Back to the futures: Retrospecting the prospects of smart grid technology

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Abstract

This paper analyzes a ten-year long technology debate, which dealt with so-called advanced electricity meters in Norway (1998-2008). The debate circled around one central question: should the implementation of this technology be forced through with regulations or should the market decide on pace and character of implementation? In 2008 it was decided that it was best to regulate the implementation. Throughout these 10 years, the debate largely concerned how the future would look with or without regulation. This paper is inspired by "the sociology of expectation", which assumes that futures are performative. This means that when the future is evoked or imagined, it influences present action and navigation. With this in mind, the paper analyzes future visions and expectations as they were formulated in the technology debate, and traces the role of these futures in the policy debate and for the policy outcome. The paper identifies two modes of future performativity: translative and transformative futures. Translative futures are often mobilized as spokespersons for desired technology or policy trajectories. Here, they work as a) *stagestting devices*: sparking debate, enrolling new actors in the debate and generating interest. Further, they work as b) *regulative tools:* establishing the need for political decisions, either to realize the content of future visions, or to avoid the contents of alternative futures. Transformative futures do more subtle and gradual work, shifting the practical, symbolic and cognitive meaning of "what" the technology in question might become in the future. As an example, the significance of the advanced electricity meters discussed in this paper changed from being a device filling the knowledge gaps of electricity consumers, to being a central hub in households delivering a range of potential services and being available for a number of different users. In this paper, I describe the gradual shift in understanding of what advanced electricity meters could be as a virtual domestication trajectory.

1. Back to the futures: Retrospecting the prospects of smart grid technology

In the 1950s many thought that nuclear power would provide abundant electricity "*too cheap to meter*" for the baby boomers grandchildren (e.g. Gamson & Modigliani, 1989). In the 1980s hopes were high for a future "solar society" (e.g. Caputo, 1984), while people of the early 2000s had high expectations for the

"hydrogen economy" (e.g. Bockris, 2002). When new energy technologies are discussed we often end up discussing how the technologies might change society. Currently, much hype surrounds the possibilities offered by a new set of technologies often referred to collectively as components of the "smart grid".

There exists a substantial body of social scientific literature that takes an interest in future expectations. This literature – often referred to as 'the sociology of expectations' - is concerned with how expectations for the future plays a role in processes of technology development and innovation (e.g. Borup, Brown, Konrad, & Van Lente, 2006; Brown & Michael, 2003). Authors in this tradition assume that expectations are performative. This means that shared expectations and shared visions of technological potential take on a form of agency: they affect and guide the navigation of present-day actors. Visions of the future can be used as tools to interest and enroll other actors with the intention of promoting certain technological pathways or political solutions. For example, when Dwight D. Eisenhower spoke before the U.N general assembly in 1953 to promote the idea of "*Atoms for peace*", he evoked images of an atomic future that differed distinctly from the gloomy and dystopic images provoked by the prospects of atomic warfare.

This paper builds on the sociology of expectations with the intention of grasping the role that future expectations play in the making of technology regulations and policy. The papers backdrop is a principal decision made in Norway in 2008, when the authorities made it mandatory for all electricity grid operators to install so-called advanced electricity meters with their customers. [1] This marked the end of a debate which had spanned over 10 years: should the installments of new, digital electricity meters be forced through with political means or should the market decide on the pace and character of implementation? I set out to do an empirical study of these 10 years of debate in order to assess how futures were articulated, and in which ways these futures were performative.

2. Futures, innovation and regulation

Social scientists working with the future have typically engaged in making some sort of prediction. Most commonly futures have been written through the application of forecasting or scenario-making techniques (see e.g. Börjeson, Höjer, Dreborg, Ekvall, & Finnveden, 2006). My intentions are different and without predictive ambitions. I want to search for potential relationships between futures and the present. Inspired by the sociology of expectations I will do what Nik Brown and Mike Michael (2003) have labeled "*retrospecting prospects*". For me, this means to study how futures with extensive use of advanced electricity meters were envisioned in the Norwegian policy debate from 1998-2008. Further, I will study the role of these futures: how where they mobilized, discussed, promoted, rejected and modified throughout the period? Most importantly, I am interested in searching for clues about the effect of such futures: in what ways where they performative; what did they *do*?

Performativity on behalf of the future means that whenever a future is evoked, discussed or imagined, it shapes our present. This is not quantum physics bending the rules of time and space but a quite simple idea. For example, when a couple expects their firstborn child, they typically prepare for this event. Not

[1] Advanced electricity meters were intended to be rolled out by 2013. However, the regulatory requirements were subject to four years of controversy over specifications, standards and other technicalities before they were finally approved. The deadline for rolling-out was changed to the end of 2017, and has now been pushed back to 2019.

because they know how the future will look, but because they have access to a repertoire of visions of a future life with children, and are able to use these as practical tools in contemporary navigation. In the words of Nik Brown, expectations and imaginative speculation are "fundamentally necessary real-time activities in order to mobilise the future into the present".

My interest lies in the role of future expectations in technology development and innovation. Specifically, I explore the implications for the shaping of political regulation, or interventions in processes of technology implementation. In part, this interest was sparked by the prominence of future expectations in the analyzed empirical material. Equally important is an understanding of innovation- and diffusion as processes of *domestication* (Author, 2012a; Brosveet & Sørensen, 2000; Hartmann, Punie, & Ward, 2005). Metaphorically, domestication is often described as a process of "taming" technology. In other words, "what" a technology could be; how it could be used and which meanings it assumes are not solely determined by technical qualities or design. Instead, technology users construct socio-technical practices and understandings in interaction with other actors, both human and non-human. One of the implications of this is that innovation processes do not end with "diffusion" or "deployment". In principle, the innovation trajectory can last indefinitely, since there is no way of telling what users ultimately make of the technology. Similarly, an innovation trajectory does not necessarily begin with a blueprint or a working technological design. Images and ideas about "what" technologies are and how they could change the world are of equal importance. This means that the shaping of technological artifacts could begin before the actual "gadget" is produced as long as ideas about te gadget exist.

With domestication in mind it is important to account for what technical artifacts are understood to be; practically, symbolically and cognitively. As Robin Williams and David Edge have pointed out, innovation could be described as a 'garden of forking paths' (1996, p. 866). This means that there is some sort of agency and 'choice' behind the process of technology selection, and that choosing an alternative path is always an option. This is quite clear in the Norwegian case of advanced electricity meters. After all, a political decision of implementing ('rolling out') one type of technology is clearly an expression of articulated agency on behalf of those who wrote the regulation. They chose this path over an alternative path where the market would decide. But what was the role of future expectations in choosing one path over the other?

Past examples might give us some hints of what to expect from the empirical analysis. In what follows I will look at a few examples in order to generate ideas about *how* futures can be performative. As a first illustration, I want to re-visit President Eisenhower and his advocacy for the idea of "atoms for peace". Speaking before the UN, Eisenhower strategically mobilized future images to bring potential allies on board in the process. In other words, futures can be strategic tools; allies in processes of translation or conviction. (see Geels & Smit, 2000; Konrad, 2006). Another famous example can be found in Rudolf Diesel's efforts to convince the Maschinefabrik August-Nürnmberg (MAN) to help him realize his new engine principles. Clearly, one of the reasons why MAN were interested was because they were convinced that a future where they were able to sell and produce more efficient engines than their competitors was within reach (Latour, 1987). A more contemporary example is found in the scientific field of synthetic biology, where expectations of potential is vital in generating scientific momentum

(Frow & Calvert, 2013). In light of these examples, I expect to see futures that are performative in the sense that they *work for* certain technological solutions, as 'spokespersons' or translators (Latour, 2005) of interest (see Akrich, Callon, Latour, & Monaghan, 2002 for more on the role of 'spokespersons' in innovation processes).

Often, they are likely to be spokespersons through projecting sublime future technological images. However, the opposite might also be true. Nerlich and Halliday (2007) have shown how negative expectations about the prospects of diseases spreading, might spur political, individual and collective action. Similarly, while firms in the business world tend to project very bright images of their own futures to the public, they frequently construct elaborate scenarios and images detailing the futures they want to avoid: bankruptcies and failures in order to craft strategies to avoid such futures (Tutton, 2011). Sometimes the prospects of potential horror might be useful to achieve cooperation with actors who would otherwise not be so willing. Take air flight as a case in point. Would passengers submit to current control regimes if there were no alternative future lingering, which contained terrorist attacks, airplanes falling from the sky and buildings tumbling to the ground?

The sociology of expectations also highlights that technological expectations are tied to anticipations about future use of this technology (Van Lente, 2006). The literature on anticipated future technology use has mainly been interested in how such anticipations influence technology design. Often, however, envisioning new technology use is to imagine much more. If the technology is pervasive enough, thinking about its future use might entail constructing an entirely new society, which in turn might have obvious implications for policy making and regulatory activities. This point makes it is useful to establish a link between the sociology of expectations, and a related literature that deals with the concept of imagined, or constructed publics (See e.g. Author, 2012b; Barnett, Burningham, Walker, & Cass, 2012; Walker, Cass, Burningham, & Barnett, 2010). This literature has typically dealt with the relationship between policy, technology development and "publics" more generally. The idea is that actors such as industrialists and policy makers act with the response of an "imagined" or constructed public in mind. As an example, someone who is planning to build a wind farm or a biomass powerplant might pursue a different path of action if the planners' perceive the public as hostile than if they consider the public to be progressive green proponents of renewable energy.

In sum, future expectations can be performative, in other words: they might have implications in several different ways. The question for me, is what types of futures will be articulated with respect to advanced electricity meters in Norway? And further, what effects might these futures have? It is clear that such meters represent novelty on the level of societal-wide infrastructure. This could entail that imagining a future with smart meters is the same as imagining a new type of society. But what society would that be? Yolande Strengers (2013) has highlighted that thinking about "smart" energy futures often implies imagining a future utopia. It stands to reason that utopic futures might *work for* the technology implementation as spokespersons for advanced meters. Knut Sørensen (2007) have pointed out that policy makers and designers tend to imagine energy users as perfect hybrids blending the qualities of engineering and economics. Thus, perhaps we can expect sublime techno-futures where economist-engineers optimize their behavior with the help of technology? On the other hand, many actors have for years been concerned about privacy-issues in relation to the implementation of smart meters. The fear is

that digitizing the electricity grid and related components might leave householder exposed to new types of surveillance (see Kursawe, Danezis, & Kohlweiss, 2011 for an attempt at mitigating such fears). In the worst variants of this future, the smart meters are stepping stones towards surveillance driven police-state tendencies, in other words: a clearly dystopic future. If such futures were found in the data, they would arguably act as be spokespersons *against* implementation.

3. The current Norwegian electricity reading regime

The accounts of Norwegian futures with advanced electricity meters analyzed in this paper have largely been written with the current Norwegian electricity reading regime as a backdrop and contrast. In order to better grasp potential agency on behalf of the futures, a quick look at the current situation is in order.

While the Norwegian electricity market was one of the first in the world to become fully liberalized (see Karlstrøm, 2012, p. for an account), electricity grid operation is monopolized. The income of network companies come from strictly regulated network tariffs which electricity consumers pay on a separate bill. Electricity grid operators are also responsible for registering and collecting measurement values from electricity meters. In other words, they facilitate communication between power suppliers and electricity consumers. Today, electricity customers usually have to read their electricity meters manually and submit the values from these readings to the electricity grid operator. For all measurement points it is mandatory to do this at least once a year. Customers using more than 8000 Kwh annually must do this more frequently, usually every third month. However, all customers are free to read and submit the values of their meter more frequently.[2] This, of course, means that power suppliers do not know exactly when the electricity customer actually uses the electricity. To calculate this, power suppliers can either use a standardized local load profile, which is also used by the electricity grid operators,[3] or they can develop their own load profiles.

The futures studied in this paper deals with the implementation of digitized, "advanced" electricity meters as an alternative to this regime. My focus is to try to understand the role of these futures in the technology debate, and ultimately in the regulation process of the technology. In other words, what have the futures done to the debate and policy process over the ten-year period?

4. Methodology

This paper tries to grasp how futures with advanced electricity meters were formulated in policy debates from 1998-2008, and how these futures were performative. To achieve this I qualitatively analyze a number of written sources from the period. These include Official Norwegian Reports (NOU's) that discuss advanced electricity meters, relevant reports from various ministries to the Norwegian parliament, State budgets and relevant annexes as well as parliamentary debates. Such documents were obtained through the official websites www.stortinget.no and www.regjeringen.no. Further, many reports were obtained from the Norwegian water resources and energy directorate. To broaden the image of how advanced electricity meters were discussed in the period a search of all relevant written

[2] Customers using more than 100 000 Kwh annually are obliged to have hourly reading of their electricity usage. In practice, this applies to industrial actors and relatively large business and does not affect standard households.
[3] This is the so-called JIP – *Justert innmatingsprofil* (adjusted load profile)

sources were conducted in the Norwegian media database retriever (retriever.no). The data were analyzed with a focus on how futures were written and future expectations for the technology.

The following analysis contains a number of quotes for illustrative purposes. All of these were originally written in Norwegian and have been translated to English for the purpose of improving readability.

5. The past futures of advanced electricity meters

The empirical scrutiny of ten years of Norwegian debate about advanced electricity meters has revealed a range of futures in the debate. Over the years, there has been a development in the understandings of the advanced meters and their futures. The futures formulated in 1998 differ distinctly from those formulated in 2008. Broadly speaking, the futures of the period can be grouped in two categories, which have emerged from the reading of the empirical material.

First, the analysis has identified a set of futures that display what I call *translative* performativity. Proponents or opponents of particular development paths often mobilized such futures as spokespersons for or against something, which means that these futures served as active nodes in attempts of transferring interest from one actor to another. In the data analyzed here, futures were translative in two ways. First, as *stagesetting devices* and secondly, as *regulative tools*. Stagesetting devices sparked debate and established interest, while regulative tools went beyond this to establish the necessity of technology regulation.

Secondly, I observed what I call *transformative* performativity. In the data analyzed here, this was a quite subtle process where the ideas about what advanced meters were and could become were transformed. This transformation changed what was seen as the potential of the technology in combination with ideas about future users, use and practices. Inspired by literature on domestication I have labelled this process a *virtual domestication process*.

5.1 Translative futures as stagesetting devices

The first way futures displayed agency in the debate about advanced electricity meters were as *stagesetting devices*. This implies that framing (e.g Callon, 2002) is of importance in policy processes and that evoking a particular future is one way to highlight certain socio-technical traits over others, or to bring technology to the public political stage for scrutiny and debate. This type of agency was often very visible in the data, because texts tended to cite the future expectations of other actors as what made the debate necessary. A clear example was found at the beginning of the ten-year long debate. In 1998, an officially appointed Norwegian committee on energy released a whitepaper dealing with the Norwegian energy balance towards 2020. The report was packed with 600 pages of advice for the Norwegian ministry of petroleum and energy and contained a set of scenarios depicting potential energy futures. While advanced electricity meters had been absent from the Norwegian debate prior to this report, they featured prominently in several of the scenarios presented.

The scenarios depicted the implementation of advanced meters as a very positive thing: linked to climate mitigation, energy efficiency and improved market functions. Borrowing David E. Nye's (1994) terminology, advanced electricity meters were *sublime*. In the scenario "*the climate road*", the

committee envisioned mandatory implementation of advanced electricity meters and a roll-out of the technology by 2003. Combined with remote load control possibilities, the scenario suggested that consumers would reduce their electricity consumption with around 4TWh annually in the near future (NOU, 1998, p. 496). Another scenario entitled "*green brainpower*" projected a future where all households had advanced metering installed in combination with real-time displays containing information about the buildings energy consumption. These elements would re-configure future electricity consumption practices: "*It turns out that this […] affects peoples knowledge of their consumption in a positive way*" (NOU, 1998, p. 522). For many reasons the committees' advice was clear: the implementation of advanced electricity meters should be made mandatory through regulation.

While those who wrote these futures clearly intended for them to have a direct effect on the policy making process of 1998, this was not to be. Instead, the scenarios brought attention to desirable aspects of the advanced metering technology. This sparked an interest and laid out scenarios that it was difficult to ignore in the years ahead. Echoes of the arguments from the report found their way into newspaper articles over the next two years. The news coverage mainly focused on the possibility of saving money on the electricity bill through a combination of more rational user behavior and new technology. For example the newspaper *Dagbladet* reported that this would give the consumers "*information and freedom of choice"* (2000). Thus, the scenarios set the stage for news media coverage as well as policy debates.

When the Norwegian ministry of petroleum and energy produced a report on energy policy in 1999, it acknowledged the scenarios produced a year earlier, as well as the general buzz and optimism surrounding the technology, and cited them as what made a discussion of advanced meters both interesting and necessary. However, the ministry did not share the enthusiasm. Advanced meters were seen as "promising", but it was stressed that much was "unknown" with respect to future development and technology use. Thus, the prospect of mandatory installment of advanced meters was viewed through the eyes of a cautious investor. In this light the idea came through as "expensive", and therefore not feasible (OED, 1999). The idea, however, was now a part of the consciousness of policy makers and industry and it would not go away.

Stagesetting futures were often accompanied by concrete policy propositions. An example of this was found in a motion by the Norwegian parliamentary committee on energy and environmental issues in the year 2000. The parliamentary committee foresaw that publics would use electricity more rationally, and that this would have substantial benefits both for individuals and on aggregate levels. Thus, they pointed to: "*the necessity of implementing two-way-communication*" (which was the preferred term for advanced electricity meters at the time), and requested that the ministry of petroleum and energy "*considered the costs and opportunities of more efficient electricity consumption by implementing two-way-communication*" (EOM, 2000).

Again, these futures would not affect policy directly. Rather, they were cited as what triggered a lengthy response by the ministry of petroleum and energy in the form of an appendix to the state budget of 2001. Here, the ministry was cautiously optimistic about the future prospects of advanced metering technology, but again concluded that mandatory implementation would be too expensive (for more on

this appendix, see section on virtual domestication trajectories). Thus, stagestting in this period was a way to sustain and make debate necessary, enrolling new actors in debate and literally placing the technology *on stage*.

A proposition written by Sylvia Brustad, Member of Parliament from the Labour party featured a third example of stagesetting futures in 2002. She wrote: "*In a situation where it seems like the expansion of new power production will remain limited, it is vital to stimulate consumer flexibility*". In the motion she asked the government to arrange for all electricity customers to be offered "two-way communication" which would provide future benefits of "smarter" electricity use through new tariffs and remote load control. This, she envisioned, would reduce electricity bills, lessen the need for investments in the electricity grid and reduce the demand for new power plants in the future. Brustad's future was more elaborate than the others we have seen so far, in the sense that it not only praised the qualities of advanced electricity meters, but also added other societal conditions that made smart meters lucrative.

In her future vision, Norwegian electricity production capacity would not be expanded. Thus, she could draw translative capacity from two futures: a sublime future where advanced electricity meters were widely implemented and a bleaker future without any "new" electricity added to the grid. Thus, she could compare the utopia of advanced meters with the dystopia of electricity shortage. Both futures acted as spokespersons for her position.

This set the stage for a discussion the following year, when advanced electricity meters were treated in parliament. While Brustad's ambitions were clearly to influence national policy, the parliamentary treatment did not provide the desired outcome. None the less, a number of new actors were now enrolled in the public debate, and her arguments also set the stage for accounts emerging in the following years.

Future accounts of advanced electricity meters up until 2003 primarily took the role of stage setting devices. While many of those advocating advanced meters wanted to influence policy directly, they were unable to do so. Arguably, this had to do with the understanding and framing of advanced meters in the period. Discussions circled around the pros and cons of "advanced meters", on relatively aggregated and abstract levels. There were little in these accounts suggesting anything in the line with what we currently discuss as "the smart grid". In what follows, we will look at the transformative performativity of futures from this period. In other words, I will look at how the significance of advanced electricity meters changed, and how this eventually made impact on policy possible.

5.2. Futures as virtual domestication trajectories. First act: information devices

Throughout the ten-year period, and in parallel with futures acting as stagesetting devices and regulative tools, advanced electricity meters underwent what I call a *virtual domestication process.* Domestication studies often show the dynamics of what happens when technological artefacts are introduced in new settings. How do new technologies influence their users' practices and vice versa, and what meanings are ascribed to the technology in the process? Here, the technology in question was only "introduced" in texts and speech. None the less, many of the same dynamics can be seen: understandings of the

potential of advanced electricity meters changed, understandings use and users changed, and ideas about the role of advanced meters in systems such as the electricity grid and society changed.

In the initial report on the future of the Norwegian electricity system (NOU, 1998), advanced electricity meters combined with feedback display technologies were understood as information tools. Current electricity consumption practices were seen as non-sustainable. Too much electricity was used, particularly during "peak" hours. Thus, a shift in electricity consumption practices was sought. The problem was framed as one of public "knowledge deficit" (see e.g. Eden, 2011), where electricity users could not make rational decisions because they were in the dark regarding their own consumption. One of the scenarios elaborated on the effects of providing information: "*it became clear that increasing the knowledge of [the customers own electricity consumption] in itself was an important motivator for decreasing electricity consumption"* (NOU 1998, p. 496). Another scenario projected the following future:

> "*together with the installation of [advanced meters], it also became mandatory to install an intelligent electricity unit which displayed ongoing electricity consumption […] The box shows consumption on a daily, weekly and monthly basis, and compares with previous years. It turned out that this 'electricity-watchdog' positively affected people's awareness of their own consumption"*

While the technology was understood as an information device, the public was imagined as a set of clever Homo Economicus. Thus, electricity consumption was seen as a way to maximize economic utility. When the public acted in ways that were perceived as irrational, the "misbehavior" could be corrected through information. This practical, symbolic and cognitive understanding of advanced electricity meters and their use would be the dominant understanding for some time.

However, it co-existed with a very similar, but still alternative understanding which was fronted by actors who worried about mandatory implementation and technology regulation. These actors also saw advanced metering as a way to provide information, but were not certain about the public. Would they respond as we would like them to? This uncertainty was voiced, amongst other places in the earlier mentioned appendix to the state budget of 2001 (OED, 2001). The appendix stated: "*two-way communication will in itself not reduce the effect load. However, the technology might cater for changes in end user consumption*". The appendix went on to conclude that:

> *"In some cases, two-way-communication might be a good tool to reduce peak loads in the grid […] However, the departments assessment is that it is not appropriate to [speed up the] installation of advanced meters through regulation. Implementing this technology today would be highly expensive"*.

These future expectations were more cautious in character. The cognitive aspect of the public as "homo economicus" was moderated, while the symbolic understanding of the technology was cast as the economic category "expensive". This illustrates that when multiple actors are involved in a domestication process on societal scale, the transformative agency of futures may pull in varied directions.

However, advanced electricity meters would soon take on a third significance. In an open editorial to a large regional newspaper in Norway, a director in the Society for the conservation of Nature conjured up two distinctly different futures. In one of these, Norway had constructed a number of "polluting gas fired power plants", significantly increasing national CO2 emissions. This future, he wrote, needed to be avoided. And the tool to avoid that future was advanced electricity meters. He wrote:

> "*The solution is not increased production capacity, but more efficient use of electricity […] with two-way-communication large peak loads can be evened out […] and needed effect can be freed up through shifting loads*" (Flatberg, 2001, p. 14)

In other words, a future *without* advanced electricity meters was equated to a future with climate intensive gas power plants and vice versa. This illustrates that futures can be both translative and transformative. Future expectations of a pollutant future set the stage in order to gain support for an alternative. Here, advanced electricity meters were given a new symbolic meaning. Now, they were understood as small, clean powerplants, placed right in the homes of ordinary consumers. The expected practical response would be that consumption patterns changed. In other words, the thesis of "homo economicus" was far from abandoned.

This symbolic understanding of what role advanced electricity meters would have in individual households and in society more generally would become solidified in the following years. Advanced electricity meters were understood as information devices on the household scale, and assumed the role of an alternative to new powerplants when actors zoomed out to talk about societal aggregates. In the winter of 2003, advanced electricity meters were discussed in the Norwegian parliament. This was a particularly cold Norwegian winter, which resulted in extraordinarily high electricity consumption (and prices). The press described the situation as an "electricity crisis" (Karlstrøm 2012). Sylvia Brustad of the labour party got the ball rolling by forwarding a motion, first to her own party, later to parliament. Here, she highlighted the importance of advanced electricity meters though evoking negative future expectations on behalf of increasing electricity production: "*In a situation where it seems like the expansion of new power production will remain limited, it is vital to stimulate consumer flexibility*". In practical terms stimulating consumer flexibility meant implementing advanced electricity meters, which she envisioned would allow customers the possibility of "smarter" electricity use through new tariffs and remote load control. This would reduce future electricity bills, lessen the need for investments in the electricity grid and reduce the demand for new power plants in the future (Brustad, 2002).

In the following parliamentary treatment, this understanding of advanced electricity meters dominated. Øyvind Halleraker from the conservative party pointed to them as information devices and market improvement tools, stating that: "*two-way-communication can make the market work even better than today by providing the customers with instant information about supply and demand*". Meanwhile, the story about advanced electricity meters as "expensive" was still important as a counterweight to the predominantly very positive virtual domestication of advanced electricity meters.

Thus, the futures formulated in the debates would not actively influence technology regulation. However, the futures formulated in the debate up until this point did two things: 1) they set the stage for

further debate, and 2) they changed the symbolic, practical and cognitive meaning of what smart meters *could be*.

5.3 Translative futures 2: regulative tools

In 2004, this began to change. Now, futures did not only set the stage for future debate, they also legitimized and made specific policy decision necessary. I will look at three examples of this. In the first two examples, futures were used to produce a market oriented policy outcome, in other words decisions that regulation was not necessary.

The first two accounts of the future to be mobilized as regulative tools were delivered in reports written by the directorate of water resources and energy. In both instances, the mandate was precisely to assess whether or not it was a good idea to speed up the implementation of advanced electricity meters through regulation. The first report (Tjeldflåt & Vingås, 2004) largely discussed this question in terms of future societal economics. The main question they wanted to resolve was whether or not regulation and a subsequent investment in a large scale 'roll-out' would pay off in the future on a societal scale. In one way, this report is somewhat peculiar because it claims to say something about the future costs and benefits of advanced electricity meters. It wanted to do so, however, specifically *without* engaging in future spectulation. The report stated: "*Possible* benefits of two-way-communication are well known […] However, what might theoretically make up societal benefits is less interesting […] What matters are the benefits that can *actually* be realized through this infrastructure, and the experiences that exists in this area" (Tjeldflåt & Vingås, 2004, p. 37).

This methodological choice, disregarding what they considered possible future benefits led to negative projections of future economics. The choice illustrates the performativity of futures through the absence of future content: without the speculative prospects of bright futures, how could the investment be justified? The answer was clear: it could not. Instead, the report focused on an alternative future. The question was: how would a future dominated by advanced electricity meters compare to an alternative scenario where the same desired outcomes were achieved through expanding the electricity production capacity? Based on their economic calculations, the directorates assessment was that it would be better to build new power plants than to install advanced electricity meters: "In a societal economic perspective it is a better idea to build new production capacity based on hydro power, than it is to implement load management in households via two-way-communication" (Tjeldflåt & Vingås, 2004, p. 60).

The combination and contrast of these futures, one with expanded power production and one with expensive advanced electricity meters, became a potent regulative tool. The Norwegian department of oil and energy specifically cited these futures as a reason to decide against technology regulation. In other words, the content of these futures not only translated into stage setting and the establishment of further debate, but triggered active policy production. The mobilization of these futures effectively ended the debate, and legitimized a particular regulative choice, namely to let the market decide on the pace of implementation.

This decision led to dormancy in the debate. From 2004-2006 advanced electricity meters disappeared from parliament. They were absent from the mainstream press. Instead, they found refuge in specialized technical magazines. The debate resurfaced in 2006, when the directorate of water resources and energy was given the same task as two years earlier: to assess the feasibility of mandatory advanced meter implementation. They produced a new report, which was more ambitious in describing the future of advanced electricity meters. For the first time in this decade-long debate, a vision was produced resembling current ideas about *smart grids* (see next section on virtual domestication for more on this). As two years earlier, however, the report highlighted that regulations had to be anchored in credible calculations. This is quite interesting: the directorate treated the future smart grid vision as a conjured up image that they would not allow to affect their decisions. In this sense, it was as if they made a conscious effort to fend off potential translative performativity on behalf of the smart grid. Instead, the future which was actually mobilized to make a regulatory decision was one where the tangible economics of mandatory implementation of advanced meters were bleak.

The third – and final – example that I will look at here, was a report from 2007. As had already been the case twice, this report was commissioned by the Norwegian government to assess the feasibility of mandatory implementation of advanced electricity meters. This time, however, the task was outsourced and the report was written by the consultancy firm ECON. It is unclear why this report was not written by the water resources and energy directorate, but rumors in the electricity industry and from electricity grid companies suggest that the reason "was political" (Throndsen, 2013).

Regardless of how ECON gained their authority, they reached a different conclusion than the directorate had done twice in the past. Several ideas about the future led them in this direction. First, they imagined a future *without* regulatory interventions, where the market decided on implementation. In this scenario, they foresaw a very slow rate of implementation. Further, they asserted that the technology choices made in such a scenario would be far from optimal. These assessments were based on the relatively straightforward assumption that electricity grid companies are economically rational actors. With this guiding their actions, ECON believed that they would not find it commercially profitable to make investments in advanced electricity meters in the near future. Further, they expected that the grid companies would have incentives to invest in cheap technology without the functionality required to realize the full societal potential of what an infrastructure based on advanced electricity meters could become in the future (ECON, p. 2). In other words, the report framed the question of technology regulation as a choice between two futures: one where Norway jumped the modern, digital electricity train and reaped a set of benefits, or an alternative future where greedy companies would gradually install sub-optimal digital technology.

Thus, they did not conjure up a competing future *without* advanced electricity meters, but feared that a future *without* technology regulations would lead to a messy patchwork of different standards and solutions. On its first page, the report stated:

> "*New, automatic electricity meters will most likely be gradually installed in Norway. The question is when this will happen and what functionality the new technology will have. ECON recommends to implement demands on functionality so that optimal functionality for society is ensured, that*

economies of scale are taken advantage of, and that third parties are granted access to the data" (ECON 2007, p.1)

Thus, ECON used a different strategy than the directorate had done in the past. Where the directorate focused on the tangible and what internalized many of the elements previously described as "speculative" and used them as the core assumptions for their recommendations. The report stated:

> "*Our analysis of quantified net benefits is negative. If we consider that the new technology can probably be used in ways that are not quantified, combined with the belief that the cost per meter is going down […] there is a chance that net benefits may be positive*" (ECON 2007, 38)

With these conclusions and recommendations about the future economics of advanced electricity meters in hand, a new regulative directive was drafted by the authorities within a year. ECON's report and future assumptions was cited as the direct reason:

> *"To have a solid basis […] ECON was hired to assess [the feasibility of implementing advanced meters through regulation]. ECON concluded that societal cost-benefit would most likely be positive when non-quantifiable benefits were included […]. With support from ECON's 2007 report, it was concluded that it would be feasible to initiate a process aiming towards a full scale roll-out of advanced metering"* (NVE, 2008 p. 8)

In other words, translative capacity was drawn from the future imagined by ECON, to legitimize the new regulations.

5.4 Futures as virtual domestication processes. Second act: towards the smart grid

As we have seen, translative futures changed from being stagesetting devices to having a clear impact on regulation: they became what I have called regulative tools. Meanwhile, the understanding of what advanced electricity meters could become in the future also changed. Up until 2004, they were largely understood as information devices constructed to fill the knowledge gaps of consumers. From 2004, they were given a much broader significance. Thus, the content of what a future with extensive use of advanced electricity meters would entail was gradually transformed towards an understanding that resembles what we currently call "smart grid". The virtual domestication process where descriptions of potential became more elaborate was probably also important in facilitating the influence that we have seen on regulation.

The first steps in this direction could be seen in the report by the Norwegian water resources and energy directorate from 2004. This report hinted at greater potential on behalf of advanced meters than filling knowledge gaps. The report predicted the emergence of new products, new markets and new actors exploiting the technology. Such a future, the report stated, could be beneficial. The report stated:

> "*Two-way communication has little value beyond precise reading and through this, precise billing. It is first when electricity products, new transfer tariffs and load management can be attached to the technology that we can begin to see value*"(Tjeldflåt & Vingås, 2004, p. 39)

The report continued by highlighting the potential benefits of linking electricity consumption to new technologies, and that there was future potential in the technology to change public perception of energy as a product:

> "*We can discuss whether or not end-users would be interested in new products. Generally, electricity is a low-interest product, and end-users do not want to focus on more than paying the bill. However, this might change. Perhaps it has been a low-interest product because choice has not existed*?"(Tjeldflåt & Vingås, 2004, p. 41)

Thus, this report hinted at a future relationship between "smart" technology and energy consumption practices that went beyond the assumption of electricity users as homo economicus. Rather, smart meters and associated technologies was seen as holding a broader possibility of creating new types of engagement, and through this engagement a set of new practices. This transformation of understanding was taken further in the next report produced by the Norwegian water resources and energy directorate in 2006 and in the report produced by ECON in 2007. In these reports, the ideas about future potential of new products, innovation and new actors became much more concrete than they had been so far.

In the 2006 report a future with advanced electricity meters was actually a future with a brand new infrastructure for delivering an array of potential services which would not only re-structure electricity consumption practices, but many other aspects of life. The significance of the advanced meters had changed from being a future provider of information, to being a central hub connecting several household practices. The report stated:

> "*services that can be delivered through infrastructure for two-way-communication […] include: alarm, health and security services; load management; energy consultancy services; broadband; IP-telephony; various types of entertainment*" (Kolbeinstveit & Tjeldflåt, 2006, p. 14).

This understanding of the advanced electricity meters potential to transform household practices and associated markets with related actors unleashed a series of new questions. The new symbolic significance of the advanced electricity meters also produced visions of new users, new markets, and new modes of use. Questions that were discussed included what types of actors that should be allowed to exploit the possibilities offered by advanced electricity meters and the data they would generate, how the data should be stored, what the role of third party actors should be, and how to ensure that the infrastructure became a platform for future innovation. These questions illustrate the socio-technical character of such an infrastructure change; once new technology is imagined, a new complicated world is imagined around the technology. This new "world" also contains a completely new set of users: household members of course, but also new companies, markets etc.

In ECONs 2007 report, the virtual domestication of advanced electrify meters combined the notion of advanced meters as "information devices" with the recent elaboration of advanced meters as a future household hub for a range of services. When discussing the advanced electricity meters as information devices the future users were still portrayed as homo ecomonicus. The report stated that "*There is reason to believe that advanced measurement technologies will benefit the customer through lower prices*" (ECON 2008, p. 33). Practically this would be achieved in two ways: information would result in

both increased competition between electricity providers, as well as altered patterns of electricity consumption amongst "end users".

At the same time, ECON discussed advanced electricity meters as the main ingredient in a broader infrastructure for various services, much like in the two examples shown above. ECON framed these as "additional services" or "additional benefits" (p. 36). importantly, the new services were anchored in the notion of the advanced electricity meters primarily as "carriers of communication". Without being very specific, they suggested that two possibilities could be alarm and safety services, as well as broadband services such as IP-telephony and entertainment services.

Thus, when the draft regulation demanding that advanced electricity meters were to be installed with all Norwegian end users was written the following year, advanced electricity meters was understood to be a device which would not only change the future consumption of electricity through the provision of information. It was also technology that could potentially influence a range of practices in households, as well as function as an infrastructure transforming both markets and industries. It is worth noting, however, that while all of this resembles what we currently discuss as "*the smart grid*" – this term had not yet been coined, at least not in the Norwegian technology debate.

6. Concluding remarks: towards a typology of performative futures

Inspired by the sociology of expectations (e.g. Borup et al., 2006; Brown & Michael, 2003) this paper has explored the role of future expectations in processes of technology regulation, development and implementation. The empirical basis for this undertaking has been a ten year-long technology debate in Norway, where the outcome was a decision which makes it mandatory to install so-called advanced electricity meters. Through this exercise of looking back at futures of the past, the paper has suggested that the futures analyzed here have displayed different types of agency or performativity.

Principally, the paper has shown that futures work, act or influence the present in two distinct ways. They do so through:

- **Translative performativity:** Translative futures are active nodes in attempts at transferring interest from one actor to another. In the data analyzed here, they were often mobilized rhetorically as a means to convince or enroll other actors in a particular technology or policy development path. This means that actors have evoked sublime or dystopic futures, in an attempt to try to influence the technology regulation process. The data has shown that this type of agency has had two types of effects. First, as *stagestting devices, and* second as *regulative tools*. When futures were stagesetting devices they catered for and sustained debate. They enrolled new actors in the debate, and established visions of future technology which could not be disregarded in preceding discussions. When futures acted as regulative tools they had direct impact on the formulation of new regulation. Thus, there is a difference in the degree to which these futures were able to affect the presence.
- **Transformative performativity:** The difference in strength or the shift from stagesetting to direct influence of regulations seems to have been influenced by the second type of agency, which I have called transformative performativity. The data analyzed here suggests that such futures act

more subtly, through *virtual domestication processes*. These futures transform or change the ideas about what the technology in question could be: symbolically, practically and cognitively. In the case of advanced electricity meters, we have seen that the understanding of this technology have shifted from being a relatively simple information device, to being a complex hub of information in what resembles what we today would call a "smart grid". It is quite likely that this gradual transformation have also raised the expectations for the technology in such a way that its mobilization for translative purposes became more potent, thus shifting from stage setting to affecting regulation.

The dynamics shown in this paper have some implications. On the one hand, they clearly show that the production of technology policy can be a painstakingly slow exercise. However, in the case of advanced electricity meters, this was probably not a bad thing. Had all households been equipped with such meters in 2003 as first suggested, they would surely not have the same potential as they have today. Competing visions of the future played a role here, both in pushing the process forward and in slowing it down. Further, while I do not have empirical data to back up such a claim, it is likely that the visions seen in the analyzed data has had tangible impact on the actual technology development process, that we can see some sort of co-production process (Jasanoff, 2004). Future visions influence technology development and policy making, while technology development shapes visions.

Given that futures affects the present; accounting for the futures of the past becomes one of the many tasks we have to undertake if we want to fully understand how policies are made and technologies constructed. Secondly, we see that the future is by no means a neutral construct. How it is framed, what is incorporated in it and what is left out, as well as who gets to define it is central in accounting for choices made. In an era where "roadmaps towards…" and "scenarios" play an increasingly important role in the rhetoric of policy making, especially in troubling issues such as climate change, this lesson is worthwhile brining into *future* research and policy work.

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