



# Advanced metering policy development and influence structures: The case of Norway



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## HIGHLIGHTS

- Roll-out of smart meters is in Norway coordinated by national regulation.
- Grid companies and related interest organizations has been most influential.
- EU has provided informal pressure on smart meter policy.
- Consumer interests have been less influential in the policy process.

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## ABSTRACT

Responding to a global trend of installing smart meters Norway has taken a route of full governmental and regulatory coordination. The article maps and analyses the main influences on the developments of Norwegian Advanced Metering policy. Based on 12 interviews and extensive document mapping the Norwegian policy developments are traced from about 1990 to 2014, divided into three phases: Before 2000, between 2000 and 2007, and after 2007. It finds that the main influence and push came from an increasingly united industry sector, fronted by the grid utilities with respective interest organizations. Policy change has been boosted by years of constrained supply, creating incentives for political action. Also developments at the EU level have been important for creating attention for smart meters, while consumer groups have been less influential. The national regulator NVE has adapted its policy process to include external expertise, in particular from the grid companies. The findings confirm that influence into policy processes is a matter of financial and organizational resources and expert knowledge. Of particular policy relevance is the weak organization of private consumer interests into these policy streams, which may be important for further policy development for distributed generation and regulation of private generation activities.

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## 1. Introduction

Norway has, in line with trends in the EU and globally, decided for a full roll-out of smart electricity meters with practically all end users by 2019. This will be centrally coordinated through implementation of an advanced metering (AMS) regulation and installment, adopted in 2011 and 2013. This policy is generally accepted as the next natural step in the development of modern electricity supply systems and towards smart grids (Hoenkamp et al., 2011). This is not least because smart meters provide perceived benefits to most interest groups. While the electricity utilities regard AMS as important for gaining better grid oversight and control that can also guide investment decisions, environmentally oriented NGOs and consumer groups emphasize the

potential for monitoring electricity use and saving electricity in private dwellings. In addition it represents a key technology for enabling generation and feeding into the grid from private households. Governments have embraced AMS, valuing the economic factors such as more precise and automatic reading and reporting of consumption as well as the benefits for the customer. Opposition to AMS has been low, save from groups concerned with consumer information privacy. AMS, as a relatively de-politicized and global trend (McKenna et al., 2012) has been endorsed by most stakeholders in Norway, meriting investigation into what it is and where it comes from, as well as who have influenced national policies for AMS. By analysing AMS policy development top-down and bottom-up, this article examines how global and European trends play out in a specific national context, shedding light on what factors influence policies on electricity and green growth more generally, and which factors are likely to be contextual.

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Studies on smart meters have focused on consumer behavior and potential for energy savings (Buchanan et al., 2014; Westskog and Wintheer, 2014) consumer acceptance rights and conflicts (Hoenkamp et al., 2011), economic and technical issues in connection with smart meters (Römer et al., 2012; McHenry, 2013). This article adds to the policy oriented part of the smart meter literature (Di Castelnovo and Fumagalli, 2013; Jennings, 2013) by analysing the political processes and stakeholder influences in the AMS regulatory process in Norway.

The aim is to describe the regulation and characteristics of roll-out of AMS in a mature and early-liberalized electricity market and to explain the shape of the AMS regulation based on streams of stakeholder influence. Through the case of AMS in Norway, this article analyses the main influences on AMS regulation in an organizational field, indicating possible trends within the sector. How was the Norwegian policy on advanced electricity metering shaped, and why did it come about? What have been the main factors of influence?

Following the Third Internal Energy Package adopted July 2009, all EU internal market member states '[...]shall ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the electricity supply market' (EC, 2009a). This also responds to a global trend, as well as reflecting national context and pressures (Renner et al., 2011). However, the economic feasibility of large-scale AMS roll-out depends on national characteristics of the electricity system; also other factors influence the willingness to implement national AMS regulations, and what form these take. National political dynamics vary among countries (George and Bennett, 2005); Norway's electricity sector was amongst the first worldwide to liberalize, and is today organized as an unbundled and mature electricity market. On the electricity transport side, the Transmission System Operator (TSO) Statnett takes care of the system planning and responsibility. 136 District System Operators (DSO) own and run the district grids and have the legal obligation to roll out AMS for practically all 2.5 million Norwegian end users by 1 February 2019. All transmission and distribution activities are regulated by the Norwegian Water Resources and Energy Directorate (NVE).

## 2. Methods and theoretical approach

Smart meters, or AMS,<sup>1</sup> are here understood as meters that offer two-way communication that measures consumption at regular intervals, typically hourly or half-hourly (Darby, 2012: 99), as well as including a remote control element. This system can provide accurate information to the consumer and billing for actual consumption, as well as activation and de-activation of supply; it can facilitate limited private household generation of electricity and feeding into the grid through the smart meter (often referred to as 'prosumers', reflecting consumer production) and is generally seen as a necessary step towards smart grids.<sup>2</sup>

An organizational field like the electricity sector is a recognized area of institutionalized life that includes government and industry, as well as other relevant stakeholders (Dimaggio and Powell, 1983). The field is determined by a shared regulatory framework and relatively unified governance structure, with

congruent and consistent patterns of domination and subordination (Scott, 2008). Over time, shared values, norms and conventions, will develop within the field beyond the technical requirements of the task at hand (Selznick, 1957: 17). Many organizations, public as well as private, are involved in operating and governing the energy systems in Norway, with actors on the political level (ministries, individual politicians), industry level, and NGOs or consumer interests.

A central assumption is that governance structures develop over time and reflect historically developed patterns. Many of the organizations within the field will contribute to enhance inherited formal structures (Thelen and Streeck, 2005). New issues that lack formal regulations will either remain uncoordinated or be dealt with in line with coordination patterns for similar issues (Boasson, 2011). Thus it is reasonable to expect that the regulation of AMS in Norway has reflected the pattern of power structures and norms in the electricity sector.

As an EEA country, Norway is obliged to adopt EEA-relevant directives from the EU, and is an active partner in the EU energy market; therefore, also the European influence will be investigated here. This perspective focuses on the importance of the institutional and political developments at the European level (Fligstein, 2008). Both formal and informal mechanisms may influence EU–Norwegian policy outcomes. European templates for AMS are likely to exert isomorphic pressure on how related regulations develop in Norway; or regulations may be the result of pressure exerted through formal rules from the EU or other European actors (coercive isomorphism), or imitation of dominant European countries (mimetic isomorphism) (Dimaggio and Powell, 1983: 67), or European-level promotion of certain templates for how governments should regulate the sectors (institutional isomorphism) (Börzel and Risse, 2003). We may expect governance structures and policies developed in the Norwegian sector to reflect dominant trends and developments at the European level, reflecting EU policy as well as developments within other European countries, and to be guided by existing European rules and practices (Greenwood et al., 2008; Streeck and Thelen, 2005). Given this perspective, we may expect Norwegian AMS policy to closely mirror trends and developments at the European level.

The two theoretical expectations will be tested against the empirical data in the analysis. The empirical data are gathered from official documents, research literature, and not least from high-level, semi-structured interviews. Such a case of policy formation so recent in time naturally follows a logic of process-tracing (George and Bennett, 2005). Thus, the 12 interviewees currently or previously in leading positions in the Norwegian Parliament (Stortinget), the NVE, interest organizations like KS Bedrift and Energy Norway, network utilities and engaged researchers, have proved vital information sources for mapping the processes and empirical data necessary for this study. Admittedly, a full process-tracing approach 'attempts to uncover what stimuli the actors attend to; the process that makes use of these stimuli to arrive at decisions; the actual behavior that then occurs; the effect of various institutional arrangements on attention, processing, and behavior; and the effect of other variables of interest on attention, processing, and behavior' (George and Mckeown, 1985: 35). However, my aim here is more modest; elements of process tracing are included in order to trace the decisions and influences so as to enable analysis of the influences and motivations of the various actors. Empirical data, for example what countries' smart meter policies and EU processes the policy developers and influential stakeholders have related to and been aware of, are mainly derived from the interviewees with supporting information from written sources. All interviews were semi-structured and generally lasted for around an hour or more. Interviewees were allowed to take the initiative, but similar questions were posed to all. All

<sup>1</sup> Various terms are used for advanced or 'smart' meters. While AMS here is understood as two-way communication and reading meters with a remote steering part (limiting flow, switch etc.), Automatic Meter Reading (AMR) or two-way communication meters refer to systems solely for reading or reporting of electricity consumption (Strøm, 2012: 10).

<sup>2</sup> A 'smart grid' is generally understood as a modernized electrical grid that uses information and communications technology to gather information and automatically act on this.

interviews were offered the opportunity to be anonymous but none wished this; any quotes have been checked with the individual interviewees if cited by name. Requests for interviews at the Ministry of Petroleum and Energy (OED) were made on several occasions; the Ministry opted instead to send information about the formal AMS process.

### 3. Results: the development of AMS regulations in Norway

The development of AMS that ended in formal regulations and implementation in Norway can be divided into three main phases: before 2000; 2000–2006; and from 2007 until today. The phases signify distinct shifts in character of AMS in Norway; where the first phase represents a formation of the idea of advanced metering, the second period represents technology maturation but still significant resistance, and gradual reduction in fragmentation of views amongst important actors. In the third phase explicit resistance to AMS amongst industry and public actors is significantly reduced.

#### 3.1. Before 2000 – ‘not feasible’ but growing interest

Interviews among the DSOs and the NVE show that AMS is not new in Norway. It is hard to set a definite starting point, but around 1990s seems reasonable, as that was when advanced meters started to receive attention within the research community. At the time this concerned mainly was referred to as two-way communication meters or Automatic Meter Reading (2VK and AMR), without the more advanced functions included in the Norwegian understanding of AMS today, like remote control of electricity. In the mid-1990s this developed further from research, to pilot testing in the DSOs during the late 1990s. According to interviewees, most interest was shown by DSOs that had a decentralized grid structure, often with a high share of infrequent and low consumption end users (typically many holiday cabins and homes), perhaps because of the greater precision level and efficiency advanced meters could represent. But at this time AMR/AMS was generally not regarded as economically feasible.

The development of AMS should be viewed in the context of the Norwegian electricity system and its special characteristics. Norway's electricity sector was amongst the first to liberalize and unbundle ownership, with the Energy Act that entered into force in 1991 (Inderberg, 2011). With almost no gas infrastructure, the considerable activity leading up and into the 1980s entailed an expansion of hydropower. This created an electricity sector that was in many ways over-dimensioned in terms of investments and spending (Inderberg, 2015). The Energy Act of 1990 can be seen as a product of this – grounded in the need for greater economic efficiency (Bye and Hope, 2006). In the initial years after implementation of the Act, the efforts of the regulator, the NVE, focused on establishing models for regulation of the natural monopolies that the DSOs represented. That model was fully implemented around 1996/1997 and is still in operation (Inderberg, 2011). After the reform, the organizational field of Norway's electricity system involved mainly industry, the political sphere and the public administration. The generation companies and large industry as end-users are less relevant for the purposes of this study.

Norway is highly dependent on electricity and hydropower. With less-developed district heating than in most comparable countries, and almost no gas infrastructure, electricity accounts for much land-based energy use, including for household heating. Almost all Norway's electricity production of about 125 TWh is generated by hydropower (IEA, 2011), so precipitation levels have a great influence on electricity prices. Import from international

interconnectors to Sweden, Denmark and the Netherlands compensate to some extent, but interviewees generally confirm that political opinion on electricity policy in Norway swings with precipitation levels (dry or wet years) and temperatures (warm or cold winters).

The research institute SINTEF investigated the idea of hourly end-user metering of electricity in the early 1990s, at the laboratory level. By around 1995/1996 some pilot projects were being conducted in several DSOs, as with the company Gjernå Kraft AS. The conclusion at the time was that hourly metering was technically possible but too expensive and thus not feasible for large-scale implementation. The first green paper to refer AMS came in 1998; here installing advanced metering systems was proposed (NOU, 1998); however, a government white paper the same year presented this as too costly in relation to the expected benefits (St. Meld. Nr. 29, 1998–1999). The following state budget devoted a brief chapter to AMS, noting that the installation of AMS was not to be achieved through regulations: this should be up to the DSOs themselves. That represents the approach from the Ministry of Petroleum and Energy in this period, as followed up by its underlying agency NVE. At this point electricity did not feature high in EU–Norway relations, as it was not then seen as EEA-relevant (NOU, 2012).

None of the interviewees mentioned any developments from the EU in this first period.

#### 3.2. 2000–2007: maturation of the AMS idea

The early 2000s were largely a maturing period where the costs and benefits of AMS in the Norwegian context gradually became better understood. Interviewees from the NVE and interest organizations indicate that a ‘hands-off’ attitude from the government represented the general approach, where installation of advanced meters would be a voluntary decision in the DSOs. This also reflected the attitude in the Parliament, which in June 2002 requested the government to evaluate various models for financing a voluntary scheme for AMS (Stortinget, 2001–2002a).

However, low precipitation levels caused considerable price volatility in the electricity market in 2001. Hourly measuring for electricity for ‘large’ end-users – those consuming more than 400,000 kWh/per annum – was already required by 1999: that included some 50,000 end-users who stood for about half of Norwegian electricity consumption, which totaled about 124 TWh (Stortinget, 2001–2002a). The energy situation also led to parliamentary proposals that all customers consuming more than 100,000 kWh were to have hourly metering by 2004. This was adopted, but another proposal that the government should ‘prepare’ to include all end-users in hourly metering was not taken further at the time (Stortinget, 2001–2002b).

Italy installed some 30 million advanced meters between 2002 and 2005, showing that it was possible to roll out on a large scale. However, several interviewees noted that the Italian context differed from that in Norway: in Italy, unaccounted electricity loss was higher than in Norway; the Norwegian electricity sector was deemed more effective after de-regulation in 1991; and thirdly, whereas the Italian decision was made by a single grid company, Norway had a great many DSOs, and could gain from far more coordination. These differences were important for differences in economic assessments of AMS, and were mentioned by almost all interviewees. However, according to a central interviewee in the interest organization Energy Norway, the full-scale roll-out in Italy served to bring it back on their own agenda. But the majority within the organization – many with a background in economics – were still negative, due to perceived costs in the Norwegian context. However, Energy Norway had representatives from several DSOs with good access to data from pilot projects, and they were

aware of the sizeable differences in the economic calculations companies were operating with at the time. Of the two extremes in particular, Eidefoss AS, a small DSO about 300 km north of Oslo, had positive calculations at the time, whereas the more central, Oslo-based Hafslund showed less promising results. According to interviewees in Hafslund and Energy Norway this was mainly because the benefits of scale had already been taken out in the large company with centralized infrastructure, whereas for more rural companies with a different technical structure the calculations generally looked better.

Around 2002 also the NVE began more focused on internal discussions about AMS, also in dialog with as the interest organization Energy Norway. Here we should note the context: while the Norwegian electricity sector had been liberalized in 1991, the economic incentive regulation of the DSO was fully implemented in 1997. One consequence of this was the establishment of the new Department of Economic Regulation in the NVE, dedicated to economic modeling and regulation of DSOs (Inderberg, 2011). Several interviewees, from the industry and from within the NVE, indicate that the NVE was split on the issue of AMS. There were clear differences of opinion between the Department of Economic Regulation, which was staffed mainly by economists, and the Energy Department, with more engineering-based professionals. The latter were positive towards AMS whereas the economists were more skeptical. While there was never any outright conflict, there were clearly opposing views about the feasibility of AMS implementation in Norway.

From about 2002/2003 AMS rose on the Norwegian agenda. The telecom industry had begun to get involved from about 2000, working with some of the DSOs. Notably, the Norwegian telecom giant Telenor started a significant project within the company. This was separated out as a distinct company formally established in 2004 under the name of Telenor Cinclus, providing full-chain solutions to AMS and machine-to-machine communication. In 2005, the DSO Skagerak Energi bought into the new company, and in the following years Cinclus concluded contracts with Skagerak, E.ON Sweden, and Fortum Sweden, for the installation and running of altogether more than one million meters, most of them in Sweden. The technology was high-risk, however; after running with heavy losses, the company went bankrupt in 2010.

Skagerak Energy, Fredrikstad Energy, Eidefoss AS and several others were at this time getting serious about AMS, through ongoing pilots or otherwise investing resources and energy. The major issue was the cost, and whether it made economic sense to lobby and push for a Norwegian roll-out. Also the NVE had begun talking more seriously about AMS. In 2004 the requirement for hourly metering was tightened to apply to all end-users who consumed more than 100,000 kWh. This meant 85,000 high-consumption end-users, representing about 60% of all electricity consumption in Norway (Stortinget, 2004). This, combined with comparisons with Sweden, which by then had decided to install meters of somewhat 'limited smartness' by 2008, contributed to rising awareness also in the Norwegian Parliament about the importance of correct billing, energy savings and energy security.

Also the Ministry of Petroleum and Energy (OED) started to show interest. In the state budget for 2006 it directed the NVE to 'continue working with the area of AMS' (letter from the OED to the author). In 2006, the Swedish government postponed its implementation of automatic metering from 2008 to 2009 – which was noted in Norway as well. Also in 2006 Energy Norway (EBL at the time) commissioned a report from ECGroup, which concluded that the societal benefits of AMS in Norway would be three times greater than the profits for the DSOs, for the first time confirming a positive calculus (ECGroup, 2006). It should, however, be mentioned that the report focused on a 'light' version of AMS that did not include remote control functions. While both that report and

an additional NVE report the same year were unclear about AMS economic feasibility (NVE, 2006), they still had significant impact within public administration. They were frequently referred to and contributed to raising OED interest, in combination with media attention on the sector caused by the dry year of 2006. The Ministry required the NVE to produce more information about the benefits and costs of advanced meters.

### 3.3. 2007–2014: roll-out decided?

In the letter of allocations for 2007, the OED instructed the NVE to conduct further analyses by June same year, on the possibilities of increased use of new technology related to metering and billing – in effect AMS. The NVE commissioned a report about hourly metering from the consultancy company ECON, which concluded loosely that AMS could entail negative economic effects, but that if non-quantifiable benefits were included, then roll-out would be 'probably social economically feasible' (ECON, 2007). It also concluded that regulatory requirements to the DSOs would be the best way to proceed in order to secure a coordinated and effective implementation. Later that year the NVE stated that they had started working towards an AMS regulation with functional requirements to the meters, aiming at roll-out 'around 2013' (letter from OED to the author 2014).

According to the Labour Party interviewee, debate in the Parliament reached the Standing Committee on Energy around 2007/2008. However, discussions at the time were marred by AMS and its relation to smart grid being 'slippery' notions, according to the interviewee, with vaguely defined terms that made committee deliberations difficult. Also here, the high technical level of the subject matter influenced the discussion. While the Parliament has been highly involved in the Norwegian Energy Act, AMS has not been regarded as a sufficiently substantial change to require more than regulatory changes and formal competence to adopt these lies with the OED. While the Ministry became gradually more active in this matter, the main public administrative arena for AMS has been the NVE. Most important public administrative activity has been concentrated to this agency, which keeps in close contact with the Ministry. Still, as is normal procedure, the parliamentary committee has followed developments in AMS, not least against the backdrop of EU Energy Market Package 2 and 3. According to the interviewees, the EU has been a driver and inspiration, but also a limiting factor, with slow progress on decisions about technical standards that has led to a hesitant approach from Norway at important junctures. This is contested by the interviewee from ESMIG, who indicates that this might be a perception in Norway and member states, but that the committee was less delayed than the prevailing ideas seemed to indicate. Within the parliamentary committee, discussions about the feasibility of AMS have mostly concerned the economics involved; according to one interviewee, the benefits in focus have been peak load reduction, grid control, customer interest, energy savings and benefits for the DSOs. The OED has appeared less eager to push for AMS implementation than the parliamentary committee. Regarding the latter, Energy Norway has been the most important lobby partner by far. Initially, the industry organizations were negative to AMS, but this changed when the parliamentary began to show interest, indicating a shift in the Norwegian context.

At this stage, four public hearings, led by the NVE, were held on AMS in Norway – in 2008, 2009, 2011 and 2013 – and most of the dynamics centered on these. As this was a new area, some changes were made to the procedure for developing regulations. Usually, relevant expertise is to a higher degree to be found inside the agency in question, with external reports covering 'weak spots' or areas in need of third-party opinions. In the case of AMS, the directorate (NVE) recognized that expertise on AMS, a new field for

regulatory practices, was to be found largely with the interest organizations, research institutions and DSOs, and not within the NVE itself. The solution was to open up the procedure. According to interviewees from Energy Norway, KS Bedrift and the NVE, main participants here were experts from the larger interest constellations, but in some meetings representatives of consumer organizations and meter suppliers participated; also, separate meetings were held with other public agencies. One of the NVE interviewees estimated the number of meetings at around 25 with Energy Norway – some of these including KS Bedrift and Defo, in addition to ‘countless of conversations at conferences, by phone and email’, in the period 2007–2014. There are no accurate figures for the other organizations during that period, but the same interviewee estimates that there were two to four meetings with the Norwegian Consumer Council, the Consumer Ombudsman and the Data Protection Agency, and some four to six meetings with the Norwegian Directorate for Civil Protection and the Norwegian Metrology Service. Energy Norway also commissioned reports to feed into the work of developing the regulations; and the NVE commissioned three more reports of specific relevance to the regulatory work (NVE, 2008).

These reports and initial meetings from 2007 resulted in the first formal AMS hearing, in October 2008. The hearing concerned a proposal for change in metering regulations (NVE, 2008). Here it is clear that there was not only a communication element and remote metering that were to be included, but also a remote control element that would enable the DSO able to limit or switch off electricity remotely. This was the first extended understanding of the term AMS in Norway as it involved system steering. The remote control of load or individual circuits involves additional equipment expanding from the two-way communication that can give the end-user information about prices and consumption (Strøm, 2012). The tentative plan for finished roll-out of AMS was loosely set to 2013 (NVE, 2008), and various communication options were sketched out. At that time the NVE estimated that 10–15 of Norway’s around 140 DSOs had implemented AMS, and that most of these companies had fewer than 15,000 end-users (NVE, 2008).

The hearing resulted in several inputs from involved interests. Several issues were brought up, but the focus in the feedback was mostly on details like frequency of data registration (every 15 min: some in favor, others preferring longer intervals). In general the hearing evoked fairly constructive and positive feedback, although several DSOs and interest organizations pointed out that the NVE take care not to deviate too far from the technical specifications used elsewhere in EU/EEA.

The second hearing, in 2009, involved a somewhat more concrete proposal. Here, the time of roll-out was pushed back to 31 December 2014, and some of the feedback from the main actors focused on 1 January 2017 as a more appropriate timepoint. A requirement for the DSOs to provide customers with a display (i.e. a visible monitor) was dropped, defined as being outside the scope of the monopoly, but an open communication channel for third-party interfaces was included. In the 2009 proposal the prosumer interests was included: ‘where customers so request, the AMS equipment will be required to measure feed-in of locally produced power’, and ‘any additional costs from acquisition and installation are to be covered by the customer’ (NVE, 2009: 10). The equipment was to be set to register irregularities in supply as well as ground failures, but remote steering of power (limitations and switch) were not included in this proposal. The hearing document referred to the EU Third Internal Energy Market package from 2009, and its requirements for 80% roll-out coverage by 2020, as an important driver. At this hearing, consumer organizations such as the Consumer Council and the Data Protection Agency stressed the protection of consumer data as vital.

The winter of 2010 was particularly dry and cold in Norway. Interviewees noted that, given the country’s hydro-dependent energy system, this spurred political attention towards the energy market in various forms. Particular attention focused on Mid-Norway, an area that suffers from weak links and energy shortage compared to the rest of the country, and Energy Minister Terje Riis Johansen officially proposed a faster roll-out for this area.

The 2010–2011 state budget explicitly mentioned the EU process: ‘NVE shall continuously follow the EU’s work on standardization for AMS’ (OED, 2010, author’s translation). The third hearing, in 2011, led to the adoption of the regulation. The NVE and OED had had frequent contact with DSOs, as well as meetings with the interest organizations Energy Norway, KS Bedrift and DEFO. According to several interviewees the political attention given to AMS at this point was important for the adoption of the regulation, with one likely final trigger being the dry winter 2010/2011. Also organizations like the Norwegian Consumer Council and the Consumer Ombudsman had input to the hearing: they favoured mandatory supply of display and protection of consumer data, in addition to stressing open and fair competition and potential problems connected to DSOs’ additional services and third-party access. The Norwegian Data Protection Authority took care to express its views on issues such as data protection. Some DSOs (for example Agder Energi Nett) and NGOs favoured mandatory display, but this was not part of the final regulation.

The regulation was formally passed by the Ministry of Petroleum and Energy in 2011. It included requirements for DSOs to install AMS in practically all end-user points in Norway, a total of about 2.5 million metering apparatuses. Further, no requirements about standards were defined in the regulation other than that it was to be ‘open’, in the sense that protectionist standards were not allowed, and to ensure that the communication part was to be accessible to third parties as well. There was also wide stakeholder support for following the European standardization work, in particular the work done by the M/411-group. The group received its mandate from the Commission March 2009, with a mandate to construct standards for European smart meters, allowing interoperability and increased consumer awareness of actual and real-time electricity consumption, relating to Articles 9 and 10 of the 2012 Energy Efficiency Directive (EC, 2012). These industry standards are typically not compulsory. The interviewee from Energy Norway noted that Norway is a small market; and, with about 140 DSOs, agreeing on a common standard is more important than in larger markets – for example, in the UK, where there are more end-users as well as fewer DSOs. It was also proposed that 80% of the end-users in Mid-Norway should have AMS by 2013. This was following up political pressure from the Ministry, in the wake of the above-mentioned ‘crisis’ winter of 2010/2011 with severely constrained power situation because of dry years (see Fig. 1 for an import–export overview of electricity for Norway. In the figure the

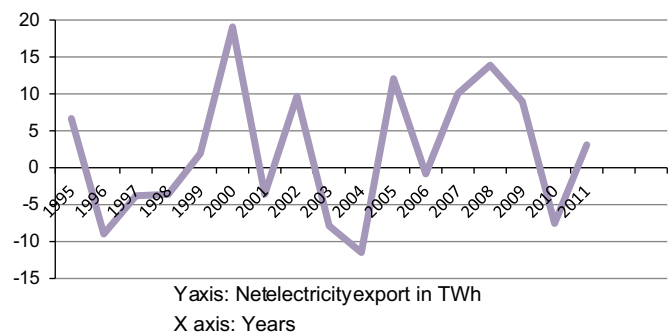


Fig. 1. Norwegian net export of electricity 1995–2011 (in TWh). Sources: Statistics Norway (2013) and Jevnaker et al. (2015)

import phases correspond with dry years). However, this proposal was not retained after the hearing: the roll-out for AMS with the adopted regulation was set to 1 January 2017 for whole of Norway (NVE, 2011).

With this, most of the involved stakeholders felt that the roll-out as set still continued some further issues to be resolved about standards, which depended on the EU M/411 group. However, 18 January 2013 a letter from the OED to the NVE took everyone by surprise, by proposing a delay of implementation by two years. In fact, the letter was not intended to be public and was quickly withdrawn, re-appearing as an official letter not long after. This 'non-letter' led to a fourth and final hearing. The hearing this time had a three-week deadline, as opposed to four months with the previous rounds. The result was two-year postponement of finalized AMS implementation deadline, now set to 1 January 2019. While the background for this delay is unclear, it was definitely a political decision. Most DSOs seemed to have aligned significant project timelines for meeting the 2017 deadline. Interviewees held this new change to be 'unfortunate', while also earlier roll-out was generally deemed not feasible, given the standardization work and technology risks. Some other minor changes were also included in the decision, as the exemption from the requirement of installing AMS was altered from end-users with 'very low consumption' to 'low consumption', in line with changes in EU regulations between the Third Energy Market Package and the Energy Efficiency Directive.

In the process that led up to the Third Energy Market Package and the Electricity Market Directive in 2009 (EC, 2009b), there was heavy pressure for AMS. This package introduced smart meters as a measure to assist the active participation of consumers in the energy supply market. Later under the 2012 Energy Efficiency Directive the requirement that at least 80% of all consumers were to have AMS installed by 2020 was upheld. In both these EU directives there are also loopholes concerning the roll-out requirement, as installation is required *if* the meters will save money in the long run (EC, 2012). The latter directive also recommends that member-states conduct a cost-benefit analysis in order to decide whether and how smart meter systems should be implemented. At present, 16 member states seem likely to reach this goal (EC, 2014). By 2013 Sweden and Italy had completed roll-out, Finland was close to finalizing (and has since finalized), and 15 member-states are planning to roll-out AMS or have started (CEER, 2012; ACER/CEER, 2013: 12). The NVE has been involved and represented on the Council of European Energy Regulators (CEER) during AMS deliberations. Interviewees referred several times to Norway's self-image as progressive in terms of liberalization.

#### 4. Discussion: why was Norwegian AMS adopted as it was?

##### 4.1. The Norwegian organizational field

Empirical data on the process leading up to the Norwegian AMS regulation and beyond show that the process was mainly driven by the industry and their interest organizations. However, there was no unison push for AMS from the industry until later in the new millennium. Some of the more effective (often larger) companies did not regard AMS as feasible, whereas those with potential for increased economic efficiency (often rural, sometimes smaller) were more in favor at this stage. However at this time the developments were research and technologically driven. Only gradually did a fragmented sector gradually come to regard AMS as something useful. With growing acceptance for implementation as potentially feasible, came insistence that it should also be governmentally coordinated. Having a large number of different standards and equipment would be sub-optimal, and that was

likely to be the outcome of an uncoordinated process in up to 140 separate DSOs. Thus the interests of the sector have been the main driver, becoming increasingly stronger and more well-coordinated with time, and confirming the expectation from the first perspective, that developments closely mirror power structures and norms in the electricity sector.

The case of AMS has, during the period analysed, also been enabled by technological developments. Up to about 2006/2007 AMS was regarded as too costly, but then communication and meter technology developments drove the price down. Without this, a full roll-out would probably not have happened in Norway.

This technology development was a game-changer, bringing growing interest among the grid actors. The main influence on the regulation has come from the DSOs and their interest organizations, as a further indication of the power structures in the sector. The NVE instigated a new procedure for developing regulations, inviting the main interest organizations into the process from the beginning. That is in line with the expectation from the organizational field perspective: the structure of new policy areas is expected to remain similar to the power structures of the field, if not uncoordinated. While developments can be characterized as unregulated before the NVE formally took over the policy process around 2007/2008, it clearly reflects a structure of influence in the field in line with the expectations from the organizational field perspective. The interest organizations are the experts on the technical side and hold expert power, and are well-positioned to develop new issues according to their definition of the matter at hand.

While the level of trust between various interests is generally high in Norway, with its long corporate traditions, it does have potential consequences when it comes to the framing and scope of the regulations. A striking finding of this study is that there have been no groups in opposition to implementing AMS in Norway – but that does not mean that all groups have similar interests and benefits, or that influence is equally distributed even in open processes and formal hearing rounds. For example, consumer interests have been heard – but have not been included to the same degree, and have had less opportunity for influencing the regulatory output. This was particularly the case in the agenda-setting part of the process. While there is no reason to doubt that the NVE has sought to pay heed to the interests of private consumers, these are still far less organized and well-resourced than the industry, which has dominated the organizational field. Consumer organizations such as Data Protection Authority, the Consumer Ombudsman and the Norwegian Consumer Council are public offices and have indeed spoken out on matters like data protection, but other potentially important issues, such as organization of smart homes, the question of displays and other interfaces, as well as 'prosumer' regulations and rates (of feed-in of electricity from the private household to the grid), have been dealt with elsewhere. These are to be controlled by separate regulations, but the AMS regulation may have implications for such areas, as AMS is often seen an *enabling* technology for further developments in the sector, and not an end in itself (CEER, 2012). Another issue-area concerns displays as a consumer interface part of the regulations. Most DSOs and interest organizations argued against this, as reflected in the end result and is strongly supportive of the first expectation of the organizational field perspective: the structure of the new policy areas of AMS clearly reflects the coordinated power structure of the sector. A further barrier has been the technical complexity and implications of AMS.

##### 4.2. Rain-driven regulations

Evident from the data is also the role of the political level: individual politicians and the Ministry of Petroleum and Energy. A

striking feature of the Norwegian organizational field as described above is its dependence on precipitation. Political engagement can be traced to match closely with the dry years. After AMS came on the agenda as a feasible alternative, the dry years of 2004, 2006, and 2010/2011 saw clear engagement from the Ministry: first instructing the NVE to go ahead with AMS potential evaluations in 2004, then proceeding to develop a regulation in 2006, and especially the somewhat rushed (according to most interviewees) proposal to implement AMS in Mid-Norway before the general roll-out. As is shown in Fig. 1 the 'dry' years correspond to these policy initiatives, while in years with electricity surplus, concrete energy policy initiatives take a place lower on the agenda. While this is indicative of the importance of electricity prices and energy security in the Norwegian context of high shares of hydropower, the correlation is not conclusive and requires further investigation as the comparison is imperfect. Interviewees generally agreed that political engagement tends to be triggered by media coverage and crisis headlines, referring to the price hikes and energy security issues. However, the important point here is the interplay between the various parts of the organizational field, where the main influence has come from the industry throughout the entire period. The empirical data shows that the main motivating factor for developing AMS in Norway has been the benefits for the electricity industry – once AMS was proven economically feasible. Among reports commissioned and published by the industry were some from the NVE and their own reports, which extended the pressure to involve also the public administration. However, in order to progress, AMS had to be politically enabled from the Ministry, which happened in 2006, and again in the critical stages listed above. From their weak involvement in the process, mostly involving formal hearings, it is difficult to conclude that the private end-users have been central to the organizational field, further indicated by their lack of influence on the final form of the regulation.

#### 4.3. EU influence

This AMS policy process has not unfolded in isolation. Norway is an integrated member of the internal EU energy market and there have been parallel processes in the EU, at the formal and EU levels, as well as processes within individual member states. Has the European area been a driver or a hindrance for Norway's AMS process? The three periods give different answers.

For the first period up to about 2000 it is difficult to find any significant European influence, weakening the initial expectation from the European perspective that Norwegian developments were likely to mirror EU trends. This is not surprising, as energy issues were not a significant part of the EEA Agreement at the time and changed in the second period 2000–2007. The Italian case of full roll-out from 2002 had a significant impact on the discourse in the Norwegian organizational field. For the first time it was demonstrated that a full roll-out could be feasible, albeit in a context different from that of Norway. This is an indication of *mimetic isomorphism* (Dimaggio and Powell, 1983) and the European perspective expectation is strongly supported from this period and onwards. Also, Norwegian stakeholders followed the Commission-led processes with the end result of AMS requirements being part of the Third Energy Package. Although this package was not formally adopted until 2009 it was part of an anticipated development and had impacts on the Norwegian dynamic. The EU processes were seen as leading to a drive in the Norwegian field: it was often argued that implementation would be necessary anyway, and this drive was followed up by the 2012 Energy Efficiency Directive. This is a clear example of *coercive isomorphism*. However, this kind of EU drive weakened later in the second period. Even though the EU goal of 80% AMS by 2020 remains a requirement

(given positive economic assessment) Norway would fulfill that requirement in any case, with almost 100% roll-out by 2019.

Second, the EU influence in the later phase represented an obstacle for Norway, especially since the actors' perception of delay of the M/411 committee's output. Norwegian industry and the NVE have cited this as grounds for waiting, in order to avoid a costly mismatch between standards and requirements. There is a need for entrepreneurs (often industry) to interpret and 'translate' EU policies into the Norwegian context (Boasson and Wettestad, 2013) – and in situations where the European area has worked as a driver and as an obstacle, stakeholders have used this dynamic to defend their standpoints. And Sweden's 2008 decision to roll out AMS was cited in defending progress in Norway. In sum, the European perspective's expectation that Norwegian trends would mirror European developments receives mixed support.

## 5. Conclusions and policy implications

The article has analysed how official policy for advanced metering systems (AMS) has developed in Norway, and under what influences. The driving force for moving AMS forward in Norway has come primarily from the industry, represented by the DSOs and interest organizations, and interacting with EU developments. From an initial period with fragmented industry opinion and drive, the industry gradually achieved consensus on pushing the issue of AMS regulations. The interest organization Energy Norway was particularly instrumental in building such consensus, and has remained a main driving force, and the findings support the expectations that the AMS policy outcome would represent the power structures of the sector, at the same time as mirroring EU trends. Additionally, there have been enabling political decisions at critical junctures in the brief history of smart metering in Norway. Often this has been connected to external events like dry years, which have put pressure on the government to be proactive and have been necessary for facilitating the next steps in policy development.

The EU influence as a driver has taken two main forms. We find *mimetic isomorphism* with European examples of AMS rollout, notably in Italy and Sweden, relating to the more general trend of AMS implementation (Hoenkamp et al., 2011; Römer et al., 2012; McHenry, 2013; Di Castelnuovo and Fumagalli, 2013; Jennings, 2013). These have been used for leverage in the Norwegian process even though the implementing context has differed significantly, and the technology employed is a simpler version of smart meters. We can note elements of *coercive isomorphism* in formal requirements from the EU, as with the Third Energy Package (2009) and the Energy Efficiency Directive (2012). Lastly, Norwegian stakeholders have used the EU standardization process as an argument for holding back AMS roll-out. In sum, the EU and domestic explanations have provided pressures for AMS in Norway, sufficient to result in central, governmentally coordinated implementation. While the EU influence has been significant, it came *after* the early domestic developments: the major factor for the policy result has been gradually increasing interest among industry. The EU trend has, however, supplied the domestic forces with important arguments and reflections, and falls into the category of already established interests enabled by technological developments (Boasson and Wettestad, 2013).

The Norwegian case indicates that, even though there are important international pressures and trends in the electricity sector, these are likely to be heavily modified by national interests and contexts. Countries differ on central features like degree of liberalization, number of DSOs, energy-source portfolio and interest structures; and these factors are likely to determine the outcomes of trends when translated into the national energy context.

Given the possible consequences for private customers, AMS has received surprisingly little public attention. The development of Norwegian AMS regulations has led to a new regulatory process, grounded in the need for the public administrative level to include necessary technical expertise. This has led a situation where regulations with implications far into the future in terms of household production and storage of electrical energy and other issues have been decided with limited attention from the consumer organizations. The interests of private customers have been formally represented in the hearings, but in practice with limited influence on the regulation. The regulatory body NVE has sought to weigh such considerations but in future policy processes down the track, such as prosumer inclusion, local energy storage, rates setting, related regulations and influence, the inclusion and representation of private customer interests requires more weight. There are likely problematic issues to be decided further down the road – questions of privacy and protection of private data – and the influence of ‘prosumer’ and other customer interests needs to be fully included in these processes.

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### References

- ACER/CEER, 2013. Annual Report on the Results of Monitoring the Internal Electricity and Natural Gas Markets in 2012. ACER/CEER, Ljubljana and Brussels.
- Boasson, E.L., 2011. Multi-sphere Climate Policy: Conceptualizing National Policy-making in Europe. Department of Political Science, University of Oslo, Oslo.
- Boasson, E.L., Wettstad, J., 2013. EU Climate Policy. Industry, Policy Interaction and External Environment. Ashgate, Farnham.
- Börzel, T.A., Risse, T., 2003. Conceptualizing the domestic impact of Europe In: Featherstone, K., Claudio, R. (Eds.), *The Politics of Europeanisation*. Oxford University Press, Oxford.
- Buchanan, Kathryn, Riccardo, Russo, Ben, Anderson, 2014. Feeding back about eco-feedback: how do consumers use and respond to energy monitors? *Energy Policy* 73, 138–146.
- Bye, T., Hope, E., 2006. Electricity market reform – the Norwegian experience In: Sorgard, L. (Ed.), *Competition and Welfare: The Norwegian Experience*. Norwegian Competition Authority, Bergen.
- CEER, 2012. CEER Benchmarking Report on Meter Data Management Case Studies. Council of European Energy Regulators (CEER), Brussels.
- Darby, S.J., 2012. Metering: EU policy and implications for fuel poor households. , 49, 98–106. *Energy Policy* 49, 98–106.
- Di Castelnuovo, Matteo, Fumagalli, Elena, 2013. An assessment of the Italian smart gas metering program. *Energy Policy* 60, 714–721.
- Dimaggio, P.J., Powell, W., 1983. The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. *Am. Sociol. Rev.* 48 (2), 147–160.
- EC, 2009a. Concerning Common Rules for the Internal Market in Electricity and Repealing Directive 2003/54/EC.
- EC, 2009b. Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 Concerning Common Rules for the Internal Market in Natural Gas and Repealing Directive 2003/55/EC (Text with EEA relevance).
- EC, 2012. Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on Energy Efficiency.
- EC, 2014. Benchmarking Smart Metering Deployment in the EU-27 With a Focus on Electricity. The European Commission, Brussels.
- ECGROUP, 2006. Toveiskommunikasjon-status, muligheter og tiltak i Norge. ECGGroup, Trondheim.
- ECON, 2007. Nye måler teknologier. ECON, Oslo.
- Fligstein, N., 2008. Euroclash: The EU, European Identity and the Future of Europe. Oxford University Press, Oxford.
- George, A., McKeown, T., 1985. Case studies and theories of organizational decision making. *Adv. Inf. Process. Organ.* 2, 21–58.
- George, A.L., Bennett, A., 2005. *Case Studies and Theory Development in the Social Sciences*. Belfer Center for Science and International Affairs, Cambridge, MA.
- Greenwood, R., Oliver, C., Sahlin, K., Suddaby, R., 2008. Introduction In: Greenwood, R., Oliver, C., Sahlin, K., Suddaby, R. (Eds.), *The SAGE Handbook of Organizational Institutionalism*. SAGE, London.
- Hoenkamp, Robin, Huitema, George B., de Moor-van Vugt, Adrienne J.C., 2011. The neglected consumer: the case of the smart meter rollout in the Netherlands. *RELP – J. Renew. Energy Law Policy* 4, 269–282.
- IEA, 2011. Energy Policies of IEA Countries. Norway: 2011 Review. International Energy Agency, Paris.
- Inderberg, T.H., 2011. Institutional constraints to adaptive capacity: adaptability to climate change in the Norwegian electricity sector. *Local Environ.* 16 (4), 303–317.
- Inderberg, T.H., 2015. Governing quasi-public network services for adaptation to climate change. *Local Environ.* 20 (4), 424–441.
- Jennings, Mark G., 2013. A smarter plan? A policy comparison between Great Britain and Ireland’s deployment strategies for rolling out new metering technologies. *Energy Policy* 57, 462–468.
- Jevnaker, T., Lunde, L., Skjærseth, J.B., 2015. EU–Norway energy relations towards 2050: from fossil fuels to low carbon opportunities In: Oberthür, S. (Ed.), *EU–Norway Energy Relations Towards 2050: From Fossil Fuels to Low-Carbon Opportunities?*. Palgrave Macmillan, Basingstoke.
- McHenry, Mark, 2013. Technical and governance considerations for advanced metering infrastructure/smart meters: technology, security, uncertainty, costs, benefits, and risks. *Energy Policy* 59, 834–842.
- McKenna, E., Richardson, I., Thomson, M., 2012. Smart meter data: balancing consumer privacy concerns with legitimate applications. *Energy Policy* 41, 807–814.
- NOU, 1998. Energi- og kraftbalansen mot 2010. NOU 1998: 11. Ministry of Petroleum and Energy (OED), Oslo.
- NOU, 2012. Utenfor og innenfor Norges avtaler med EU. NOU 2012:2. Ministry of Foreign Affairs, Oslo.
- NVE, 2006. Automatisk måleravlesning og toveiskommunikasjon. Styringsinstrument eller avlesningsautomat?. Norges vassdrags- og energidirektorat, Oslo.
- NVE, 2008. Avanserte måle- og styringssystem (AMS). Forslag til endringer i forskrift 11. mars 1999 nr. 301. Høringsdokument oktober 2008. Norges vassdrags- og energidirektorat, Oslo.
- NVE, 2009. Avanserte måle- og styringssystem (AMS). Forslag til endringer i forskrift 11. mars 1999 nr. 301. Tilleggshøring 2009. Norges vassdrags- og energidirektorat, Oslo.
- NVE, 2011. Avanserte måle- og styringssystemer. Høringsdokument februar 2011. Norges vassdrags- og energidirektorat, Oslo.
- OED, 2010. St. prop 15 (2010–2011). Programkategori 18.20 Energi og vannressurser. Ministry of Petroleum and Energy, Oslo.
- Renner, S., Albu, M., Elburg, H.V., Heinemann, C., Łazicki, A., Penttinen, L., Puente, F., Sæle, H., 2011. European Smart Metering Landscape Report. SmartRegions, Vienna.
- Römer, Benedikt, Reichart, Philipp, Kranz, Johann, Picot, Arnold, 2012. The role of smart metering and decentralized electricity storage for smart grids: the importance of positive externalities. *Energy Policy* 50, 486–495.
- Scott, W.R., 2008. *Institutions and Organizations. Ideas and Interests*, 3rd ed. Sage, Thousand Oaks, CA.
- Selznick, P., 1957. *Leadership in Administration: A Sociological Interpretation*. University of California Press, Berkeley.
- St.Meld. Nr. 29, 1998–1999. Om energipolitikken. Ministry of Petroleum and Energy, Oslo.
- Statistics Norway, 2013. Electricity annual figures, 2011. Released 20 March 2013. Retrieved 3 January 2014 from <http://www.ssb.no/en/energi-og-industri/statistikker/elektrisitetaar/aar/2013-03-20?lane=tabel&sort=nummer&tabel=104211>.
- Stortinget, 2001–2002a. Forslag fra stortingsrepresentant Sylvia Brustad om å legge til rette for at strømkunder over hele landet får tilbud om toveiskommunikasjon mellom strømkunde, strømleverandør og nettselskap.
- Stortinget, 2001–2002b. Innstilling fra energi- og miljøkomiteen om forslag fra stortingsrepresentant Sylvia Brustad om å legge til rette for at strømkunder over hele landet får tilbud om toveiskommunikasjon mellom strømkunde, strømleverandør og nettselskap.
- Stortinget, 2004. Minutes from Meeting 26 May 2004, 10 AM. Stortinget, Oslo. Available on: (<https://www.stortinget.no/no/Saker-og-publikasjoner/Publikasjoner/Referater/Stortinget/2003-2004/040526/ordinarsporretime/9/>).
- Streeck, W., Thelen, K., 2005. In: Streeck, Wolfgang, Kathleen, Thelen (Eds.), *Introduction*. In: *Beyond Continuity. Institutional Change in Advanced Political Economies*. Oxford University Press, Oxford.
- Strøm, P.A., 2012. Vurdering av informasjonsikkerhet ved innføring av AMS innen kraftdistribusjon. Institutt for telematikk, ITEM, Norwegian University of Science and Technology, Trondheim.
- Thelen, H., Streeck, W., 2005. Introduction: institutional change in advanced political economies In: Thelen, H., Streeck, W. (Eds.), *Beyond Continuity: Institutional Change in Advanced Political Economies*. Oxford University Press, Oxford.
- Westskog, Hege, Winther, Tanja, 2014. Electricity consumption: should there be a limit? Implications of people’s attitudes for the forming of sustainable energy policies. *J. Sustain. Dev.* 11 (1), 97–114.