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

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Abstract: This article contributes to the understanding of adaptive capacity within national sectors by utilising two perspectives from institutional theory. Resting on interview data the paper analyses the Norwegian electricity sector and the influence on adaptive capacity to climate change from changes in formal structure and institutional culture. The sector underwent transformational change between the beginning of the 1980s and mid-2000s, with the reform from 1991 as a watershed, and gradual consolidation from the late 1990s. From a self-regulated vertically integrated sector with an emphasis on robustness of supply the sector changed into a liberalised and unbundled structure, with economic efficiency as the guiding principle. These changes reduced adaptive capacity to climate change. After the late 1990, gradually adaptive capacity has increased somewhat. The paper argues that also social contextual factors need to be taken account of, both to understand adaptive capacity to climate change and to provide practitioners with an ability to increase it.

Keywords: Electricity Sector, Adaptive Capacity to Climate Change, Institutional Change, Adaptive Governance, Regulations

Introduction

Adaptation to climate change is often considered to be first and foremost facilitated 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 determines adaptive capacity. This rational, instrumental approach assumes that if knowledge levels are sufficient, if resources are available, and if the benefits of reducing vulnerability to a changing climate are larger than the costs of adapting, then measures will be taken (Stern, 2007). Yet there is considerable evidence to suggest that many measures that are, in principle, uncomplicated to implement in response to increased climate risk, are not being carried out. Explanations for this can be found in the institutional environment, or in multiple stressors complicating adaptation considerations (O'Brian and Leichenko 2008; Keskitalo 2008). It can also be a product of formal structure like unclear responsibility structures (Palm 2008), or cultural factors not in accordance with adaptation (O'Brien 2008). Exactly how these institutional factors influence adaptive capacity is still unclear, and more research is needed to uncover how they work, and how they relate and influence one another (Engle and Lemos 2010:5). For example, in the electricity sector, adaptations like changing the standards of electricity grids to account for increased icing loads, or removing vegetation that threatens pylons in windstorms are being made, but to a little degree. Why are these "unproblematic" adaptation measures not being taken? What barriers to adaptation have been ignored?

This article takes an institutional approach, and through two complementary perspectives it asks how changes in the instrumental and cultural context can influence climate change adaptation. Using the example of the Norwegian electricity sector, the article analyses the consequences of changes in both formal structure and institutional culture over the past decades and implications for adaptive management of Norway's electricity grid. I argue that adaptive capacity, which can be understood as the ability to change behaviour, make decisions or take measures to reduce vulnerability to climate change (or take advantage of new opportunities) (see Adger et al. 2007: 727), is influenced by both instrumental *and* cultural factors. An instrumental perspective focuses on formal structures consisting of the explicit rules and regulations that define who can do what, both between organisations and inside of them (Christensen and Peters, 1999). An institutional culture perspective considers identities, norms and values that shape organisational behaviour (Christensen et al., 2007b). The paper concludes that a more integral approach to adaptive capacity is needed, in order to identify potentials and barriers to adaptation. In particular, attention should be paid to the shared values, norms and conventions that develop within an organisational field (DiMaggio and Powell, 1983). In some cases, instrumental strategies may be necessary but insufficient, and a transformation of organisational fields may be required for successful adaptation to climate change.

The paper rests on empirical data from 21 in-depth semi-structured interviews along with formal documents and research literature. The interviewees were broadly chosen from the political, administrative and company level, and at different levels within the organisations, to control for different positions in the field. They were selected on the basis of experience and variance. The emphasis has been with 7 interviews that have been conducted with the regulator representatives and 11 interviews with grid company representatives. 2 interviews have been done with persons otherwise involved in or with particular knowledge of the sector. They were all asked specific questions about changes in formal structure and organisational culture in the Norwegian electricity industry but were also allowed to reflect freely on the matter, to allow for new impulses and ideas. Additionally, historical accounts and official documents like public reports and hearings were employed for empirical information about change in the sector and the discourses of the time. As parts of the required information, like precise numbers of professional demographical changes in the sector does

not exist, indications through personal accounts support the indications about informal structure within the sector. Institutional factors like informal rules and cultural logics can sometimes be difficult to disentangle, especially for historical accounts many years back in time. To check for changes in culture open questions like "has there been demographic changes in the sector", and "has there been a change in accepted or legitimate types of decisions" have illuminated cultural differences over time. However, in this case all the interviewees made it very clear about the different institutional logics; even though the interviewees feel different about the changes in institutional logics they are robust findings. Several interviewees also took initiative to describe the changes in culture.

The Norwegian electricity industry represents an excellent example of a sector that has experienced major organisational changes over the past decades, with potential consequences for the capacity to adapt to climate change. From early onthe sector was characterised by government-set prices for electricity, and a formal structure that resembled a planned economic sector. The emphasis was on a robust grid system, with little regard to the economic costs. A normative logic dominated by engineers characterised the organisational culture. In the early 1990s, radical New Public Management (NPM) reforms were enacted. These reforms included the unbundling of electricity production and transmission, as well as the introduction of the logic of economic efficiency, leading to changes in the organisational culture away from the engineers' emphasis on robustness of supply. Later developments are characterised by the resumption of administrative control and steering. The general trend since about 2000 seems to be towards a more integrative approach, addressing increased complexity through more direct regulation (Christensen et al., 2007a). The changing organisational field of the Norwegian electricity sector suggests that both instrumental and institutional-culture approaches are necessary to understand adaptive capacity.

An Institutional Approach to Adaptation to Climate Change

An institutional approach is utilised to understand adaptive capacity to climate change, by two perspectives. For the *instrumental* perspective, a key hypothesis is that formal structures influence and channel attitudes and actions (Christensen et al., 2007b: 144). Therefore, organisations with their formal structures are *tools* or *instruments*. By changing the formal structure, institutions can be utilised as means to an end. Typically this happens through reforms, like the energy act of 1990 in the Norwegian sector. This makes it a dynamic perspective, because the instrumental understanding of organisations so closely links structure to action, leading to a different organisational outcome, when changes in formal structure are made.

The driver for action in this perspective is based on rational actors (Christensen et al., 2004: 31). 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., 2007b: 21).

The individual organisation or sector can implement formal rules and regulations (means) for effective goal attainment, whatever goals have been set. Formal rules channel thoughts and behaviour, and through this channelling they also modify rationality limitations (March and Simon, 1958). Adaptive capacity in the instrumental perspective would be constrained by the resources and information available (Brunsson, 2003: 168), and the capacity to handle climate change vulnerability depends on organisational coordination and clear distribution of responsibility (Christensen et al., 2007a).

On the basis of the perspective the first step in an analysis of the Norwegian energy sector involves assessing the goals. Then 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 is required. The means are the formal regulative measures, which can be measured by looking for change in structure or formal rules and procedures for dealing with the new challenges. High adaptive capacity in this perspective will mean forceful demands in the direct regulative scheme as to a clear distribution of responsibility, what expertise to maintain where, and clear expectations to grid companies concerning maintenance and back-up grid. The *institutional-cultural perspective* , sees organisational actors as constrained by institutional culture. A set of *institutional factors*: stable routines, norms, and values both constrain and empower action by giving meaning to social life in spite of changing external organisational environments.

Such institutional factors emphasised by this approach exist not only at the individual and organisational levels, but could span an entire sector or the equivalent of an 'organisational field' (DiMaggio and Powell, 1983). This can be defined as a recognised area of institutional life, including key suppliers, resource and product consumers, regulatory agencies, and other organisations that produce similar services and products (DiMaggio and Powell, 1983). Agents within such functional fields share a common regulatory framework, and a relatively unified governance structure with congruent and consistent patterns of domination and sub-ordination (Scott, 2001). Over time, shared values, norms and conventions will develop within the field.

Actors within organisations do not in general act on a consequential basis; rather the choice of one option over another is generally based on a *logic of appropriateness* (Christensen and Røvik, 1999; March and Olsen, 1989). Individuals and organisations fulfil or enact identities by following informal rules and procedures that they deem appropriate to the situation at hand (March, 1994). Actors thus act out what they believe is expected of them, bound by norms and values in which decisions made would 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). Different appropriate behaviour can often manifest in *institutional logics* within the same institutional setting, where contradictory practices and beliefs exist (Thornton and Ocasio 2008). Such institutional logics may compete, coexist or get defined out, sometimes through change in demography (Lounsbury 2007; Reay and Hinings 2009). The relative balance and change between these can be important cultural influences for adaptive capacity.The perspective claims that organisational change requires change in the organisation's identity, values, norms and routines – institutional logics. An institutional conception of governance would emphasise the legitimisation of policy choices and the maintenance of norms (Christensen and Peters, 1999: 167), seen as necessary for ensuring successful adaptation (March and Olsen, 1989). Successful governance for climate change adaptation would therefore depend on a normative and legitimacy basis, 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, within the different institutional logics. These can be carried by representation of professions, and barriers to adaptation will exist where the institutionalised values do not provide a legitimate basis for implementing these measures. This perspective thus predicts a high adaptive capacity if the prevailing appropriate logics in the organisational field provide a legitimate basis for maintenance, social responsibility, robustness of the system, and taking climate changes seriously. Adaptive capacity in this perspective is an institutionalised culture which provides a legitimate basis for acknowledging vulnerability to climate change and for adaptations aimed at lessening such vulnerability.

The Reform Processes: Formal and Cultural Changes

Between the 1980s and 2010 the Norwegian electricity sector went through radical changes both in formal structure and the cultural legitimate basis. Below follows a mapping of the phases of development experienced by Norway's electricity sector through over the past three decades.

Before the Reform: The 1980s

Until 1991, the price of electricity in Norway was regulated through long term contracts (Midttun and Summerton, 1998). Engineers working in the sector had developed a great sense of pride in belonging to one of the most prestigious sectors, 'building the country' through the development of its vast hydropower resources (Nilsen and Thue, 2006). By the end of the 1980s, however, this sense of pride had already begun to decline.

In the 1980s the structure of the electricity sector came under increasing pressure (Bye and Hope, 2006). The regulator the Norwegian Water Resources and Energy Directorate (NVE) was divided in 1986 and the division that owned most of the central grid were turned into a public company with the establishment of Statkraft (Thue, 1996). This only seemed to bind Statkraft. Strict limits on possible actions and binding of the price combined with an emerging grey electricity market – not illegal, but neither regulated – yielded a combination that was difficult to handle.

Production and distribution of energy were often performed by the same companies. In fact, after the production and grid functions was taken out from the NVE and established as Statkraft, most of the central grid was owned by it while still generating around one third of the nation's electricity (Bye and Hope, 2006). In addition to Statkraft, most energy companies still remained publicly owned, either as state corporations or by local governments, with only a small minority in private hands.

The high number of small organisational units was publicly regarded as a weakness, because of lack of expertise (OED, 1985: 17). Interviewees indicate that inefficiency and poor coordination were common. The companies, and particularly the smaller ones, often sold power at self-cost, because of considerations other than economic ones, or simply because of lack of economic expertise. As one interviewee from the central grid owner expresses it: "there were no customers, only subscribers", and "the price was decided based on how much things cost – and we could just increase the price if we needed." Combined with the fact that trade and consumption of electricity were largely domestically confined because of weak connections abroad, this contributed to a steady rise in consumption.

Less attention was paid to the cost of projects. All investments in production and capacity in this period were subject to cost reimbursement, either through direct market prices, cross-subsidisation, or direct subsidies (Bye and Hope, 2006). A major surplus capacity was developed (although it was overtaken by increasing consumption later in the decade), reflecting the many large-scale development projects that were carried out despite major overruns of initial cost estimates.

In the period up to the point of the reform in 1991, emphasis was put on security of supply, as well as general economic growth in Norway. Most of the interviews indicate an engineer's values and logic of thinking largely represented the appropriate code of conduct. Other values current at the time were the industrial modernisation of Norway, in which cheap electricity played an important part (Olsen, 2000: 123). Although there exist no precise data about sector professional demography, all interviewees claim that the engineers were the clearly dominant group within the sector. Further, this group traditionally emphasised the structure of the grid, secure supply of energy – often over-dimensioning the structures to guard against exposure to climate loads. By the 1980s most of Norway's major dam projects

had been completed, and the leakage of expertise began. In addition, there was in the sector a rising awareness of the lack of efficiency, and also a changing legitimacy basis due to increased awareness in the general population about the impacts made by hydropower projects on nature. The general view in the late 1980s was that "something" would have to be done to make the sector more cost-efficient (Thue, 1996).

Implementation of the Energy Market Reform: The 1990s

The free electricity market had started to develop about a year and a half before the energy bill was passed in the Norwegian parliament, the Storting, in 1990 (Nilsen and Thue, 2006: 277). At this stage the emerging 'grey' markets seem to have developed in close connection with a sizeable power surplus in the final years before the reform, where wholesale actors sold power outside the general and regulated agreements.[1] However, most companies were still far from market-based thinking.

The Energy Act was a radical reform. Power suppliers were now to compete for customers across former local monopoly areas, and electricity prices were set by market value. The Energy Act defined the new setting in which the power sector was to work by unbundling production from transmission of electricity into a competitive market and monopolistic functions respectively, the latter to be subject to government regulation. Robustness in severe weather conditions came in the background, even though awareness to climate change rose on the agenda internationally.

The NVE gradually developed a model for incentive regulation of the grid companies, which was implemented in the later part of the period (Langset et al., 2001). With the model revenue caps could be estimated to use for economic incentive-based regulation of the grid companies, and an interviewee from the regulator indicate that companies were positively interested in the developments of an incentive-based regulatory model, whis was to become stricter than for example Sweden. The more efficient the company, the more revenues they were to be allowed.

In 1992 Statkraft was split up, in line with the Energy Act. The new public companies Statnett SF and Statkraft SF became monopolistic central grid owner and market-exposed companies, respectively. The changes went even further, making it justifiable to see the reform as a clear example of a New Public Management (NPM) reform, inspired by private corporative management (Olsen, 2000: 180ff). Investments in grid structures came to a halt, reflecting market-based risks and falling prices due to the massive surplus capacity that had been revealed. But investments made earlier provided some slack for maintenance without increasing vulnerability.

Less formal changes were also evident, although not always highly visible. The most prominent change is perhaps that the economic paradigm changed from a macro-oriented planned economy model to a more micro-based self-regulatory regime (Thue, 1996). Along with this re-orientation came the entry of the electricity economists. Until just before the reform, the economists as a group did not have any particular foothold within the sector. The market reform implied a change of professional boundaries. The sector was re-defined from a primarily technical to a primarily economic issue, skewing the weight of professions towards economic expertise (Midttun, 1996). This led to a change of appropriate values which undermined adaptive capacity, from the engineering logic to social economic values of efficiency.

[1] Because of Norway's almost 100% dependency on hydropower, the national electricity market will fluctuate in line with yearly run-off (supply of power) and temperature (demand). The combination of high run-off and high temperatures led to a considerable production surplus in the years immediately preceding the Energy Act (Nilsen and Thue, 2006: 276-7).

Increased Complexity: After 2000

The economic incentive-based regulation for grid companies can be said to work by its goals (Bye and Hope, 2006). But it was soon argued that, relying solely on the economic incentive-based mechanism, grid companies would have incentives to run the companies more efficiently by cutting costs, including maintenance expenses and re-investments (Langset, 2007). This would in turn mean reduced quality of supply and greater vulnerability to climate change. To handle this potential problem, interviewees from the regulator show that the idea of "Cost of Energy Not Supplied" was born in 1996. It defined a method for assessing the cost of a break in electricity supply, and provided the possibility to include costs of a black-out to the grid companies. It was implemented in Norway in 2001, under the name KILE. This model is an attribute to the general regulatory scheme by affecting the revenue cap in case of energy not supplied. The point is basically to make it unprofitable for grid companies to reduce transmission system reliability to levels not acceptable to society (Langset, 2007). The system is based on the socio-economic cost of the energy that is not supplied. The grid company is fined for planned and unplanned blackouts, based on the calculated cost directly related to the amount of energy not delivered. The goal of the model is thus to create an overlap between corporate and social economy, thereby efficiently securing maintenance and robustness to climate loads. The model has been much more successful achieving efficient running of the grid than attaining maintenance.

Interviewees from the regulator NVE indicate that the number of grid companies today – about 150 according to regulator interviewees (although the precise numbers are varying somewhat due to changes in the field) – is reduced from pre-reform, reflecting the changed framework, but is still higher than was foreseen. Some of these companies are deemed too small to involve a high level of expertise, presenting the NVE with challenges for communication of the regulating scheme. Interviewees from the regulator claim that other companies, often the larger ones, challenge the regulator to a larger degree. One example is the recent development where some grid companies have used what they see as possibilities in the regulatory regime for increased outsourcing of their technical staff. This has led to concerns that extensive outsourcing may reduce security of supply by draining the companies of expertise needed for operating the grid (NVE, 2008).

The slow rise of a third appropriate logic in the sector reflects this. Interviewees from both the regulator and the grid utilities point to a *corporate economist's logic*, where appropriate conduct is concerned less of national security of supply and more of company revenue. This logic moves the general responsibility of supply to the regulator level, through facilitating feasible regulatory framework. This is still a slightly varying picture, in that some of the 'old' culture seems to remain in that some of the companies seem to act more according to the two earlier logics, than the corporate logic.

A report published by Norwegian Defence Research Establishment (FFI) concluded that the nation's energy system had major vulnerabilities to external events – including climate change – and that the post-reform changes were partly to blame for the heightened vulnerability (Fridheim et al., 2001). The reform's division of grid and production was accompanied by greatly reduced incentives for grid companies to keep up maintenance efforts. Continued increase in vulnerability of the grid is expected, according to the report, unless measures are taken. This view has been confirmed by a recent report from the Office of the Auditor General (Riksrevisjonen, 2008).

Both company representatives and regulator interviewees explicit or implicit claim it is evident that the NPM-inspired move from direct ownership (agency) and instructions, via a firm belief in the framework and incentive-based economic regulation, is today challenged by gradual acknowledgement that some direct regulation is also necessary, especially as seen by the interviewees from the regulator. As one of the latter expressed it: "Up until around 1990

there was a focus on direct regulation no matter the cost. Then it was a focus on framework [incentive] regulations. Today there is a recognition that we need both." We can therefore argue that this is a period of *re-regulation* (post-NPM), based on the need to regain more direct control of some of the steering (Christensen et al., 2007a). Indicators of this trend can be found in several of the NVE's most recent activities, which represent a shift to direct regulations like demands of the professional competency to keep within the company and restraints of out-sourcing.

Awareness of potential vulnerability to climate change was not high in the first two periods. Today the potential vulnerabilities should be well known in Norway. Also, some specific incidents have raised awareness. One example is the storm *Narve*, which affected parts of the country badly in January 2006, causing major devastation of the central and local grids. It left the entire north of Norway dependent on supply via the grid to Sweden, and cut off power for thousands of people, many for more than a week. Also the local community of Steigen experienced a week-long power failure in 2007 because of high winds combined with poor maintenance of the back-up lines. But the Norwegian experience with rough weather seems to weaken fears vulnerability from the impact of climate changes. And in Statnett's plans for investments in the central grid, no mention is made of potential problems linked to the structure's possible vulnerabilities to changes in weather patterns (Statnett, 2005).

There are today *three* appropriate logics at play in the electricity sector. First, there is the engineer's logic, which is an inheritance from the 'good old days'. The smaller grid companies and the engineers seem to adhere to this, emphasising the sector's social responsibility, and robustness of the system. The second logic that emerged in the 1990s was the logic of social efficiency, or social economics. According to this logic, whatever is efficient is deemed appropriate. It predominates with the regulator and at the political level, but is also present in some grid companies. The latest logic has evolved gradually since about 2000, and focuses on corporate economy. It is acceptable to promote the interests of the grid company, also at the expense of the rest of society. This view is found especially among some of the larger grid companies. These companies have professional ownership structures and do not hesitate to challenge the regulative regime.

The basic empirical findings from the two perspectives in the three periods are summarised in Table 1.

Table 1: Empirical findings

Period	Informal factors	Formal regulations
1: –1991	• Heavily institutionalised field • Engineer's logic • Robustness of supply	• Planned economy • Direct regulation, ownership • Low focus on costs
2: 1991–2000	• Re-institutionalised field • Social economists logic • Cost-efficiency	• Unbundling • Tentative development of the regulatory regime • Incentive-based regulation
3: 2000–	• Institutional fragmentation • *Three* logics of appropriateness: engineer's, social economist's, corporate economist's • Cost efficiency and revenue	• Modified incentive regulation (KILE) • Direct regulation • Increased complexity • Efficiency focus but extended scope

Changing Institutions: Implications for Adaptive Capacity

The Influence from Formal Structure

From an instrumental perspective, formal sectoral restructuring is a crucial point for adaptive capacity. In the first period we find that the planned economic model, even if inefficient from an economic perspective, made it possible to build a robust national system. This was a time of direct regulation and ownership. Most resources were directed at the main goal of creating a robust energy supply based on cheap electricity, and challenges about grid failure were always economically covered. The formal structure was relatively simple and direct, and the responsibility for security of deliverance was relatively clear: If there was a need for strengthening the grid, resources would be accessible to cover the costs from the top. The instrumental perspective indicates that the structure encourages a robust grid, and that vulnerabilities challenging the grid structure in most cases, where perceived, would be covered.

The high number of small companies led to a varying level of expertise. Lack of competence may have influenced negatively on climate change adaptive capacity, although access to resources may compensate for parts of this structural problem. In sum the first period is a phase of high adaptive capacity to climate change by the instrumental perspective, mainly due to the goal of a robust supply of electricity and the high access to resources.

NPM has generally been criticised for 'hollowing out' state capacity (Painter, 2001: 209) – a result of the focus on efficiency, structural devolution, disaggregation, competition, management principles and outsourcing (Self, 2000). This is an instrumental point, leading to a weakening also of the capacity to adapt to climate change, because of two main factors. First, NPM contributed to a *loss of control* because of fragmentation through increased horisontal and vertical specialisation. It has also been criticised for leading to accountability problems, loss of capability – even of being a catastrophe (Christensen et al., 2007b; Rhodes, 1994). Second, NPM can be said to be conflict-reducing in that it downplays other goals, giving priority to efficiency. But it also reduced the sector's capacity to adapt to climate changes because a change of main goals represented in the formal structure. Robustness was made second priority. In terms of socio-economic efficiency it went fairly well (Hope, 2007), but the ability to adapt was reduced because of this.

The unbundling of production and transmission and distribution meant more actors in the field, with different interests. While the regulation of the generators was fairly straight forward, the period is distinct for NVEs tentative development of a regulatory scheme which first and foremost was designed for improving efficiency. The Energy Law required the grid companies to secure a robust supply, but both regulatory incentives and possible sanctions were unclear, leaving little reasons for investing money in a robust grid. This created a "responsibility gap", where it was unclear if the main responsibility is with the regulator NVE or at the company level (Palm 2008). The second phase can therefore in sum be said to be a period of low adaptive capacity where the formal structure dis-encouraged the actors in the sector of adaptive behaviour.

In the phase from about 2000, we see a move to more complex regulatory scheme and increased direct regulations, with the aim of mending shortcomings of the reform. Together with the main regulation model, the KILE system is introduced, which fines grid companies for blackouts. This contributes somewhat to create incentives for adaptive behaviour. There is, however, large variations between companies how to approach this. Further, uncertainties and a low awareness about climate change seem to lead companies to avoid looking too far ahead, and focus on a shorter timeframe.

Further, on a higher level, there is the difference between the socio-economic losses of a blackout and the influenced economy of the individual company. An interviewee from the

NVE pointed to the fact that for complex end-users like airports and railway stations, the first- second- or third-order consequences of a power failure may be so massive that it is difficult to include in a regulator's fine. Several other regulator and company interviewees claim that this gradually has led to the recognition, both in parts of the NVE and the political level, and at the company level, that there are limits to economic incentive-based regulations, and that they need to be complemented by greater emphasis on direct measures.

The grid is a weak point of the system, but today far less resources are devoted to reinvestments than before deregulation (Rutledal et al., 2000). This is mainly caused by the NPM reform. As yet, the challenges of climate change have not altered this picture: for example, in the plans for investments in the central high-voltage grid between 2005 and 2020 there is no mention whatsoever of climate change or changes in weather patterns (Statnett, 2005). A report from the Office of the Auditor General of Norway in late 2008 confirms this development. It concludes that regulation of the grid companies is not sufficient to encourage the necessary level of investments and maintenance in the distribution grid, and additional regulative measures need to be taken (Riksrevisjonen, 2008). The NVE, for its part, stresses the latest failure statistics: after implementation of the reform, the frequency of failures has declined slightly (Gjengstø, 2008). However, these statistics might not give a representative picture of the overall state of the grid facing new challenges.

Some available tools of direct regulation which can increase adaptive capacity have not been utilised extensively. As one of the interviewees from the NVE explained, they have been cautious both in expanding their mandate, and also in using the possibilities for direct regulation at hand. However, this may be changing. While continuing the development of incentive-based regulation, the NVE appears to be taking a slightly more active role as regulator on direct regulations. Increased mapping of possible vulnerabilities are taking place through several research and action programmes, and the emergency preparedness department in the NVE has a focus on vulnerability to climate change. NVE contributes to the public mapping of climate change, although awareness seems to be fragmented organisationally. Sectoral thinking, also within the NVE, is an obstacle for effectively increasing adaptive capacity to climate change through formal structure, even though there are signs of change. Analysing the cultural factors are also necessary, however.

The Influence of Changes in Institutional logics

In the first phase, before the Energy Act of 1990, the dominant paradigm remained the *engineering logic*, actively encouraging a robust grid and security of supply. Critics of the time focused on economic inefficiencies, but in general any measure that increased what was seen as 'necessary' measures to secure supply would rarely be questioned. The cultural room led to a capacity to implement costly measures and secure a robust supply that was large – some would even argue too large, on the cost of other goals.

All this was to change in the second period from 1991. With the reform, forces in the external environment introduced the sector to the economists. And as the reform also changed the framework conditions, more economists were needed. In a very short time, conflicting institutional logics emerged with the demographical changes both in the NVE and in the grid companies; from having had an identity as providers of the very foundations of modern Norwegian society, the sector would now charge market prices like any other market.

The shift in norms and values meant that basic decisions were now increasingly to be legitimised *not* by the norms of security of supply, but instead of an institutional logic of *social economy*. This logic scopes the wholeness of the electricity system, where general economic efficiency is the legitimate norm. This was a major change which shifted the former culture of over-investment in the dimensioning of grids and maintenance levels towards economic feasibility as the dominant norm. This has over time led to an under-investment

problem in many companies, weakening system resilience and adaptive capacity to climate change (Rutledal et al., 2000: 25). Adaptive capacity by this institutional logic is a concern of cost-benefit, at the national level. Acceptable decisions are those which are efficient, and the efficiency in adaptations can be uncertain. They have been difficult to ground in the new logic, reducing the adaptive capacity of the Norwegian electricity sector.

The culture in an organisation or field typically is something that evolves in a process-like way (Selznick, 1957), not least through the informal norms and values brought in by employees. This is evident also in Norway's electricity sector. The introduction and expansion of the economic profession in the sector had an enormous impact on what were considered appropriate values. Even if they are now more marginalised than before, engineers have continued to be an important group. An institutionalising process tends to build in new factors, layer upon layer. We find that the incursion of economists and their logic served to strongly undermine the legitimacy of concerns other than economic efficiency, thereby reducing adaptive capacity (Inderberg and Eikeland, 2009). Even if adaptation to climate change was not yet on the agenda, organisational capacity to handle challenges that conflicted with efficiency concerns on *any level* was low, because of the low legitimacy accorded by the dominant logic.

Also when it comes to informal factors, there has been change in the last period from around 2000, although less rapid than in the 1990s. In some ways there have been linear developments of private business logics, with outsourcing of functions (engineering, construction, maintenance) and lay-off of personnel (Nilsen and Thue, 2006: 308ff). A corporate institutional logic has arisen. This acknowledges the fact of a responsibility gap, with a classic principal-agent problem, where the new culture undermines the NVEs regulatory scheme. The NPM reform has led to an 'arms-distance-regulation', which de facto reduces the grid companies' general responsibility for security of supply. This could in the longer run force the NVE to depend more on direct regulations to increase adaptive capacity.

On the other hand, some grid companies seem to have continued the old inheritance of social responsibility, and claim that it is *in spite of* the regulative framework that they have a potential to adapt: that it is what remains of the old engineer's value-approach that enables them to maintain a certain level of preparedness. The destructive storm *Narve* and the Steigen blackout seem to have raised awareness somewhat, but not enough to exert major influence on the dominant logic as to legitimate expensive measures for reducing vulnerability.

Gradually the reality of the formal changes has dawned upon the sector, bringing in more of the corporate economic appropriateness. Today all three logics seem to be present at the same time. The logic of the social economist is closer to that of the engineer, with the corporate logic opposing the two. But the socio-economic logic rests on the regulatory scheme of the NVE, and does not justify the regulator's trust in the social responsibility of grid companies to 'save' the robustness of the Norwegian energy system by carrying out measures on their own. It is a logic grounded in common pecuniary interests on the national level. The engineer's logic also operates on the national level, but it is less concerned with economy, and more with the operation of the system and security of supply. And thirdly, the logic of corporate economy is probably a product of the incentive-based regulative system. This logic legitimatise corporate concerns, thereby shifting responsibility for the system to the NVE alone.

How then do these informal factors influence the adaptability of the Norwegian electricity sector? The institutional-cultural perspective holds that adaptive measures can be implemented if consistent with the appropriate logic of the organisational field. Here is presented a fragmented view of the sector's culture, which makes it less likely that any measures taken by the NVE will be considered appropriate by all three logics. This complicates and weakens adaptive capacity in the sector.

Together the two perspectives provide an integrative approach to adaptive capacity. This can be illustrated by the concerns that companies will relax on their social responsibility, even if few will admit that this could be the case with their company. That indicates that the formal regulations are underdeveloped for adaptive capacity to climate change. This can be explained by the interaction between the instrumental and cultural factors, where the appropriate logic in (parts of) the organisational field compensates for some of the weaknesses in the formal regulative structure. The slowly-changing cultural factors lead to a stable basis for identity, with influence on overall performance. That might compensate for shortcomings in the formal regulative structure – but it could also act as a barrier to adaptation, especially if the corporative economic culture wins terrain. In the Norwegian energy sector, there seems to be influence in both regards.

Conclusion

This article has analysed adaptive capacity applying two institutional perspectives from organisation theory. It started out with a presupposition that the capacity for organisational adaptation is not merely dependent on recourses and knowledge. Two institutional perspectives emphasise how the formal regulative structure and collective norms and values respectively influence capacity to adapt to climate change.

To illuminate how changes in institution influence adaptive capacity to climate change, the article has used changes within the Norwegian energy sector, from the national to the local level, in three different periods. The analysis shows that changes in formal regulations, as well as the cultural changes in the sector, have exerted influence on adaptive capacity.

The formal changes in the sector were considerable. The market reform in 1991 brought a new focus on cost efficiency through competition, something that largely undermined other considerations like security of supply and maintenance. We find a high adaptive capacity before the reform, based on direct regulation and ownership. Then follows a period with undermining of formal responsibility. A slow increase in the willingness from the regulator NVE to use direct regulations from the 2000s, together with an increased awareness of vulnerability to climate change impacts, indicates a slight increase in adaptive capacity. This corresponds with the implementation of NPM reform, with a relatively one-dimensional scope of efficiency, and later a loosening of this emphasis in the last period.

The institutional-cultural changes in the sector were also radical and relatively quick. An engineer-dominated field up to 1991, the appropriate considerations to take would be a focus on robustness of supply, never mind the price. The incursion of the electricity economist around this time led to a change in the appropriate logic. From now the legitimate argument for decisions was cost-efficiency. The built-up over-capacity in the sector made it possible to negate maintenance without evident problems. The transition of norms reduced adaptive capacity considerably from the first to the second period. With the development of a several institutional logics in the last period, which fragmented the field somewhat and legitimised exclusive corporate considerations, adaptive capacity was further reduced. The general responsibility for a robust supply of electricity has thus been moved to the regulator.The article confirms that adaptive capacity is context-specific and varies over analytical units (Smit and Wandel, 2006). The New Public Management reform in this case has clearly undermined the capacity to adapt to climate change, both through creating a responsibility gap and goal replacements, and also through the undermining of culture that consider robustness a worthy goal. Still, some general insights can be derived. Given the general cost efficiency character of NPM there are reasons to believe that some of these findings are valid also for other cases. Further, the important role of institutional change in

promoting or hindering adaptive capacity has seldom been included in discussions and debates about climate change adaptation. In particular, the way that culture influences change has largely been neglected in the climate change literature, even though such theoretical approaches have been widely utilised in social science in general. Explanations of adaptive capacity that rest on solely formal factors are inclined to miss important barriers to adaptive capacity, and the findings of the article indicate that adaptive capacity is strongly influenced by, and changes with, changes in both formal structure and/or cultural norms. The capacity to adapt is dependent on factors that go deeper than a rational approach to adaptive capacity will suppose. A one-dimensional instrumental analysis of decision processes, which presupposes that actual adaptation will take place in response to new knowledge, will fail to capture the social context in which decisions are made.

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