companies conducted production, trading and transmission or distribution of electricity in vertically integrated companies. Although these elements are mutually dependent, they are different in nature, so it

makes analytical sense to view them as separate entities. Due to the monopolistic nature of the network services, the critical status of the sector, its exposure to climate and given the research question of the thesis, the natural object of analysis is the electricity grid sector.

Although much of the adaptation focus has been on developing countries, vulnerability reduction and CCA vulnerability are real and imminent issues for developed countries as well (Ford and Berrang-Ford 2011). Other types of barriers can be illuminated by choosing cases from developed countries, and the Nordic region is made up of countries that generally score high on indicators of CCA capacity (Smit and Pilifosova 2003). With the transformations in the energy sectors in Norway and Sweden over the past 30 years, these two countries stand out as relevant study objects for investigating how organizational change can influence CCA capacity. The period for analysis is mainly focused on the period between 1985 and 2010, with some variations among the articles. Further methodological reasons for this selection are discussed under Chapter 3.1 ‘Choosing the objects of study’.

The changes of the Norwegian and Swedish energy sectors have unfolded in similar ways, albeit with some national differences – due to administrative traditions, institutional culture and other historical lessons within the national context, as well as natural conditions such as hydropower dependency. At the same time the power plants are geographically spread out due to the nature of the generation capacity, more so in Norway than in Sweden due to the dominance of hydropower.

Electricity accounts for around half of total energy consumption in Norway and the Norwegian electricity sector is heavily dependent on hydropower: in 2009, 95.9 per cent of Norway’s electricity was generated by hydropower (127.1TWh), while thermal power generated 4.7 TWh and windpower 1 TWh (IEA 2011a) – totalling 132.8 TWh. This generation structure leads to net import or export depending on annual precipitation. Generation capacity is spread out across the country with hydropower plants naturally located near local resources. The transmission and distribution grid connecting production, transport and end-users is today about 129,000 km in total, of which the central transmission grid is 11,000 km (St. Meld. nr 14 2011-

2012:16). It is often characterized as relatively weak since there is no continuously connected corridor of 420 kV transmission grids between the north and south of the country. Norway depends partly on Swedish transmission capacity for such transport of electricity.

During the 1980s the Norwegian electricity sector underwent significant change, culminating with the liberalization of the sector in 1991 (Thue 1996). This reform, early and radical by international standards,² established a clear division between electricity generation and transport. Previously, the Norwegian sector had been vertically integrated in the sense that the generation and the transport of electricity were usually done by one and the same company. The price of electricity was determined politically, and the sector was under direct political control. All this changed with the reform; from then on, grid companies were separated. While the production companies were to be exposed to competition in an electricity market, network activities were defined as a natural monopoly and placed under governmental regulation (Olsen 2000). This regulation took the form of direct and economic incentives, with a clear emphasis on the latter, to create stimuli for greater economic efficiency for the natural monopolies in a competition-like setting. Power was to be sold in a market provided by the electricity broker later known as NordPool, which also served Sweden after 1996.

The Swedish sector's infrastructure consists of 15,000 km of high-voltage central transmission grids of about 540,000 km grid in total (Svensk energi 2012). The structure of the Swedish sector differs from that of Norway in several ways. First, the Swedish sector generates 90 per cent of its electricity from roughly equal shares of hydro- and nuclear power.³ While most generation of hydro-based electricity is located in the north of Sweden, consumption takes place predominantly in the south of the country. Most of Sweden's nuclear power plants are located closer to the consumers, but there is still a great need for transmitting hydroelectric power from the northern

² In fact only California, Chile and the UK were earlier international 'liberators', to varying degrees, than the Norwegian Energy Act of 1990.

³ The residual approximately 10 per cent of electricity is generated mostly by district heating and wind power (IEA 2008:76).

production areas to the south. Furthermore, and as a consequence of the former, a well-developed 420 kV transmission grid has been constructed between north and south.

The organization of the sector in Sweden prior to the reform was largely similar to that of Norway, although political control was less direct and electricity prices were set in a self-regulating structure, with the state-owned company Vattenfall the dominant actor. Sweden liberalized the energy sector in 1996 and went through a similar unbundling process as Norway did five years earlier. Also in 1996, the Norwegian transmission system operator Statnett sold half of the electricity broker NordPool to the Swedish Svenska Kraftnät to create a shared electricity market. In Sweden, the reform had a milder and less abrupt nature, as the process unfolded over a longer period of time. Although the Swedish model was generally regarded as relatively effective, the national political discourse at the time focused on the need for greater economic efficiency.

The next section briefly reviews adaptation theory and develops the theory framework of this thesis. This will enable us, after examining some pertinent methodology issues, to discuss the findings of the articles in relation to the research question.

2 Theory Framework

The four articles in the thesis apply a framework developed within organizational theory.⁴ A complementary framework resting on an *instrumental perspective* and an *institutional-cultural perspective* (Christensen et al. 2007) is employed to analyse how change in the two sectors influences CCA capacity, and the articles relate to the two perspectives on different levels.

Social science theory should facilitate the cumulative building of knowledge. To this end, the articles in the thesis provide bridging insights between organization theory and the adaptation literature. Empirically tested and developed theories, in this case from the institutional field, create a basis for *a priori* presuppositions as to which factors may exert organizational influence on the CCA capacity of the sectors in question. In this sense, theory thus serves to suggest how and why two or more phenomena are related. On the basis of the theories (axioms and theorems), specific empirical hypotheses or expectations can be derived about possible reasons for adaptive capacity to climate change. This is the logical link between theoretical axioms and theorems on the one side, and the hypotheses on the other. For a causal connection between X and Y to be justified, it is also necessary to show covariance between the two phenomena as part of the empirical expectations. In other words: a social science explanation in general, including the explanation of CCA capacity in the electricity sectors in Norway and Sweden, typically requires that the researcher (i) make plausible an empirical connection between two phenomena and (ii) demonstrate an argument for why such a connection is likely to exist. Such arguments in the social sciences are often provided *a priori*, in the form of indicating some kind of mechanism for how a particular variable influences another (Waltz 1979:5f). An empirical and a theoretical element are thus provided, together answering what has happened and how this has happened. The answer to these two questions together satisfies the why-question. That is the social science explanation.

⁴ Although one of the contributions is a chapter in an edited book, they will in this context be referred to as 'articles'.

2.1 Adaptive capacity and organizational theory

Adaptive capacity is the capacity or ability of a given entity, often one or several organizational units (in this case the Norwegian and Swedish electricity sectors), to implement adaptive measures in concert or individually. Examples of adaptations in the focus sector could be strengthening the electricity grid for direct or indirect climate loads (like wind, icing, precipitation, tree-falls) by means of insulating wires or undergrounding the distribution grid, relocation of the grid, increased maintenance of the grid structure, or increased monitoring and follow-up on wood-cutting of the grid gate to reduce tree-falls. Adaptations could also include mapping of potential future vulnerabilities caused by changes in weather patterns but connected to other developments in the sector, or heightened emergency preparedness. The various adaptations may take many forms, and in this thesis the ability to implement them represents adaptive capacity.⁵

While central to adaptation research, in practice the concept of CCA capacity is often used rather vaguely. Certain components tend to be regarded as ‘important’, ‘required’, ‘depending on’, or simply ‘key to enhancing adaptive capacity’ (Brooks et al. 2005:168). Adaptations are often seen as manifestations of adaptive capacity, representing ways of reducing vulnerability (Smit and Wandel 2006). A common approach has been to link adaptive capacity to a range of ‘determinants’ (Yohe and Tol 2002; Smith, Klein, and Huq 2003; Smit and Wandel 2006). What is clear is that vulnerability and adaptive capacity are closely connected (Brooks 2003; Brooks, Adger, and Kelly 2005). This connection has been summarized by Smit and Pilifosova (2003:21) as:

$$V_{it}^s = f(E_{it}^s, A_{it}^s)$$

Where

V_{it}^s = vulnerability of system i to climate stimulus s in time t

E_{it}^s = exposure of i to s in t

⁵ While CCA also includes reaping the benefits of climate change, the natural focus for this research is on vulnerability reduction. Therefore the emphasis in this thesis will be on reducing the potential future effects of climate change on the electricity grid – and the capacity of the sector to do so.

A_{it}^s = adaptive capacity of i to deal with s in t .

It should be noted that the functional relationship is not specified in this equation, although a positive relationship is expected between V and E , meaning that the greater the exposure to climatic risks, the greater the vulnerability. A negative relationship is also expected between V and A , meaning that the greater the adaptive capacity, the lower the vulnerability to climate risks. This implies that increased exposure to climate change leads to increased vulnerability, while increased CCA capacity decreases vulnerability. Conversely, if a sector experiences a decrease in adaptive capacity for whatever reason, vulnerability to climate change can be expected to increase. The triangular relationship between vulnerability, exposure and adaptive capacity expressed in the equation above does not indicate what the different components of adaptive capacity to climate change are. The equation contributes to clarifying the function of CCA capacity and its relation to exposure and vulnerability. This thesis analyses the 'A' in the formula, but it is important to grasp the background to adaptive capacity, before discussing what influences it.

Much of the adaptation literature has been criticized for not shedding light on the more social dimensions upon which adaptive capacity is contingent (Adger 2003; O'Brien and Leichenko 2008; Adger, Lorenzoni, and O'Brien 2009b; O'Brien and Hochachka 2010). Scientific discussions within the CCA community have been divided between a technical-scientific and a cultural-social branch (O'Brien and Hochachka 2010; Oppermann 2011). The former tends to emphasize change in behaviour and technical solutions to the specific challenges and vulnerabilities, constructing the adaptation discourse around three dimensions: ecological and physical limits, economic limits, and technological limits (Adger, Lorenzoni, and O'Brien 2009b:2). The cultural-social branch holds that these factors are important, but that such solutions tend to be developed within 'silos', producing piecemeal adaptations that address specific outcomes but remain blind to other, equally important areas (O'Brien and Hochachka 2010:91). Adaptive capacity under a solely technical-scientific dimension struggles to explain why adaptations are not made when the

‘determinants’ to adaptive capacity are fulfilled (Inderberg and Eikeland 2009). Even when it is known that the benefits of adaptation are higher than the cost of adopting simple adaptive measures, adaptations are not necessarily carried out. Underlying norms, values and worldviews may need to change before the adaptations can be seen as necessary (Wolf 2011). We need to understand and explain the social acceptability of the various adaptation options, in order to be able to understand the barriers to adaptation, and thereby adaptive capacity (Adger 2003:29f). Adaptation is thus underpinned by normative and formal structures, and these need to be considered explicitly in adaptation research and practice (Wolf 2011:22f). The articles in this PhD thesis do so through the theoretical foundation outlined below.

CCA could benefit from insights made from other traditions within the social sciences (Berkhout, Hertin, and Gann 2006). Organization theory has already struggled with the question of organizational adaptation to a more general set of challenges for many years. The organization literature sees adaptation as ‘modifications and alterations in the organization or its components in order to adjust to changes in the external environment (Cameron 1984: 123). CCA is specifically directed at minimizing malign consequences and reaping the benefits accruing from changes in weather patterns – and this includes adjustments in behaviour as well as in resources and technologies (Adger et al. 2007:727). The organization literature has not been utilized to any great extent for shedding light on CCA, but these two ways of understanding adaptation differ mostly in the scope and unit of analysis. By introducing insights from organization theory we can contribute to developing our understanding of CCA.

The thesis is based on the assumption that social phenomena can often be explained fruitfully by several complementary theories, each focusing on different dimensions of what is to be explained (Scott 2008). In order to uncover insights from the dimensions of the technical-scientific and cultural-social approaches in the adaptation literature within the same framework, the thesis explains the adaptive capacities in the electricity sectors of Norway and Sweden by beginning with two perspectives that cover each dimension. Organizational adaptation can best be understood by combining perspectives that take their point of departure in formal, as

well as in social, possibilities and barriers. In the ‘real’ organizational world, the output of a reform or adaptive measure is often complex and multi-dimensional. Still, useful analyses about CCA capacity can be made, and a fuller theoretical framework will gain explanatory power. If only because the ‘real’ organizational output is hampered by a formal room of rational manoeuvrability, as well as by a cultural basis that requires legitimization of decisions for them to be brought to life, taking account of only one perspective would yield an incomplete picture.

A fully complete picture informed by theory is possible only in the ideal world of the social scientist. Theory is but an isolation and simplification of aspects concerning how the world actually works – but it still makes sense to employ a research design that encourages a broad picture to illuminate the phenomenon studied with an *a priori* starting point of at least dual perspectives (Gourevitch 1978:881f). Since actual organizational behaviour includes formal as well as informal elements within and outside of the organization, policy formulation and the practice of adaptation also need to take account of both these dimensions of organizational life (Scott 2008).

The two perspectives presented and applied in this thesis are not mutually exclusive. Rather, they represent complementary contributions for shedding light on the research question and the object studied in a broad sense: the capacity of the Norwegian and Swedish electricity grid sectors to adapt to the changing climate. Even if organization theory is a suitable tool for examining the capacity of a given sector or system to adapt, the theory perspectives on the research problem will have to be grounded individually. One basic reason for choosing the two major theoretical approaches to the subject matter of this thesis is that the two perspectives focus on different dimensions. One focuses on the formal constraints and potential to adapt, whilst the other puts emphasis on the cultural restrictions, covering broad and different dimensions of institutional life (Scott 2008). This divide is not insignificant, as it is important to pay attention to possible findings about CCA from perspectives that shed light from different angles (Wolf 2011).

From the rough and loose division between formal and informal explanatory factors it is possible to crystallize more distinctive theories and models. The two

perspectives – the organizational-instrumental perspective and the institutional-cultural one – provide very different takes on exactly what CCA capacity is. The organizational-instrumental perspective focuses on the formal structure of the sector, its regulatory scheme and responsibility structure, in order to provide an understanding of its capacity or ability to adapt. The institutional-cultural perspective is more concerned with the institutionalized values, norms, and culture from within the sectors, in order to explain the potential for implementing adaptive measures. Together the two perspectives therefore describe two aspects of the dependent variable: adaptive capacity to climate change. The individual perspectives are explored further in this chapter.

A thesis consisting of several articles runs the risk of repeating itself on some levels. Theory is one such level. The main theory perspectives utilized in the analysis will be presented here, but located within a somewhat broader context than that of the four articles. It is to be hoped that this will help to lead the reader through a slightly different account of the theory perspectives than in the direct applications in the articles themselves. All the same, some repetition is unavoidable in the design of an anthology-based thesis.

2.2 The organizational-instrumental perspective

The four thesis articles have employed a formal and a cultural perspective to shed light on CCA capacity. In the organizational-instrumental perspective the assumption of the bounded rational organizational actor is translated into formal organizational structure, where actors are assumed to relate to formal rules as to role expectation and organizational behaviour (March and Olsen 1989). The formal organization and its structure – both between and within organizations – thus becomes the framework within which individual agents respond and behave. Formal rules channel thoughts and behaviour, and through this channelling they also modify rationality limitations (March and Simon 1958).

These formal structures are often held to be important, without further theorizing (Næss et al. 2005).⁶ With the organizational-instrumental perspective this can be further clarified and operationalized, as the organizational formal structure should be expected to influence organizational capacity for adaptation. In the articles, this is done on two levels. The first three articles operate on the sector level of analysis, focusing primarily on the regulatory authorities and the grid companies. The fourth employs this perspective to explain the behaviour of individual companies in Norway and Sweden.

The formal structure clarifies which problems and solutions are chosen, thereby shaping the content of internal policy. This is done indirectly, through privileging certain actors which carry certain definitions of problems or solutions, or directly, by specifying or incentivizing preferred outcomes (Christensen and Peters 1999:6). The formal structure here means regulations, rules, and command lines that determine who can do what. They influence all sides of organizational behaviour by creating constraints and sanctions, as well as incentives, for whole organizations, between as well as within them, among divisions and down to the individual organizational agent. Thus the formal structure constitutes a coercive force that drives action (Peters 2005:43).

Because formal structure can be determined and altered in order to achieve different ends as goals change, organizations with their formal structures are tools or *instruments*. By changing the organizational structure, organizations can be utilized as means to an end. This typically happens through reforms, like the Norwegian Energy Act of 1990 and the adoption of a similar reform by Sweden in 1995. This makes it a dynamic perspective, because the instrumental understanding of organizations so closely links structure to action. By altering the rules or structure to fit the various goals set, the formal structures influence and channel individual attitudes and actions in a changed way, leading to different organizational outcomes. In this way the organization or sector can (and does) implement formal rules and regulations (means)

⁶ What is here referred to as organization or organizational structure is in the adaptation literature often termed 'institutional setting' or 'institutional structures' (Næss et al. 2005).

for effective goal attainment. The rationality of the individual is thus moved up one level and embedded within the organizational structure.

The driver for action in this perspective is based on the logic of consequentiality (Christensen et al. 2007:3). This holds that individual actors are driven by a bounded rational approach to action, where the limits of the ideal rational process are included (Simon 1947). In focus here is the hierarchical ‘structure that consists of positions and [formal] rules for who shall or can do what and which defines how various tasks should be executed’ (Christensen et al. 2007:21).

The organizational-instrumental perspective sees the formal structure as the primary influential factor of individual preference-shaping. Given the assumption of the consequential-logical organizational actor, the formal rules and procedures that empower various individuals holding positions and that constitute abilities to react to organizational behaviour will be the most important factor for identifying barriers to adaptation to climate change.

Adaptive capacity in this perspective will be constrained by the resources and information available (Brunsson 2003:168), and the capacity to manage climate change vulnerability will depend on organizational coordination and clear distribution of responsibilities (Christensen et al. 2007). With this perspective, the first step in analysing the Norwegian and Swedish energy sectors involves assessing the goals. Then follows examination of how formal structural regulations serve as means (or barriers) to achieve the goal of (re)solving the problem of adaptation to climate change. The means are the formal regulatory measures, which can be measured by looking for change in structure or formal rules and procedures for dealing with the new challenges. In this perspective, high adaptive capacity will mean forceful demands in the direct regulatory scheme as to a clear distribution of responsibilities, what expertise to maintain where, and clear expectations to grid companies as regards maintenance and back-up grids.

2.3 The institutional-cultural perspective

Whereas the organizational-instrumental perspective finds a footing in a larger paradigm of social science, the normative or sociological branch of new institutionalism emphasizes the importance of institutional factors like norms and values, and how these influence organizational behaviour (Hall and Taylor 1996). This reduces the conceptual difference between ‘institutions’ and ‘culture’, challenging the distinction between ‘institutional explanations’ based on organizational structure and ‘cultural explanations’ based on shared norms and values (Hall and Taylor 1996:947f). ‘Organizations’ are then formal structures, while ‘institutions’ are a common set of norms and values. In such a paradigm the cultural and the institutional are both broadly understood as a common set of norms, values, and informal rules and routines ‘infused’ in the organization, ‘beyond the technical requirements of the task at hand’ (Selznick 1957:17).

Institutionalization is thus understood as the process that orders and constrains but also enables forms of interaction and organization, constituting institutional logics that cannot be reduced to a matter of rational choices or to a series of environmental contingencies (Cooper, Ezzamel, and Willmott 2008:673f). It is what happens as organizations become institutions or when institutions evolve. This emphasizes the normative pillar of organizations and sectors (Scott 2008).⁷

This sociological angle represents a way of understanding institutions widely. Here institutions include entities like the judicial system (hardly possible to refer to as ‘organization’) or even more loosely ‘common practices’. While these informal entities often are represented by organizational boundaries, this is not necessarily the case (Peters 2005:107ff. Organizational culture directs the attention towards the individual institution or sector and the dominant norms and values within this sphere (Christensen and Peters 1999).

Institutionalized organizations or sectors tend to develop understandings of ways of behaviour, something that becomes a common framework for what is appropriate

⁷ This is not the same as a normative theory, but rather emphasizes the significance of norms as an important factor of institutional life.

behaviour (March and Olsen 1989; Christensen and Røvik 1999). This rule-following logic of organizational action is a strong force for driving action, combining identity with situations. Organizational actors do not always turn to the consequential logic as bounded rational actors: rather they assess what kind of situation is present, and decide on the appropriate course of action on the basis of what is expected. This in turn is based on the organizational norms and values such as standard operating procedures, professional standards and conceptions of identity (March 1996:21f). More experienced (i.e. more institutionalized) actors can be expected to have greater expertise in interpreting situations, identities, and the matching of these, making legitimate, or appropriate decisions.

The *institutional-cultural perspective* orients itself within this institutional tradition, and puts emphasis on behaviour within an institutional context. The model regards organizational action and actors as being constrained by institutional-cultural factors: stable routines, norms, and values that both constrain and empower action by giving meaning to institutional social life despite changing external organizational environments as described above. The values infused in the institutionalization process provide stability, but on the other hand this may lead to organizational inertia (Hannan and Freeman 1984).

Institutional factors like those emphasized by this approach are found not only at the individual and organizational levels, but could also span an entire sector as defined in the thesis' introduction (Scott 2008; DiMaggio and Powell 1983). In this perspective, agents within sectors will often share a common regulatory framework and will tend to develop shared values and norms over time, crossing strict organizational boundaries.

In general, actors within organizations do not act on a consequential basis, rather the choice of one option and not another is based on a logic of appropriateness (March and Olsen 1989; Christensen and Røvik 1999). Individuals and organizations fulfil or enact identities by following informal rules and procedures that they deem appropriate to the situation at hand (March 1994). Actors act out what they believe is expected of them – and action is thus bound by norms and values in which decisions made will

tend to be similar to those made in earlier comparable decision-situations (Cyert and March 1992:120f). Action, then, is what is expected by an actor in a process whereby situation and roles are matched, fitting an informal ‘rule’ to a situation (March and Olsen 1989).

Barriers to adaptation will exist where the institutionalized values do not provide a legitimate basis for the implementation of these measures. These institutionalized values can be summed up as *institutional logics*, referring to ‘broader cultural beliefs and rules that structure cognition and guide decision making’ in a field or sector (Lounsbury 2007:289). Such institutional logics can be identified through empirical investigation in individual organizations, in sectors or in society (Thornton 2004). The logics express a set of more or less coherent norms and values, and there may exist one or more of such logics at any given time (Reay and Hinings 2009).

This perspective holds that organizational change will require change in the identity, values, norms and routines of an organization. An institutional conception of governance would emphasize the legitimization of policy choices and the maintenance of norms (Christensen and Røvik 1999:167), seen as necessary for ensuring successful adaptation (March and Olsen 1989) through learning (Levitt and March 1988). Successful governance for CCA would therefore depend on a basis of legitimacy, to avoid resistance to changes in structures and practices (Næss et al. 2005:129).

The institutional-cultural perspective focuses on the cultural legitimacy of possible adaptation measures based on appropriate values. Barriers to adaptation will exist where the institutionalized values do not provide a legitimate institutional basis for implementing these measures. It thus predicts a high adaptive capacity if the prevailing appropriate logics in the sector provide a legitimate basis for maintenance, social responsibility, robustness of the system, and taking climate changes seriously. Here, high adaptive capacity is an institutionalized culture which provides a legitimate basis for acknowledging vulnerability to climate change and for adaptations aimed at lessening such vulnerability.

Against the backdrop of this theory framework it is necessary to discuss some of the relevant methodological issues of the research design. This is done in sub-chapters

3.1 to 3.4, before we move on to the findings of the four articles and the analytical contributions of this thesis.

3 Research Design

The study consists of a set of four articles that examine adaptive capacity and the reasons for change in adaptive capacity in the Norwegian and Swedish electricity grid sectors:

1. Inderberg, Tor Håkon (2011). Institutional constraints to adaptive capacity: adaptability to climate change in the Norwegian electricity sector. *Local Environment*, 16(04), pp. 303–317.
2. Inderberg, Tor Håkon (2012). Governance for adaptive capacity in the Swedish electricity industry: Do changes in structure and culture matter? *Accepted for publication in Public Management Review*.
3. Inderberg, Tor Håkon (forthcoming). Changes in organizational culture, changes in adaptive capacity? Examples from the Norwegian and Swedish electricity sectors. In *Adapting to Change: Integral approaches to climate change responses in Norway*, edited by K. O’Brien and E. Selboe. Cambridge University Press.
4. Inderberg, Tor Håkon and Liv Arntzen Løchen (2012). Adaptation to climate change among electricity distribution companies in Norway and Sweden: Lessons from the field. *Local Environment*, 1-16, *iFirst Article*.

3.1 Choosing the objects of study

Case-selection aims to identify the cases that offer the best chances of shedding light on the research question at hand. Investigating CCA capacity in quasi-public network services, with the chosen theory approach, makes a design of case-comparison highly suitable; it can be expected to increase the robustness of the findings through the comparability of the mechanisms identified among the cases selected.

In a most-similar approach, a different outcome on the dependent variable can be explained by the variation of a small number of factors (Moses and Knutsen 2007). Cases are chosen on the basis of their expected contribution to the theoretical explanations and to theory building, by offering a range of factors that generally

overlap, but deviate on one or a few crucial factors (Gerring 2008). Not all of these crucial factors will necessarily be known prior to the selection process, but can usually be identified as work progresses within the chosen cases. As noted in the theory section, the main factors for investigation in this thesis are changes in the formal structure and the organizational culture in the two sectors. Norway and Sweden are generally regarded as having very similar political and administrative systems (Lijphart 1999). The choice of sectors was made early in the research process, and was grounded in a most-similar logic. The two cases serve as good examples of a highly regulated, quasi-public sector, affected by weather and changes in climate.

Against this backdrop, the choice of Norway and Sweden was natural. General similarities are evident within the countries' political systems, welfare systems, history and culture. The electricity systems of the two countries are similar in many respects and have not developed entirely in isolation from each other; over the past 40 years or so, they have become increasingly integrated. In addition, both countries have undergone similar restructuring over the past 20 years and today are facing similar challenges as regards external pressures from the European Union to phase in more renewable energy.⁸ This research design makes historical comparisons between the two national sectors particularly pertinent as it increases the likelihood of bringing out important factors that lead to differences in the dependent variable 'adaptive capacity to climate change'.

But are the two sectors not too similar to be fruitfully compared? Or, given their interconnectedness, are they not two parts of the same system – which would make comparisons less valid?⁹ Let us look briefly at the relevant historical developments in the two countries. The first connecting transmission lines between Norway and Sweden were built by a local energy company in mid-Norway, between Nea and Järpstrømmen in 1960 (Skjold 2006:146). This was the start of the Swedish–Norwegian cooperation, driven by the recognition that the most effective means of securing electricity delivery included connections abroad in general, and with Sweden

⁸ Although Norway is not formally an EU member (as Sweden is), through the EEC agreements it is under similar obligations to integrate EU legislation in a wide field of issues, including energy.

⁹ Thanks to Dag Harald Claes at the University of Oslo for raising this issue.

in particular. The Norwegian state was not a notable driver for integration until the government financed a 400 kV transmission line in the south that was finished in 1963.¹⁰ Since these first interconnections there have been more and today the two countries are linked by five high-voltage transmission links. This is clearly of mutual benefit. With a high storage capacity for hydropower Norway has the option of selling surplus energy in wet years, while the possibility to import in dry years is of vital importance if precipitation fails. Sweden, on the other hand, gets the benefit of the Norwegian surplus power, and in particular makes use of the more flexible reservoir power for peak loads. The two countries' electricity systems can thus be said to be mutually dependent. Geographical considerations strengthen this impression. Norway and Sweden together form a peninsula divided lengthwise and separation of the two systems seems technically rigid and ineffective. In 1996, a common Nordic electricity market was established, with Sweden acquiring 50 per cent of what was to become NordPool, the Norwegian–Swedish (later Nordic) electricity exchange (Olsen 2000). Since then, the Norwegian and the Swedish markets have become increasingly interconnected. Today the two countries are highly mutually dependent: Sweden gets electricity supply from Norwegian hydropower during peak loads, while Norway depends on Sweden's transmission grid for electricity transmission from north to south in Norway, as well as supply in dry years.

Although these facts indicate the mutual dependency of the systems, and the interconnectedness and similarities between the two countries, there is no reason that the grid regulations, formal structure and similarities between organizational cultures could not be compared fruitfully. It is true that either country will be vulnerable to failures in the other's system, and it is equally true that the interconnectedness makes the domestic system more resilient to internal failures. However, that issue is beyond the scope of this thesis, as we are primarily concerned with organizational CCA capacity and not technical vulnerability *per se* (see Formula 1). The research question points to CCA capacity as an organizational potential in the two cases and thus does

¹⁰ 400kV is the highest voltage level of the Nordic transmission lines, capable of transporting power over distances with minimal loss.

not invite a more technical analysis. The interconnectedness of the two does provide for greater system robustness; however, along the dimensions in question this should not constitute a problem for comparability between the two cases – no more than the within-case diachronic comparison conducted for each of the two countries themselves.¹¹

The cases represent a population of deregulated quasi-public sectors in developed states which often can mobilize highly developed knowledge, resources, and skilled agents (Bennett 2005; Ford and Berrang-Ford 2011). This makes the two electricity grid sectors a good choice as cases; the expected high adaptability based on standard adaptation approaches should make it easier to identify other barriers to adaptation than, for example, access to knowledge and resources. These cases or sectors can then be structurally compared, so as to shed light on the instrumental and institutional mechanisms on formal structure and organizational culture, and the implications for adaptive capacity. In Article 4, where the objects of analysis are four individual grid companies, case selection is specifically explained.

3.2 Empirical data collection

The written sources for the gathering of empirical data are of both primary and secondary nature (Moses and Knutsen 2007). The primary sources are typically laws, acts, and other official or historical documents that relate to the power sectors. Some newspapers and relevant popular journals have been consulted as well. These sources have been a valuable source of information principally as regards the formal structure. They have also contributed information about the sectoral culture and the change in this over time. Other sources of information include secondary literature about the companies and the sectors referred to throughout the articles and in this framework chapter.

A valuable addition to the written sources is participant observation, which has provided excellent background information as well as indicating specific ideas and lines of further inquiry. This has largely been conducted through attendance and

¹¹ This type of autocorrelation can be a problem in diachronic comparisons, but given the time-scope in this study it is arguably less of an issue for the analysis at hand.

interaction at seminars and conferences in Norway and in Sweden, where sector actors such as industry and regulator representatives were present. Early in the research process this took the form of assimilating background information and actor dynamics. Later this became more active, expanding to include talks, presentations, and panel participation.

The most important source of information, however, has been the 40 interviewees. For the more informal parts of information required by the theory perspectives, in particular to cover the cultural-institutional perspective, interviews with representatives from within the sectors are the main information source. Interviewees include actors from companies, regulators, transmission system operators, politicians, historians and social scientists. These individuals were selected based on their in-depth knowledge of the subject matter or in particular areas of importance. All are regarded as primary sources, as they are all actively involved in the electricity grid sector, on various organizational levels. The interviewees contributed to informing the theory perspectives presented in the thesis, but were particularly important as regards the institutional-cultural perspective. Interviewees were chosen based on a snowball selection process, but also through deliberate targeting to achieve a broad representation of grid-sector stakeholder interests (see list of interviewees in Appendix 1). The emphasis has been on selecting representatives from the regulatory agencies and from the industry, but these representatives are not a homogeneous mass of actors and interests. For example the state regulator, the Norwegian Water Resources and Energy Directorate (NVE), has several relevant departments that emplace requirements on the grid companies, and the considerations within the agency are in some instances conflicting.¹² This made it a demanding task to cover all perspectives, but has also provided opportunities for triangulation. The Swedish regulator EI (the Energy Market Inspectorate) and the Swedish Energy Agency are today two separate governmental bodies (since 2007), unlike Norway's NVE, which is still one body. Additionally the industry itself consists of different types of grid companies with varying needs,

¹² For instance the department for emergency preparedness (focusing on robustness and resilience) and the department for economic regulation (more concerned with the efficient running of the system) can at times have different perspectives.

interests and views. This is evident in Article 4 in particular, which shows the variation in adaptation among four different companies in Norway and Sweden. For this reason, interviews were conducted with large and small grid companies, in different geographical locations.

Specific considerations about the interviews have been made clear in each article, and they feed into a larger research strategy for the thesis as a whole. To this end almost all Norwegian interviewees were asked about their perceptions about Swedish practices, and conversely for the Swedish grid-sector representatives. Some interviewees were selected because of their familiarity with the comparison case. In general, grid company representatives tended to be less knowledgeable about the other country's practices than were regulator and higher-level interviewees. Also, in some of the larger grid companies with 100,000 customers or more, knowledge of the other case was somewhat higher than for the smaller grid utilities.

A list of interviewees and a general interview guide are provided in the appendices. Most interviews took between 1.5 and 2 hours, and were usually recorded. Some flexibility including the use of open-ended questions was allowed for, leaving the interviewees room to reflect and volunteer free responses. All general areas in the interview guide were covered, and the semi-structured approach was important in allowing additional points of view and factors of influence to be brought into the research. This approach provided invaluable information, in particular the empirical data required by the institutional-cultural theoretical perspective, which has largely relied on new data. The research literature has provided little documentation of how the grid utilities actually behave and how the organizational cultures have changed in Norway and Sweden, although in some of the historical accounts it is treated implicitly (Thue 1996; Olsen 2000; Thue and Rinde 2001; Bladh 2002; Nilsen and Thue 2006; Högselius and Kaijser 2007, 2010). This remains true for the work of the four articles, but on a more general level for Articles 1 to 3, where the individual electricity grid sectors are analysed and compared, and to a more detailed company-level analysis in Article 4. The interview data correspond between these analytical levels, indicating that the data are verifiable. While the more formal factors required to be mapped by

the organizational-instrumental perspective are to some extent covered by formal documents, the interviews have also been important in guiding the understanding of how the formal structure works. The interview data have also been useful for interpreting official documents.

Some mixed findings can be noted from the interview data. For the more general questions involving long time-horizons, the interviewees, especially the less experienced ones, generally provided more vague information and expressed greater uncertainty. The more experienced among them, and in particular representatives with a long time in the grid companies, expressed more confidence regarding the historical information, as regards practices before the reforms in Norway and Sweden alike. For the regulatory schemes, the empirical descriptions vary somewhat between the types of stakeholders interviewed. In Norway, there were some discrepancies between the descriptions of the regulations given by company representatives and by regulatory representatives. Here, some regulatory representatives expressed more trust in particular in the economic incentive regulations than did the company representatives. This distinction was less pronounced in Sweden, but both groups described the situation between 2003 and 2007 as one of mistrust and high tension between regulatory and company representatives.

3.3 Research design: caveats and generalizability

The research design of this thesis includes comparisons between countries as well as within-case-comparison, in particular for Articles 1, 2 and 3. Since several time-periods are compared within Norway and Sweden, there is a diachronic element to the research design. This should increase the robustness of the findings by illuminating the change in the factors that explain adaptive capacity in Norway and in Sweden.

It has been argued that qualitatively and quantitatively oriented approaches rest on similar underlying logics, a stance taken largely to the publication of the seminal *Designing Social Inquiry* (King, Keohane, and Verba 1994:3ff). However, its argument is contested. While the present thesis rests on an empirical case-study logic, it argues that the case-studies' conclusions are not necessarily weakened by the 'small-

N-problem' of over-determination, or in-determination. Because the generalizability and robustness of findings do not depend solely due on the number of evidence and cases (as argued in *Designing Social Inquiry*), but also on the type of evidence, conclusions drawn from case studies can be as robust as those from studies covering a larger number of cases (Bennett 2008). In fact, since case studies are typically more sensitive, they can be better suited for using theory in new fields and for theory development. Among the strengths of such an approach are conceptual validity, identifying the scope conditions, and the ability to derive new hypotheses, explore causal mechanisms and handle complex causal relations effectively (George and Bennett 2005).

In a case-study analysis, control for spuriousness and possible intervening variables will have to be done in alternative ways; in this case, triangulation of the information gathered among the different interviews, and among the interviews and the other sources was used. Further control lies in the interviews and an open case-study approach sensitive to context and other explanatory factors. Process-tracing elements in the approach further reduce the likelihood of competing external explanations (Checkel 2006), although this can never be completely eradicated in a social science study where controlled experiments cannot be conducted. Moreover, the researcher can never dismiss the possibility that the relationships between one or more independent and the dependent variable may be spurious (Elster 1999:5). Causal relationships in a study like this are established through interpretation of empirical data across theoretically founded variables.

A comparative case design between the two countries' electricity sectors was chosen to increase explanatory power, and to promote developments in theory. The explanatory variables were not narrowly defined *a priori*, but were further specified during the process of gathering empirical data. Models were developed prior to the research, but the exploratory element of the study is handled by openness to new mechanisms.

Any research design will necessarily involve some trade-offs. As various designs have different strengths and weaknesses, the main guide in choosing among these should be based on the overriding goal of the study. The trade-offs will relate to every

choice made in the research. Although the initial choices are more formative for the study than the later ones, trade-offs at that time will tend to be more clouded, because the consequences of each choice are less clear to the researcher. This is a challenge that could ideally be handled for every question and choice along the research process. That, however, is impractical; and some choices are more important than others. With the earlier choices, like the methodology approach or theory-based foundations of hypotheses, one may hold that considerations about benefits and trade-offs should be taken very seriously. As these lead to further choices, they will steer the research design to a greater degree than will choices made at later stages.

Opting for a case-study oriented approach, for example, will entail a trade-off in that the generalizability of the study could be more limited and must be made clearer than what is usual for a random sample in a quantitative design (although it is also important to show the limitations there) (George and Bennett 2005). One possible approach could be a quantitative one, where effects of operationalized ‘determinants’ are measured for their effect on adaptive capacity. However, this would not contribute significantly to developing the concept of ‘adaptive capacity’ much further, as there is a need for identifying mechanisms and developing theory (Bennett 2008). To offer insights for the concept either through a family resemblance or a necessary and sufficient approach, a focus on the mechanisms through a within-case analysis would be fruitful (Goertz 2006). This approach could bring the concept further and increase comparability within the adaptation literature.

On the other end of the scale, some challenges and trade-offs follow from the researcher’s choice of dependent variable(s). ‘Proving’ or measuring the concept of ‘adaptive capacity’ may be a challenge. This study has approached this problem by designing a ‘case study within the case study’, in Article 4, where four companies have been tested on the findings from the previous three articles. An alternative next step would be to develop more refined indicators for the two dimensions of adaptive capacity – formal structure and organizational culture – to measure the effect of these indicators on the capacity to adapt to climate change. This is perhaps best done

through a high N-study, but would require a different research strategy than is chosen here, to build up the right kind of quantitative data.

A within-case analysis, with the goal of finding and establishing ‘causes of effects’ of the case in question, is better equipped than a high-N study to identify intervening variables and other complex causal chains like equifinality (Mahoney and Goertz 2006). Further, the context awareness of the case studies is a benefit for adjusting the path of the research process along the way. Through process-tracing it may also be more likely to determine scope conditions, for example, moderating the identified mechanisms (Checkel 2006). Triangulation of sources and looking at the counterfactual possibilities are inherent in the study, although not always explicitly shown. They will increase robustness of findings and chances of identifying moderating and mediating factors. While the empirical data are not likely to be generalizable between cases, the case for generalization of mechanisms is a different one (George and Bennett 2005). This is in line with the goal of identifying new insights about important mechanisms that influence adaptive capacity and that can be generalized to the population.

3.4 The research process and article publications

The ideal research process rarely exists anywhere but in textbooks. Although the process of creating this thesis is no exception, it has been fairly clear-cut. The articles were produced on the basis of interviews in Norway and Sweden, and in somewhat different order from what is presented in the end product here. The PhD process started with parallel theory work and preliminary interviewing in Norway. This process enabled a practical calibration between which theoretical models to use on the subject matter and sharpening the questions for further interviews. This grounding of theory proved valuable for the later research process in that it secured the relevance of the final theoretical models. Several models – including rational-actor models, actor-network models, path-dependency perspectives, and myth-perspectives – were considered at this stage of the research process, before the final choice fell on the two perspectives presented above.

The first article to be written and published was Article 1 in this thesis: *Institutional constraints to adaptive capacity: adaptability to climate change in the Norwegian electricity sector*. This article involved substantial interviewing and set the framework for the articles that followed. The contents were presented and ‘tested’ on the audience of stakeholders and practitioners in the energy sector, encouraging discussions and criticism along the way.

That article has contributed to form the argument and frame the comparative design of the thesis, and thus leads the structure of both the *Governance for adaptive capacity in the Swedish electricity industry: Do changes in structure and culture matter?* (Article 2), and the book chapter (Article 3) *Change in organizational culture – changed adaptive capacity? Examples from the Norwegian and Swedish electricity sectors*. The chapter on Sweden was written simultaneously with the comparative book chapter. Its findings were presented at the conference ‘Climate Adaptation in the Nordic Countries: Science, Practice, Policy’ at the University of Stockholm 8–10 November 2010. Although submitted at a later stage, the findings from the article on Sweden (Article 2) informed the comparative chapter (Article 3) throughout the writing process.

It was also necessary to go beyond the strict ‘capacity’ discussion. Moving to the practice of adaptation, the need for an ‘on the ground’ study of CCA practices provides a fuller picture of what the grid companies actually do to adapt to the changing climate, and as such represents a crucial test of the CCA capacity analysis of the two sectors. This article required some additional interviews to clarify actual practices in small and large grid utilities in Norway and Sweden, but the comparative design of the article (Article 4) leads to findings indicating that the adaptive capacity shown in the previous articles is indeed able to find its way into the real world and manifest itself in actual CCA practices. This adds robustness to the findings and general argument of the thesis.

4 Main Results and Discussion of Findings

Through its four related articles this thesis has mapped changes in the Norwegian and Swedish electricity grid sectors and how the organizational ability to implement climate change adaptations in the two countries has been affected. It has done so on two analytical levels: the national sector and the individual grid utility, and through two main dimensions of comparison: the national and diachronic.

The main contribution of the thesis has been to analyse in terms of theory how organizational factors influence and shape adaptive capacity to climate change, through formal structure and organizational culture in the two sectors, and to investigate empirically the dynamics between these two dimensions. The results and conclusions are discussed within the frame of each individual article. This section reviews and discusses the articles' findings in light of the overarching research question: *What changes in organizational dimensions such as formal structure and organizational culture can be found over time in nationally regulated quasi-public network industries and how do these changes influence CCA capacity?*

4.1 Findings and the use of theory in the individual articles

The four thesis articles take their starting point in the two main perspectives described in Chapter 2: Theory Framework, and at different levels of analysis. The main contributions of these articles are briefly described and discussed here. Then the broader implications are discussed before a summary of the findings is presented.

The first article, *Institutional constraints to adaptive capacity: adaptability to climate change in the Norwegian electricity sector* maps the changes in formal structure and organizational culture in the Norwegian electricity grid sector, and discusses how these influence CCA capacity. It uses a sector-level framework with two complementary theoretical approaches, and illustrative examples are taken from company practices. The organizational-instrumental approach sets focus on change in formal structure. Weight is given to the distribution of responsibility and what expertise to maintain where, along with clear expectations to companies concerning grid maintenance and back-up.

The operationalization of the institutional-cultural perspective follows the concept of institutional logics (Lounsbury, Geraci, and Waismel-Manor 2002; Lounsbury 2007; Reay and Hinings 2009) as an extension of the more general notion of rule-following behaviour as defined by organizational culture (March and Olsen 1989). More concretely it lies in the practices in the sector, grounded differently before and after the New Public Management (NPM) reforms of 1991 and 1996. Most interviewees pointed to a change of norms that underpinned the decisional reasoning. Similar tendencies can be read out of official documents, for example through the gradual inclusion of the term 'socio-economic benefits' in the formal documents surveyed. It is evident that the operationalization of the different cultures or institutional logics can be oriented fruitfully to the change of the norms and values present in the organization at any time. Another indicator is the drift mentioned in the article as regards professional demography.

The two theoretical perspectives are described, before the empirical data covering the formal structure and organizational culture in the Norwegian electricity sector are mapped. The changes in the formal structure from before the reform in 1991 up until today, along with changes in institutional logics, are identified and mapped in three phases: from the early 1980s to 1991, between 1991 and 2000, and from 2000 up until 2010. As to the changes in the formal structure, the article shows that the Norwegian electricity sector started off as a planned economy with direct regulation and ownership, with scant focus on economic cost. In the second phase the vertical integrated structure was unbundled; generation was then market exposed and grid activities were to be regarded as a natural monopoly. Later in the second phase a tentative incentive-based regulatory scheme was developed. This was in the third period modified to create some incentives for the grid companies to be held accountable for quality of supply as well. The regulatory scheme developed along the same principles as one model and became more sophisticated over the years.

In terms of organizational culture, the first period was dominated by the institutional logic of engineering, partly replaced by two other institutional logics after the reform: the social economist logic and the corporate economist logic. These logics

are further described and discussed later in this chapter (4.3), but an important point is that the engineering logic does not disappear completely, which helps to understand some decisions made by the grid companies in spite of regulatory framework.

Article 1 discusses the implications of the change in organizational structure and culture for adaptive capacity on the Norwegian sector level. It finds that its CCA capacity was reduced significantly after 1991. This was caused by the changes in both formal structure and organizational culture. The earlier direct control and company structure, together with emphasis on robustness over cost efficiency, was replaced by the exact opposite. After 2001 Norway saw a slight increase in CCA capacity; the maturation of the regulatory scheme addressed some issues regarding quality of supply. In terms of organizational culture, however, the Norwegian sector was increasingly fragmented.

Article 2, *Governance for adaptive capacity in the Swedish electricity industry: Do changes in structure and culture matter?* performs a similar empirical mapping and analysis for Sweden as was done for Norway in Article 1. The theory framework, operationalizations and design of the article follow the same structure as for the Norwegian case. Thus we have two separate articles with comparable yet different results, with similar research designs and theory frameworks.

Although the cases were selected so as to be most-similar, the findings reflect different national contexts. The Swedish sector underwent reform in 1996, when the vertically integrated structure was unbundled. The article shows that while Sweden's electricity sector was in no form of crisis, the reform was intended to effectivize it further. The system was one of self-regulation of electricity prices where individual companies made the pricing decisions independently. The vertical integration in the system had started to loosen up before the reform, as shown by the division of Vattenfall and Svenska Kraftnät in 1992. The article shows how the balance in the Swedish system's culture, characterized by engineering logic but with economic considerations and thus more of a hybrid, shifted towards a more economic focus in 1996. The result of the reform – fragmented and oft-shifting regulatory models – enabled the hybrid culture of engineering and economic considerations to dominate the

decision-making space. This contributed to ensuring that the transition to the NPM reform did not further weaken CCA capacity in Sweden, with a mild cultural transition from an engineering approach with economic leanings, to an economist approach with engineering considerations.

The findings from the first two articles are used for comparative purposes in the **Article 3: *Change in organizational culture – changed adaptive capacity? Examples from the Norwegian and Swedish electricity sectors.*** The similar design of Articles 1 and 2 enables an explicit comparative analysis that was not possible without the individual cases being analysed first. Comparison between the sectors in the two countries is made along the most important dimensions of the two perspectives, limited by the format of the article. This is manifest in both theory perspectives, but in particular in the categorization of the institutional-cultural perspective. Whilst Article 1 identified a taxonomy of three institutional logics, in this comparative article two economic logics are treated as one. Sweden's more hybrid logics were kept to those of engineering and economics, as in Article 2. The less fine-grained approach in Article 3 was deliberately chosen in order to emphasize the most significant differences between Norway and Sweden.

This has some implications for the findings and the analysis and Article 3 initiates the discussion of the broader comparison between the Norwegian and the Swedish cases, including differences and similarities in CCA capacity. We will see that the Norwegian sector is in some aspects a more complex case than the Swedish one. The empirical data required for a comparative theoretical discussion are incorporated, in simplified form, into the third article. Theory insights are increased as a result of this simplification, so the complexity of the cases is not lost. This ensures a nuanced theoretical approach, whilst simplifications are made to elucidate the general analytical points for discussion.

The final article, **Article 4, *Adaptation to climate change among electricity distribution companies in Norway and Sweden: Lessons from the field,*** puts the findings from the cumulative sector-level processes to the practical test. Two large and two small individual grid companies from Norway and Sweden are chosen for analysis of

how some of the factors of the national contexts actually influence decisions about CCA. As such, this represents a first test of the adaptive capacity of the representative cases in each country.

The company-level analysis uses the theory findings from the previous, sector focused articles to investigate whether the differences in adaptive capacity identified between the Norwegian and the Swedish electricity grid sectors can also be traced to the practices of the four companies selected. As such it utilizes a similar operationalization of the organizational-instrumental and the institutional-cultural perspectives as a sector background for the four grid companies. Two additional factors are controlled for as potentially relevant factors that might influence company adaptation behaviour. The first, organizational capacity, is operationalized as company size, in terms of the number of end-users attached to the company grid. The second control variable is exogenous shocks, in the form of experience with extreme weather-events.

Article 4 also finds that in practice there are differences in the CCAs implemented by the chosen grid companies. The Swedish companies have implemented more adaptations towards extreme weather than have their Norwegian counterparts. The two theory perspectives and differences in the national context explain this. The article also finds that larger companies have implemented more adaptations to climate change and extreme weather, whereas (and not surprisingly) previous experience with weather events has contributed towards greater adaptive behaviour in both Norway and Sweden.

In this way, the four articles, individually and collectively, contribute to answering the overarching research question of this thesis. They are each individual parts of the general research design and contribute by mapping the empirical background of the respective electricity grid sectors and the changes in the theory-relevant variables. These have been derived from the institutional-cultural perspective and the organizational-instrumental perspective, as described in Chapter 2. Article 3 performs a comparative analysis of Norway and Sweden. Articles 1 and 2 focus on each of the sectors in isolation. Three articles have therefore been involved in the analysis of each

sector, on different analytical levels. This ensures good coverage and overlap, and the findings between the articles are relatively consistent.

The articles represent analyses of whole sectors, or individual companies, which focus on the sectors' organizational capacity for CCA. This is therefore not an analysis of vulnerability or exposure to climate change, but remains an example of nationally regulated quasi-public sectors and their organizational capacity for adaptation.

Generally the empirical findings indicate that both sectors develop along similar tracks. There are also differences, caused by the national context that has shaped each sector. If we look at the dimensions of functional role division and of autonomy among the grid utilities the reforms in Norway and in Sweden closely resemble each other. The grid companies in each country have been autonomized in the sense that they are no longer directly controlled and have as such been transformed from an integrated part of public administration to a quasi-market situation (Statskontoret 2004; Claes and Mydske 2011). In neither country have they been actively privatized, as the municipalities are the majority owners of the grid utilities in both sectors.¹³ But they have been 'cut looser' from public steering; the companies are no longer part of a larger functional structure (the earlier vertical integration that also included production and trading). The grid companies are responsible for ensuring the functionality of the infrastructure, while the division between the regulating state and the grid utilities has increased the distance between these two. Today the state has the indirect responsibility for the collective goods provided by the supply of electricity through the grid system.

4.2 Formal structure in the two sectors

On the surface, the Norwegian and Swedish electricity grid sectors share many similarities, work towards many of the same general goals, and face similar general challenges. In both countries, the general balance between robustness of supply and maintenance on the one hand, and economic efficiency on the other, can be seen as an

¹³ The most notable private-owned grid companies in Norway and Sweden are arguably Hafslund, which covers the Oslo area and E.ON (former Sydkraft), which is responsible for the grid in southeast Sweden, including the Stockholm area.

inherent goal-conflict due to the nature of the network sectors (Claes and Mydske 2011).

Comparing the formal structure between two sectors in two countries is not a simple matter. The sheer complexity of the regulatory framework makes it difficult to compare the two fully and in detail, since minor differences in some of the elements in the regulatory models, the company structure of the sectors, or any other endogenous or exogenous factor between the two sectors can significantly impact behaviour. Some comparisons still make sense in practice; this is done in the articles, where more detailed descriptions of the formal structure and its changes in both sectors can be found. Here only a brief recapitalization is offered. The challenge of comparing regulations was dealt with by gathering information through interviews as well as formal documents, focusing on how the actors in the sectors perceive the formal structure and by identifying what they regard as important.

The main differences between the two regulatory frameworks are described in further detail in the individual articles, particularly in Articles 1 and 2. Broadly seen, the regulatory frameworks consist of a core made up of economic incentive regulation and a set of direct regulatory requirements. This is also followed up by regulatory supervision of the companies. Before the reforms in Norway in 1991 and in Sweden in 1996, both sectors practised a form of self-regulation in an industry that was vertically integrated, meaning that the same companies often generated electricity, sold the power as well as performing transmission and distribution activities. In Norway the sector had more developed links to the political level, as electricity prices were directly determined at the political level and decisions to reimburse investments were also made there. In Sweden, the connection to the political level was weaker and the system was a more truly self-regulatory one (Amundsen and Bergmann 2003). Price decisions were in practice made by the largest state-owned company, Vattenfall, and the dominance of that one company ensured that the other companies related to this price. Municipal companies were not allowed to make a profit. There was also a formalized complaint mechanism through which individual customers could appeal. In both countries, however, energy-price levels were low and the basic criterion for the setting

of the price level was self-cost. In Norway this had the backing of an implicit guarantee for reimbursement of large costs.

The reforms in Norway and Sweden were followed by a total reshuffling of the organizational structure in both sectors. Without going deeper into the historic reasons for the differences here, we may note that the general tendency was similar: the generating companies were separated from the transmission and distribution companies, with several other systemic changes resulting as a consequence of this primary shift. The Swedish system has been the most unstable one in practice, in terms of the number of regulatory models and level of conflict since the turn of the millennium. Five different models have been in effect since the reform. Norway, by contrast, implemented a tight economic incentive model in 1997. Although some additions and adjustments have been made, the model is still in use (von der Fehr 2010).

There are some differences between the Norwegian and the Swedish regulations. For example, the expected rate of return allowed by the regulatory framework is different, with Norway allowing for a lower rate of return than the Swedish models (Eurelectric 2011). The Swedish models have generally been looser, in the sense that they have allowed for higher revenues. Also, the fact that the Swedish system has generally allowed new investments to increase the real value of the infrastructure has encouraged investments that would probably not have been made otherwise. Lastly, both systems have implemented incentives for punishing low reliability of supply. While both countries have fines for lengthy blackouts, only Norway has implemented an additional and more finely grained set of fines for electricity not delivered.¹⁴

4.3 The prevailing cultural logics in the two sectors

The research has indicated several distinct professional cultures or institutional logics within the Norwegian and the Swedish electricity grid sectors. Three cultural logics have been identified for the Norwegian sector and two for the Swedish. For Norway there is the ‘old’ engineering logic, followed by the later development of two

¹⁴ The main innovation here is the ‘Cost of Energy Not Supplied’, referred to as KILE in Norway.

economics logics: that of the social economist and the corporate economist. The three logics share some characteristics but also differ on some important points. The logics of engineering and of social economics emphasize both system responsibility and collective good. They operate on the societal level, but follow different lines of reasoning. While the engineering logic focuses on system-functionality, that of the social economists pays less heed to the technical system, but emphasizes cost reduction as a social good. The main goal is to reduce costs, so as to free economic means for a wider set of purposes (Thue and Rinde 2001:233ff). These factors involve macro-level considerations, but with different ends. While power-construction projects before the liberalization of 1991 disregarded the economic costs, this was facilitated by political reimbursement of investments (Bye and Hope 2006). The social economic logic grew out of a de-prioritization of these attitudes, reinforced by the growing numbers of economists working in the electricity sector in particular around and after the time of the reform in 1991 (Thue and Rinde 2001). In the ‘old’ system, the individual companies and the regulator shared goals to a large degree. After the reform this changed and is probably one of the reasons for the development of the third institutional logic in the Norwegian sector. Before the reform, the companies largely had their costs covered. Introducing economic efficiency and market rules also served to accentuate differences in interests between the state and the regulator on the one hand, and the grid companies on the other. While the state provided the sector’s main framework conditions, it became increasingly acceptable for the individual companies in the sector to consider maximising profit as the main goal. While this last logic, the corporate economist’s logic, has gradually grown after the cultural consolidation of the sector, it is not yet fully accepted in all circles. Nevertheless, it influences behaviour in the sector and therefore deserves mention.

Sweden has experienced less radical cultural development over time, and is more hybrid in its institutional logics. Here it is more accurate to talk about the ‘economics-aware engineer’ and the ‘engineering-aware economist’,¹⁵ as the prevailing institu-

¹⁵ In Article 3 the terms ‘balanced engineer’s logic’ and ‘balanced economist’s logic’ were used to signify the hybrid nature of the institutional logics.

tional logics in the sector before and after the 1996-reform (see Article 2). The historical reasons for this are not part of the research question and have not been in focus for the analysis. It seems plausible that some of the differences between the formal structures in the two countries at least to some extent have influenced differences in culture (see 4.6 below and Table 1). Sweden's self-regulatory system, without interference from the political level in price-setting decisions, may have contributed to wider responsibility for price awareness in the sector. The interviews, in particular with some of the Vattenfall representatives who were involved in price-setting, confirmed this, and emphasized the importance of this economic awareness in Sweden's still engineering-dominated sector. In isolation it is also easy to see the cultural drift in the Swedish sector, from a 'functional' engineering logic to a more social economic one. However, through the comparisons between the two sectors, the less radical cultural move in the Swedish sector compared to the Norwegian one becomes clear. While it took some time for changes in behaviour to become evident in both countries (Midttun and Summerton 1998), the Norwegian sector has been characterized by a radical de-legitimization of culture not found in the Swedish sector. On the contrary, the move to market reform was one of hesitance and slowness, and far less abrupt in Sweden than on the other side of the border. The pre-reform Swedish system was described as 'effective' (Högselius and Kaijser 2007), but the drift towards a market reform nevertheless led to changes in the sector. Since the working institutional logic from before the reform was never de-legitimized in the same way as it was in Norway, there was not the same transformation in institutional logic. The changes can be seen as modifications; they were also slower than in Norway. The main cultural and instrumental findings from the four articles are summarized in Table 1 below.

Determinants, in the strict sense of the word, are not easy to test statistically, since quantitatively, the goal is to determine the 'effects of causes' (George and Bennett 2005). The theorized factors should be referred to as 'indicators' or similar, since we are not talking about determinants here at all; rather we have a loose set of indicators

which influence adaptive capacity to a given entity, be it individuals, organizations, or sectors.

Table 1 General empirical findings from the four articles

	Culture (pre-reform)	Instrumental (pre-reform)	Culture (post-reform)	Instrumental (post-reform)
Norway (sector-level)	Engineering paradigm	Clear responsibility, availability of funding, and steerability	Culture transformed from engineering to include also social economics and corporate economics logics	Development of one strong, economic efficiency-driven regulatory model
Sweden (sector-level)	Hybrid paradigm: economics-aware engineering logic	Clear responsibility, availability of funding, and steerability. Steering less political (prices set by companies)	Culture transformed from engineering to include also social economics and corporate economics logics	A fragmented regulatory scheme reduced the influence of the formal structure

The thesis rests on empirical findings from formal structure and organizational culture to be able to make claims about the influence of these on CCA capacity. The issue at hand concerns bridging the perspectives to show the influence of such factors at the sector-level, and organizational capacity for change. This represents a novel use of these perspectives on CCA. First we will look at the perspectives individually, before the mutual influence is considered.

4.4 Formal structure and CCA capacity

All four articles show an influence of formal structure on CCA capacity. In addition, they indicate that there is a trade-off, or goal conflict, between economic efficiency on the one hand, and robustness, maintenance and security of supply on the other. The balance between these two considerations has to be found in any regulatory scheme in a setting with quasi-public network services. This balance should perhaps not be too

static, as some flexibility is necessary to enable adjustment, both to accommodate internal and external considerations to the sector in question.

Against this backdrop, the fragmentation of the two sectors has been a significant finding in the cases. Worth noting is the finding that the goal orientation of the formal structure can be fairly well coordinated for one set of goals, but at the same time fragmented for a different set of ends. In this way the formal structure can be geared to specific outcomes. This gearing can be identified in different ways for each of the national electricity grid sectors. The extreme case is again Norway: the formal structure is fairly well coordinated to achieve economic efficiency but when it comes to CCA capacity, the means and responsibilities inherent in the formal structure for achieving a robust structure whilst ensuring necessary adaptation for future climate change are vague and fragmented. Sweden is, as shown in Articles 2 and 3, more balanced between the two considerations.

This finding is in accordance with some of the NPM literature, where such reforms are found to undermine capacity in general and also more specifically for CCA (Painter 2001; Eakin et al. 2011). In the Norwegian and the Swedish cases, NPM reforms have taken similar (although not identical) forms, characterized in both places by the division and rationalization of organizational elements, increased auditing and budgetary discipline and increased responsibility to (and for) the various organizational entities. In this sense, Norway again stands out as a radical electricity reformer, in contrast to other sectors in Norway, which has been called a late and ‘reluctant reformer’ of NPM (Sahlin-Andersson 2001; Christensen, Lie, and Lægreid 2007). By contrast, the Swedish electricity reform took a less extreme form.

In many ways, the NPM reforms illustrate the dimension between economic efficiency and security of supply in the network services well (Claes and Mydske 2011). To succeed, electricity liberalization requires more sophisticated regulation (Pollitt 2008). Some of the economic incentives for non-price objectives like security of supply may also pull in different directions, as can be seen in Norway and Sweden alike. Both countries have formalized disincentives for long-term blackouts, although only Norway has included fines for short-term failures (i.e. energy not delivered).

Norway has a more finely grained regulatory model for catching also the shorter failures (and the failure statistics have indeed improved more or less continuously since 1991), but this does not necessarily say much about system robustness or capacity for CCA. What the four articles indicate is a reduced capacity to manage climate change caused by the changes in the formal structure. This finding is consistent even though the implementation of some regulatory measures (fines for failures) does create incentives for the grid utilities to invest in system robustness and should be regarded as a regulatory acknowledgement of this real or potential challenge.

This finding from the instrumental-organizational perspective is further strengthened by the identification of a responsibility gap in the formal structure for both countries. This implies that the grid utilities, which have the formal responsibility for providing reasonable security of supply, have in fact reduced the influence of important framework conditions necessary for achieving it (Palm 2008). The articles point to this phenomenon in both countries, but indicate that the responsibility gap is a larger problem in Norway – because the Norwegian regulatory scheme is a more efficiency-driven framework than the Swedish one (Eurelectric 2011). The responsibility gap is qualitatively similar in both countries, as could be expected for all quasi-public liberalized sectors.

Ultimately there are questions to be reflected upon. Seen from the top down, the responsibility gap accentuates the question of how far public administration stretches. Seen from bottom up, the relevant question is not who holds responsibility for important collective goods that are outsourced, but how the state facilitates the provision of steady supply. The Norwegian regulator NVE does not seem to indicate a change in framework conditions in relation to the changing climate, nor does the Swedish Energy Agency, although both regulatory agencies appear to be constantly assessing the needs for doing so (Swedish Energy Agency 2007; NVE 2010).

4.5 Culture and CCA capacity

Culturally we find the same trade-off as in the formal structure, in the sense that different organizational cultures, or institutional logics, weigh the considerations between

security of supply and economic efficiency differently. But which encourages adaptation the most? This is explicitly analysed in the individual articles for the respective electricity grid sectors. Here we offer some general insights on how organizational culture influences CCA capacity.

Firstly, organizational behaviour is in the institutional-cultural perspective based on informal rule-following, where organizational actors match identities to situations, and determine the appropriate behaviour (March and Olsen 1989). This concept of a cultural identity in organizations or sectors is summed up in the term ‘institutional logics’ (Lounsbury 2007). Such logics, expressing broader cultural beliefs and rules, can be distinguished from each other and empirically defined as summed up in Table 1 above. Company or sector culture can in this way exert considerable influence on organizational performance, depending on the ‘cultural fit’ between the shared culture and the organizational goals (Wilkins and Ouchi 1983).

Another significant finding from the articles is that there are differences between the institutional logics in the Norwegian and the Swedish electricity grid sectors and that these have different ‘cultural fits’ regarding adaptation. While informal rules are less visible to the random observer, they are not necessarily less important as regards organizational behaviour. As described above, both sectors have experienced change in institutional logics, but to differing degrees. The Norwegian sector stands out as truly culturally transformed when compared to that of Sweden, and this has implications for general insights into CCA capacity.

The four articles analyse the connection to CCA capacity separately. What is clear from the analysis is that different institutional logics legitimize actions that correspond with adaptation to climate change in different ways and to differing degrees. Risks are to some extent ‘selected’, in the sense that different cultures will respond differently to different types of risks (Wildavsky and Douglas 1983). Concretely, over the timescope of the analysis, the Norwegian pre-reform institutional logic was the culture that encouraged adaptation seen as robustness-building and system functioning when faced with a changing climate. That logic had other problems, however, not least the lack of economic efficiency that led to the undermining of the logic itself. The cultural

transformation in the Norwegian sector moved organizational legitimate considerations to the other extreme, and in doing so largely undermined CCA capacity, as shown in Articles 2 and 3. The two remaining institutional logics, the socio-economist and the corporate economist, can be said to exist in a more fragmented field, where the logics co-exist but on largely different levels in the sector. The social economic logic is, perhaps naturally, more clearly expressed through interviews with the regulator and the ministry than in the grid companies.

This has consequences for CCA capacity. The cultural transformation in the Norwegian sector undermined the perceived validity of considering robustness over cost. Normatively appropriate decisions were, after the reform, increasingly directed at efficient use of funding, effectively reducing the cultural ability to include considerations that were difficult to calculate into a cost-benefit approach. However, even with this trend the engineering institutional logic did not completely disappear. In parts of the regulator NVE – for example, the Section for Emergency Preparedness – this logic has remained dominant, whereas the Section for Economic Regulation now follows the logic of social economics. There are some tendencies of this in the company flora as well, where the larger companies to some degree represent the corporate economics logic, directing responsibility for security of supply to the regulator level, and challenging the regulator's decisions. It is, nonetheless, possible to find remnants of the engineering approach in some of the smaller companies.

The Swedish example indicates different findings as to the influence of institutional logics on CCA capacity, compared to Norway. First of all, the Swedish cultural drift has been smaller and more of an incremental development, arguably not exclusive to the electricity industry but in line with developments in the wider organizational environment. This is perhaps a question of conventional apprehensions regarding cultural change (Selznick 1957; Thornton 2004) and thus also as to how culture may affect CCA capacity or other types of organizational performance. Still, we can recognize some of the same aspects with the Swedish institutional logic as with the Norwegian if thought of as ideal types. The gradual Swedish drift in culture was considered less undermining for CCA capacity compared to the Norwegian sector

(Articles 2 and 3, and demonstrated in individual companies in Article 4). According to the institutional-cultural perspective, this is caused mainly by the change in institutional logic in Sweden, although less so than what we see in the case of Norway.

A distinct characteristic of the Swedish sector is the relative absence of conflicting institutional logics. The reasons for this are partly due the gradual change of the Swedish culture. Organizations do not exist in a social vacuum (Meyer and Rowan 1977), and in today's social climate the engineering logic would probably be seen as quite extreme. We should not underestimate the impact and transformation of a more economic efficiency directed culture in the Swedish organizational environment from the electricity grid sector, in particular through the growth of the NPM paradigm (Christensen and Læg Reid 2001; Statskontoret 2004). While these gradual cultural changes in Sweden have served to reduce CCA capacity, the impact of cultural change is less significant than in the Norwegian sector.

This discussion of formal structure and organizational culture as isolated theory approaches shows that, while each perspective does contribute by itself to understanding adaptive capacity to climate change, we cannot get much further without discussing them together as well. Some of the dynamics between these two dimensions of CCA capacity seem to cross the borders between the two perspectives. It has already been argued that formal structure influences organizational culture and that formal structure has been shaped due to that same culture. The next section discusses how these dynamics work together and how they influence CCA capacity.

4.6 Analysing formal structure and culture together

The formal structure and cultural factors within a sector should be expected to influence each other, and should therefore be analysed together to assess CCA. One concrete example of how such conclusions can change based on analytical scope can be found in the case of Norway. One of the conclusions of the 2010 Norwegian Official Report (NOU) on the organization of CCA in Norway is that the organization of the electricity sector (including production) and legal framework has a high capacity for CCA (NOU 2010:10:114f). A previous Official Report had come to the opposite conclusion, indicating that the liberalization and extended market focus in the sector

had led to significantly weakened robustness in the sector over time (NOU 2000: 24:58). The findings of this thesis support the chronologically earlier claim, and are based on a wider perspective also applied in the official report from 2000. As discussed above, the thesis finds that CCA capacity was higher in both countries prior to the reforms, in terms of both formal structure and organizational culture, albeit inefficiently so. As expressed by Michael Pollitt: '[t]he old vertically integrated system did provide security of supply – at a cost' (Pollitt 2008:xxi). For Norway this cost eroded the legitimacy of system functionality, emphasized before the reform and when construction activity in the sector came to a halt. The high cost received increasing attention and effectively contributed to de-legitimizing the old system.

The findings of Norway and Sweden still differ in several regards, and before moving on to discuss CCA capacity specifically, we need to look at how formal structure and organizational culture influence each other. As the more extreme case of the two, the Norwegian case contributes to illuminating some of the theory insights in the thesis in relation to the Swedish case, which provides an excellent comparative reference. This helps to shed light on mechanisms that indicate interplay between organizational culture and formal structure.

Usually cultures are slow to change, as seen in the Swedish case. With Norway, however, we find a radical cultural shift over a relatively short period of time. One of the reasons for this is the change in formal structure. Before the 1991 reform, the vertically integrated and politically controlled formal structure should be expected not only to have a direct effect on organizational behaviour, but also to exert influence on the organizational culture of the sector. As explained in Article 1, electricity prices were decided at the political level, set to self-cost, and investments were often reimbursed. This formal structure contributed strongly to undermining the awareness of costs in the Norwegian sector. The result was a rather radical institutional logic that paid scant attention to economic efficiency. The Norwegian version of the logic of engineering, referred to in the articles as the engineer's logic, naturally sought its legitimacy on the basis of other principles. Since the dominant professional group was the engineer, legitimate decisions under a formal structure that de-emphasized

economic cost naturally tended towards technical system building and system functionality. This was found in Sweden as well, but there the system was a more truly self-regulatory one. Since it was not based on expected political-level cost reimbursement, the actors who set electricity (and thus also grid transmission) prices had to be more sensitive to the marginal price. By contrast, once the large hydropower projects were finished during the 1980s, the Norwegian system almost de-legitimized itself and the system had to be rationalized (OED 1985; Bjørndalen et al. 1989). The organizational culture was effectively undermined and this opened up for the possibility of a rearrangement of the formal structure.¹⁶ In many ways a ‘window of opportunity’ opened in this period (Kingdon 1995), prepared for not least by the de-legitimization of the engineering logic. How the sectoral culture in this way influenced the resultant formal structure is also indicated by how far the formal structure went, now organized by a principle that was radically shifting the goals of the sector from functionality and robustness to cost efficiency. The lack of de-legitimization on the Swedish side of the border, along with a hesitant approach to the reform, is a further indication of cultural influence on formal structure in times of change.

Influences can also go the other way. From the two national quasi-public network services we can identify some mechanisms for how formal structure sets limits to action and influence institutional logic indirectly (e.g. by changing professional demography) and directly (e.g. by emphasizing or de-emphasizing cost considerations). Institutional logic influences organizational action and drives motivations for behaviour, but usually unfolds within the limits of the formal structure. The formal structure, then, can be set narrowly or widely, through the level of specifications of company behaviour and the audit and control of this (Shore 2008), thereby enabling more or less of the organizational culture to unfold in action. The Swedish regulatory models have generally been ‘looser’ in this sense than the Norwegian ones. They have also been weaker, being frequently replaced and de-legitimized. These numerous

¹⁶ It is important to note here that this was not the only reason for the change in the formal structure, attempts had also been made previously (Skjold 2009). This particular point in time in the Norwegian electricity system merits separate analysis, as it can potentially bring new insights about how de-legitimization processes and individual actors can produce critical junctures (Collier and Collier 1991) that lead to a radically changed legacy and a new path.

changes leave greater room for organizational culture to guide behaviour than a narrower and stricter set of incentives and sanctions that would normally require a more consequential driver for organizational action to take place. The Norwegian and the Swedish cases illustrate this theoretical point well, but these expectations need further research for testing and confirmation. The idea does seem intuitively logical and provides some context for theory discussions of organizational behaviour.

The thesis has also indicated how changes in formal structure can lead to changes in sectoral demography, and thus indirectly lead to changes in institutional logics. Organizational demography also influences decisions (Chatman et al. 1998) and in fact accelerates the change in institutional logics. This mechanism is indicated by the processes in the Norwegian case, when the reform created the need to recruit more economists. There are good reasons to claim this to be a contributing factor for the accelerated change in institutional logics, further facilitated by the de-legitimized logic of engineering.

As mentioned earlier, formal responsibility for ensuring a robust supply of electricity has remained with the grid companies, although their influence over the framework conditions to do so is limited. This responsibility gap corresponds with the cultural split in the sector. Introducing economic efficiency and incentive regulation also meant introducing a principal-agent problem, since the grid companies developed to have a different set of interests from those of the state post-reform. Again we see a similar structure in the two countries, but less so in Sweden because of the frequent changes in regulatory models, along with a 'looser' regulation. While the regulator and the responsible ministries still take the macro-view, the formal structure is intended to replace the self-regulatory system in both Norway and Sweden. After the reforms, regulations were designed to fulfil the goals of the sector. Arguably, this leaves room for the grid companies to follow other targets. In other words: societal-level considerations are taken care of by the regulatory structure and are no longer the responsibility of the individual grid company – as long as it fulfils the formal contract. The social contract has thus been replaced by a formal contract, leaving room for goals to drift if not explicitly regulated. The culture will also be influenced by the type of

regulation and control (Shore 2008). Since companies can be expected to be rational utility-maximizing entities (adhering to the formal structure) and also driven by the prevailing institutional logic, the regulatory framework must take into account the types of logic(s) that dominate the sector (Ayres and Braithwaite 1992).

The interplay between the social-economic logic and the corporate-economic logic can thus be seen as shaped by the formal structure, the principal–agent split, and the responsibility gap. Or is it the other way around? Distinguishing between these two directions of influence can be difficult, but across the two sectors a correlation has been observed between the type of formal structure and the institutional logics. The cases would be difficult to disentangle by themselves, but the presence of a reference case is helpful here. We have argued that the formal structure after the 1991 Norwegian reform was shaped in response to the de-legitimized institutional culture. But the new structure did imply a regulation that formalized the relationship between the regulator and the grid companies. It is reasonable to assume that this formalization of responsibility, together with increased auditing and goal orienting, has influenced the organizational culture of the sector (Douglas and Wildavsky 1983; Shore 2008). Regarding time, the regulatory model of incentive regulations came into being before the cultural consolidation in the sector, and it is thus reasonable to see the formal structure as influencing the growth of the corporate economic logic along with the social economic one.

All in all, these discussions lead to the preliminary conclusion that, from a regulatory perspective, the cultural fragmentation of the Norwegian sector will be a challenge not only for increasing CCA capacity but for most goals. As different logics will respond differently to any given set of regulations, tailoring a regulatory framework to the prevailing organizational culture in the sector will be easier, the less fragmented a culture is (Ayres and Braithwaite 1992). For Sweden, with less cultural fragmentation, it should be easier to construct a regulatory model that includes different considerations.

A further paradox arises from the fact that the weakness of the regulatory models in Sweden has in fact contributed to strengthen CCA capacity. This is due to the

Swedish dynamic between formal structure and organizational culture, where the frequent shifts in regulatory models after the 1996 reform left the grid companies with more room for manoeuvre than in Norway. This arguably led to a greater room for cultural ‘drivers of action’, and since the institutional logics in Sweden made a better ‘fit’ with adaptation than did the Norwegian we have the paradox that the weakness of the formal structure can actually mean increased adaptive capacity.

By analysing the formal structure and organizational culture together as well as their mutual influence, the thesis shows that adaptive capacity has been reduced in both countries after the reform, although less so in Sweden than in Norway. Taking this discussion a step further, it can be useful to apply Goertz’ (2006) distinction between conceptual levels. If we think of CCA capacity in this way, the basic level for CCA capacity would be the concept as used in theoretical propositions; the secondary level divides the concept into constitutive dimensions; and the third level, referred to as the indicator/data level, represents the operationalization of the concept, or the measurement level (Goertz 2006:6). In terms of this categorization, the thesis has contributed on the secondary level, showing how the two dimensions of formal structure and organizational culture constitute adaptive capacity; and on the indicator level, by showing how formal structure and organizational culture can be qualitatively measured and assessed. These operationalizations then make it possible to compare CCA capacity across sectors and countries.

An important question is whether these dimensions are sufficient, necessary, or contributing factors for high CCA. Sufficient individual factors are rarely found in social science, and the discussion above shows why this is also the case here. However, a review of the literature indicates that there are a relatively high number of conditions often deemed necessary for effective adaptation in a sector to occur. The literature review in Chapter 2 Theory Framework hints at some factors emphasized by the literature, often in the form of ‘determinants’ (Smit and Pilifosova 2003). Among these – implicitly for developing states – are technological options, financial and human resources and their distribution, the structure of critical institutions, certain social rights, risk-spreading processes, and public perceptions (Yohe and Tol 2002).

Why the various factors figure on the list is not fully clarified in the literature, although it has been derived from the IPCC third assessment report (IPCC 2001). For sectors in developed states the list is less developed (Ford and Berrang-Ford 2011), but the data in this thesis indicate that the dimensions of formal structure and organizational culture must be favourable to adaptations for them to happen.

Given that quasi-public network services, like other sectors, are strongly influenced by formal structure and organizational culture, if one or the other does not favour adaptation in one or more of the ways shown in the thesis, there is a risk that adaptive capacity may simply be ‘vetoed out’. Both the formal structure and the organizational culture can therefore be said to be close to representing necessary factors for adaptation to occur. However, as shown, cultural norms and values can undermine or modify the effects of structural factors, at the same time as formal structure can be shaped to (en)force certain patterns of behaviour and types of decisions (McCubbins and Page 1987; Christensen and Peters 1999:9). This indicates that, on a continuum, there are reasons that some degrees of substitution between the formal structure and organizational culture could occur to influence adaptive capacity.

5 Conclusions

This PhD thesis has analysed the electricity grid sectors in Norway and Sweden with the goal of exploring their capacity for climate change adaptation (CCA). This has been done by developing a framework for comparing climate change adaptive capacity across organizational units and sectors, and across countries. The framework has illuminated significant organizational dimensions that influence CCA capacity. The electricity grid sectors studied in the thesis represent quasi-public network services that offer important services for the public good and are well suited as objects of analysis for furthering the understanding of CCA capacity and its barriers. While the framework can be applied beyond the quasi-public network services and to generate hypotheses to explore general links between organizational culture and formal structure further, the specific empirical findings cannot necessarily be generalized outside this population of cases.

Adaptation to climate change has been seen as being facilitated first and foremost by knowledge and resources (Yohe and Tol 2002). Indicators such as resources, structure and participation of institutions, human and social capital, risk spreading and awareness have been held to determine adaptive capacity. Such an approach assumes that if knowledge levels are sufficient, if resources are available, and if the benefits of reducing vulnerability to a changing climate are greater than the costs of adapting, then measures will be taken (see for example Stern 2007). Yet the present study offers evidence to suggest that while many measures are in principle uncomplicated to implement in response to increased climate risk, they are in some cases simply not carried out in practice. For example in Norway, work is being done on changing the standards of electricity grids to account for increased ice loads, undergrounding of distribution grid, or removing vegetation that threatens pylons in windstorms, but only on a small scale.

The introduction of the dual framework from organization theory contributes to developing the understanding of CCA capacity further as well as bridge insights between the organization and adaptation literature. The main lessons are highlighted by each of the four articles in the thesis. Two articles analyse country-specific CCA

capacity in Norway and Sweden and find that the two perspectives point to very different types of factors influencing organizational capacity to adapt. This is followed by the third article, which explicitly compares CCA capacity in the two sectors. Lastly, the thesis includes an article where the application of the perspectives and the impact of the factors they predict are investigated at the individual company level. This shows that the findings on sector level CCA stand the test of the 'real world' company behaviour.

Norway and Sweden went through radical ownership-unbundling reforms in 1991 and 1996 respectively and analyses have been conducted on pre- and post-reform CCA capacity in both countries. The findings in the thesis are that pre-reform CCA capacity was reduced compared with the post-reform state in both countries, but with a greater reduction in Norway than in Sweden. This is due to the more radical Norwegian reform, where economic efficiency was emphasized more than in Sweden. This has been found both in the sector's formal structure (explicit rules and regulations that define who can do what, both among organizations and inside of them) and in the organizational culture (identities, norms and values that shape organizational behaviour) (Christensen and Peters 1999). CCA capacity has been reduced in both sectors, but less so in Sweden, which was able to achieve more of a balance between robustness of supply and CCA considerations on the one hand, and economic efficiency on the other.

The four articles contribute to theory by shedding light on the dynamics between the generic dimensions of formal structure and organizational culture. A further theory contribution of the study is to identify mechanisms for the interplay between the two dimensions. For example, in situations where formal structure is weak, cultural factors yield more influence on CCA capacity and company behaviour. This further underlines the argument made in the thesis that these perspectives should not be used in isolation for explanatory purposes, since the interplay and mutual influence would be lost in such an analysis.

A general question for quasi-public network services is how to ensure that incentives to conduct maintenance, upgrades and infrastructure reinvestments are in

place and at the same time have incentives for efficient running of the grid (Claes and Mydske 2011:22). This underpins the research question. Two developments challenge the balance between these two considerations. Firstly, the New Public Management reforms in the two electricity sectors tipped the emphasis in favour of economic efficiency. In both sectors we find a focus on dividing up and outsourcing of services, with increased weight on budget discipline in the individual units. This division of formal structure has made system consideration more particularized for the individual utilities by de-coupling the grid utilities and the sub-units from the general system level. The system transitions coincided with general trends abroad where democratic control and direct state regulations were replaced with market-based and more self-regulatory systems (Moses and Brigham 2007). While the pre-reform period prioritized system robustness above economic efficiency, the articles in this thesis show a change to an opposite emphasis post-reform. We find that the grid sector, previously the responsibility of the public administration (more so in Norway than in Sweden), became de-politicized, quasi-public and professionally independent.

The thesis shows that depending on the context, social and cultural factors are important influences on CCA capacity, both positive and negative. Using examples from the Norwegian and Swedish electricity sectors, the articles analyse the consequences of changes in formal structure and organization culture over 25 years and the implications for the adaptive capacity of the electricity grid. From the findings of the four articles, the thesis argues that CCA capacity is influenced by elements in formal structure and organizational culture. Furthermore, the thesis holds that a more integral approach to adaptive capacity is needed in order to identify potentials for and barriers to adaptation. In particular, attention should be paid to the shared values, norms and conventions that develop within a sector.

The thesis also finds that the dynamics between these factors must be examined, as they mutually influence each other and should be taken into account together to better understand the dynamics of CCA capacity. For example, actions decided by organizational culture can be expected to dominate over formal structure, as well as influence it. The findings suggest that if sufficiently culturally de-legitimized and if

there are alternative ways of organizing formal structure in the sector, the organizational culture can be expected to have strong influence over current practices, and possibly over re-organization of formal structure as well.

Conversely, in situations where formal structure is transformed it can be expected to have at least indirect effects on the organizational culture. Sometimes, as exemplified most clearly in Norway, a change in formal structure brings with it a need for new professional backgrounds, leading to change in demographics and institutional logics. New formal goals can be set, influencing the organizational behaviour produced to fulfil them. The tighter the formal structure (in auditing, incentives and sanctioning), the greater impact it can be expected to have on organizational culture. The mechanisms indicated here should be researched further, in order to further our understanding and theorization of the dynamics between formal structure and organizational culture. The bottom line of these findings is that, for an organization to improve its CCA capacity, instrumental strategies can be necessary but insufficient; a deeper transformation of the sector may be required for successful adaptation to climate change to occur.

Several policy implications of CCA capacity in the Norwegian and Swedish electricity sectors can be derived from the thesis findings. Firstly, the regulatory frameworks should, from a CCA perspective, formally include clear responsibility and incentives structures for robustness considerations to be built into the core design of the formal structure. Regulatory frameworks predominantly emphasizing economic efficiency need to take account of the long-term effects of under-investments. The economic cost of increasing robustness can therefore be argued for as a long-term policy. Such goals can be formally included as a mix of legal requirements and economic incentives to prevent maintenance lags from expanding and extending further.

This insight should be combined with awareness of the ‘ruling culture’ of the sector. Regulatory frameworks function within a national context with historical roots and organizational culture. Direct regulations should not be tighter than necessary. If adaptation is ensured by the cultural factors, then the regulatory framework should

perhaps leave room for this to occur. Greater control and more auditing can act to undermine the culture of trust (Shore 2008). But direct regulations also need to be dynamic, constantly monitored, assessed and adjusted to the current situation to be able to account for changes in culture.

The findings also indicate that larger companies are in a better position to manage anticipatory CCA than their smaller brothers. The larger grid utilities are better equipped to handle uncertainties and plan ahead for extremes. In discussions about the numbers and size of grid utilities in both Norway and Sweden this should be taken into consideration for state intervention in the company flora.

In addition to generating new empirical data on developments in the two electricity sectors in Norway and Sweden, this thesis has contributed to the understanding of CCA by introducing a previously unused framework to uncover new types of influences on the limits to and potentials for adaptation. Also, it informs organization theory, in particular as regards the mutual influence of and dynamic between formal structure and organizational culture.

A PhD thesis often contributes by generating more questions than it answers. The thesis has shown some of the factors that affect the dynamics between formal and cultural factors in an organizational setting, and raises new questions about prerequisites for radical cultural change. Further development and understanding of what influences adaptive capacity and how it does so in different contexts are important. The uncovering of new mechanisms of CCA capacity and mutual influences thereof highlights the need for further research.

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Article 1:

Tor Håkon Inderberg (2011)

**Institutional Constraints to Adaptive Capacity:
Adaptability to Climate Change in
the Norwegian Electricity Sector**

(published in *Local Environment*, 16(04), pp. 303–317)

Article 2:

Tor Håkon Inderberg (2012)

**Governance for Adaptive Capacity
in the Swedish Electricity Sector:
Do Changes in Structure and Culture Matter?**

(published in *Public Management Review*, 14 (07), pp. 967-985)

Article 3:

Tor Håkon Inderberg (forthcoming 2012)

**Changes in Organizational Culture,
Changes in Adaptive Capacity?
Examples from the Norwegian and Swedish
Electricity Sectors**

in:

Adapting to Change: Integral Approaches to Climate Change Responses in Norway,
K. O'Brien and E. Selboe, Cambridge University Press. *For review*

Article 4:

Tor Håkon Inderberg and Liv Arntzen Løchen (2012)

**Adaptation to Climate Change among
Electricity Distribution Companies in Norway and Sweden:
Lessons from the Field**

(published in *Local Environment*, 1–16, iFirst Article)

Appendix 1: Chronological List of Interviewees

40 interviews conducted face to face unless otherwise stated.

- 25.06.2008 Svein Fikke, Independent consultant, meteorologist, Oslo
- 12.08.2008 Lars Martin Espegren, Director Grid Division, NVE, Oslo
- 02.09.2008 Marianne Karlsen, Directorate for Emergency Preparedness (DSB), Tønsberg
- 10.09.2008 Asle Selfors, Licencing, NVE, Oslo
- 26.09.2008 Tore Langset, Economic Regulation, NVE, Oslo
- 01.12.2008 Even Ungersness, Hafslund AS, Oslo
- 09.02.2009 Arne Pettersen, Statnett SF, Oslo
- 26.02.2009 Kjetil Grasto Røn, Hafslund AS, Oslo
- 03.03.2009 Helga Stenseth, Ministry of Petroleum and Energy (OED), Oslo
- 03.03.2009 Henriette Nesheim, OED, Oslo
- 04.03.2009 Odd Håkon Hoelsæther, retired CEO, Statnett, Oslo
- 06.03.2009 Margareta Bergstrøm the Energy Market Inspectorate (EI) (Phone interview)
- 19.03.2009 Agne Hansson, MP, Centerpartiet, Stockholm
- 25.03.2009 Asmund Kristoffersen, MP, the Labour Party (DNA), Oslo
- 16.06.2009 Tony Rosten, EI (Phone interview)
- 19.06.2009 Rune Volla, Director Hafslund AS, Oslo
- 09.09.2009 Arne Olsen, Director, Licencing, NVE, Oslo
- 01.11.2009 Annelie Edvardsson, Swedish Hydropower Association, Stockholm
- 03.11.2009 Astrid Haavik, BKK AS, Bergen
- 03.11.2009 Ingvald Midttun, BKK AS, Bergen
- 03.11.2009 Torbjørn Kikhorn, BKK AS, Bergen
- 03.11.2009 Martin Vangdal, Småkraft AS, Bergen
- 03.11.2009 Arne Namdal, Småkraft AS, Bergen
- 19.11.2009 Nils Arne Nes, NTE AS (Phone interview)
- 19.11.2009 Bjørn Høgås, NTE AS (Phone interview)
- 26.11.2009 Dagfinn Vatne, SKL AS, Oslo
- 22.12.2009 Heidi Juhler, Energy Norway, Oslo
- 26.08.2010 Lars Thue, BI School of Economics, Oslo
- 07.10.2010 Håkan Edmann, Karmark Energi AB (Phone interview)
- 11.10.2010 Mats Johansson, Vattenfall AB, Stockholm

11.10.2010 Torstein Watne, Vattenfall AB, Stockholm
12.10.2010 Lena Lange Jaakonanti, EI, Stockholm
12.10.2010 Göran Ek, EI, Stockholm
13.10.2010 Kristin Melnes, Stange Energi AS, Stange
13.10.2010 Harald Husom, Stange Energi AS, Stange
20.10.2010 Erik Boysen, Agder Energi AS, Kristiansand
20.10.2010 Arne Folgerøe, Agder Energi AS, Kristiansand
28.10.2010 Anders Petterson, Swedish Energy, Stockholm
29.11.2010 Mikael Bohjort, E.ON AS, Stockholm
28.02.2011 Marianne Karlsen, Ministry of Environment (MD), Oslo

Appendix 2: Interview guide

A semi-structured approach was used for the interviews. This flexibility in style enabled the interviewer to probe further into certain topics when the need arose or the opportunity presented itself, as well as allowing the interviewee space to provide more detail as they wished. The questions are meant to produce data to shed light on the research question of the thesis, based on the theoretical perspectives. An exhaustive list of the questions posed and their precise wording is not given here; the dynamic interview setting makes it practical to list only the main topics and guidelines followed for lines of questioning used during the interviews. The interviews themselves were conducted in Norwegian and in Swedish. What follows is an English translation.

Process and interview setting

First, the project and the researcher were introduced, then the conditions of the interview were clarified and agreed upon; including the options for quotation, anonymity, integrity and the use of the information acquired. In the cases where digital recording was both practicable and possible, interviews were recorded with the explicit knowledge and permission of the interviewee. The recording equipment was placed on the table between researcher and interviewee. The interviewees were given the option to remain anonymous, but none elected to use this opportunity. Their name and affiliation is therefore listed in the previous appendices.

Following an introduction of the researcher and the project, the interviews began with the interviewee introducing him/herself and their own background, before the line of questioning opened with a focus on the formal procedures, laws and regulations in the respective country sector. Questions about culture, norms and values usually came later in the interview, to allow for rapport between the researcher and subject to build up, which in turn facilitated a greater sharing of information by the subject, and therefore deeper insights; but this too was flexible, according to the natural flow of each individual interview.

Question framework

Changes in the sector (reform)

- Can you describe the time before and after the reform? Why did it happen? How has it been since and can you divide it into phases?
- Can you describe the regulatory systems before and after the reform?
- Are there important elements, attitudes or ways of thinking that have *not* changed as a result of the reform?
- Are there conflicting elements between the formal requirements and expectations as regards company behaviour? If so, how is this observable in company behaviour?

Formal organizational structure

- To what extent have the industry's goals changed since the reform? Were and are these shared by all or most actors in the industry?
- With regard to the formal organization, before and after the reform:
 - Who had regular contact with whom?
 - To what extent is or was there informal contact between players in the sector?
 - How could this have affected the ability to tackle new challenges for the industry?
- What means does the regulator have to influence and control networks and production companies to take account of the climate? How has this changed with the reform?
 - Which of these does the regulator use actively and to what extent?
- To what extent are weather and weather vulnerabilities a formalized part of the licensing allocation process?
- What kind of legal requirements are in place to ensure the grid utilities maintain the security of delivery? What about before the reform?
- What are the advantages and disadvantages of the reform in relation to CCA and robustness of supply?

Sectoral organizational culture

- What was the argument for the implementation of the reform that came with the Energy Act in 1991 (for Norway)/1996 (for Sweden), and to what extent have the goals of the reform been achieved in practice?
- The reform led to a lot of changes in the sector. Can you indicate anything that did not change as much as you would expect? How does this influence the sector today?
- To what degree is there a shared understanding about what the sector *is*?
 - Has there been a change in the sector's self-image over the last 20 years?

- In the same time-span, has there been a change in what the actors in the sector perceive as important and less important?
- From the 1980s and up until today: how would you characterize the sector's change in the following factors: identity, norms, demography.
 - Do changes in these factors influence the sector behaviour? How?
- To what extent is there a difference between how the industry adapts and how the industry could / should work for adaptation to climate change in relation to:
 - Economic regulation
 - Direct legislation
 - Stated wishes from the regulator / directorates / ministries
 - To what extent are these management mechanisms sufficient to ensure adaptation to climate change?

Climate change, vulnerability and adaptation

- Are there any structures in the industry that prevent or promote CCA or other external factors? What factors influence vulnerability?
- Regarding the grid in Norway/Sweden. What kinds of mapping of climate loads and vulnerability to these are being done today?
- How does the sector perceive climate change today?
- How is it *talked about* in the sector about climate change, vulnerability and adaptation?
- What is *done* in the sector about climate change and adaptation?
- To what extent do you feel the political leadership, relevant ministries, relevant directorates and/or grid companies have focused on, and acted on CCA?
- How would you describe the cooperation between the most important governmental actors in the case of CCA? How about the grid companies?
- Are there any factors with the companies that lead to differences in CCA? Changes over time?
- To what extent can we say the sector is fragmented or coordinated in the approach to CCA, and to what extent has this changed as a result of the reform?
- Are there any other factors you could think of that could influence CCA in the sector?
 - Are there other people you recommend that I should talk with about this?
- Is there anything else you would like to add, that we have not already talked about?
- Thank you for your time and contribution.

