Title

Material participation and the smart grid: Exploring different modes of articulation

Abstract

Many experts are worried about the would-be character of smart grid users, and that they will not engage with smart grid technologies out of disinterest or lack of knowledge. This has been held as problematic as users are conceived as a fundamental key to unlocking the full potential of the smart grid. This paper engaged smart grid users from the Norwegian demo Steinkjer pilot, and through focus group interviews, articulations of every day smart grid enactments were collected. Eliciting little lack in either knowledge or interest, informants were able to articulate relevant smart grid enactments through a spectrum of skepticism, pragmatism and enthusiasm. Mobilising the concept of *material publics* (Marres 2012) this paper argues that smart meters bridge the green political economy of climate challenge issues and the user's context of everyday energy consumption. The paper found evidence that user articulations, whether skeptical or enthusiastic, are firmly rooted in a political engagement. This suggests a strong case for material publics of the smart grid, indicating that explanations for user disengagement likely can be found in subversive co-articulations among users, rather than disinterest or lack of knowledge. This paper suggests acknowledging smart grid users as politically engaged, material publics.

Highlights

- We conducted focus groups of smart grid users
- Users articulated a range of enactments from skepticism, pragmatism to enthusiasm
- Strong political sentiment was found, as opposed to disinterest or lack of knowledge
- Co-articulations of smart grid enactments by users can be subversive towards smart grids
- This poses a challenge which must be addressed in smart grid implementation scenarios

Keywords

Material publics, smart grid, smart meter, focus group, green political economy

Introduction

Smart meters, an enabling integration of ICTs into the energy system, are framed as the first stepping stone on the path to making the energy network "future ready." Such a transition involves being able to shave peak load curves and make the grid more efficient, thereby increasing the life of our current grid. It also promises to decrease consumption and carbon emissions by enabling the grid to include more renewable resources. Finally it is supposed to enable the price incentive to be brought to the consumer in real time, as users are constructed as responsive to an increase in penalties and rewards more pervasively administered through price incentive schemes made available with these new technologies (Faruqui et al. 2009, Moghaddam et al. 2011). This is where the household, with its would-be flexible consumer, enters into the smart grid. An important task for experts has thus been to figure out how to get household consumers to relate to smart meters in an active manner. New technologies and market models that exploit smart meter capabilities are expected to arrive in the wake of this. For instance, the smart meter is constructed as having the ability to bring "prices to devices" (Chassin, 2010), whereby the actual energy cost of running a specific appliance at a given moment may become a piece of information that can be acted upon by appliances. Users are expected to actively enter into a feedback configuration with the meter regarding the supply and demand situation of energy between market and household, aided by the new capabilities of the new meter (Torriti et al. 2009). But as smart metering technologies are becoming ever more pervasive questions pertaining to the non-technical aspects of these artifacts are still un-answered. Without the participation of an active user, the concerns are that the potential benefits of household smart metering may not be fully realised. Will consumers get involved? In what way will the smart meter engage the public? Will households change their energy consumption practices in response to the smart meter and in what ways? In this paper we provide new evidence to shed more light upon these questions drawing upon focus group interviews with participants in one of Norway's smart grid living labs. More specifically, we discuss how an *object centered* perspective (Winner 1980, Akrich 1992, Latour 1994) may provide a better understanding of ways that *material publics* (Marres 2011) are constructed in relation to smart metering technologies.

The structure of the article is as follows: First we outline earlier research about how users relate to smart grid technologies. Secondly we outline the theoretical perspective of this paper. We then describe the interview data and methodology, followed by an analysis of the empirical material. Finally, we conclude with a discussion about what our findings might entail for some common *expert*-descriptions of the variability of enactments of engagement afforded by future smart grid technology developments. The findings will hopefully also contribute to a widening of the scale of user engagement in smart grid conceptualisation.

The smart grid and the user – earlier findings

In the last few decades there have been several studies discussing the future role of users in the smart grid and there is also growing bodies of studies focusing on actual user behavior as smart meters proliferate in households. These have all underlined that many Demand Side Management (DSM) interventions require changing the role electricity has for users, and that DSM targeting the "energy consumer" will struggle to achieve its potential as this framing is far from how people see their relationship to the grid and their energy use (Goulden et al 2014). In parallel, studies on aggregate scales of the effects of DSM have sometimes uncovered modest results. In the UK, a recent analysis of the large-scale Energy Demand Research Project, involving some 60,000 households

including 18,000 with smart meters, observed no statistically significant savings from standalone Smart Energy Monitors (SEM) and just 3% savings from SEMs when they were accompanied by smart meters (Raw and Ross, 2011). A smaller German pilot study incorporated a field test of smart meters in 288 households reported reductions in different test groups in the range of 2.5% to 10.9%, or 6.7% on average (Reiter & Emmermacher 2013). A similar study, also from a German demo project pilot, incorporated 650 households and found savings in the range of 5-10% (B.A.U.M. Consult GmbH 2012:17). These kinds of results make it clear that the role often given to smart meter technologies by experts as the "silver bullet" or the "missing link" (O'Sheashy 2003) between users and the energy market is probably exaggerated, even though 10% in pure energy reduction might not be such a bad result. Still, the variation within these numbers should still be disconcerting to smart grid proponents.

The list of studies available which focus on end user experiences with smart meters and the extent to which households might be willing or able to engage in so-called load-shifting behaviors – which has been a major preoccupation of engineers and other experts – is still quite short. None the less, and going a long way to explain the above mentioned variance, we know quite a lot from studies looking into the effects for instance of a general provision of information and feedback on domestic energy consumption, which has been seen as perhaps the key means of overcoming the so-called "double invisibility" of energy (Burgess & Nye 2008). These studies have highlighted the significant difficulties involved in accomplishing considerable savings in domestic energy use through forms of information provision. An identified problem with these studies have been that they traditionally have focused narrowly on individual decision making processes, that depict households as "black boxes" (Darby 2003) neglecting to account for the ways in which feedback must be made sense of, negotiated, and acted upon (or not) amid existing domestic situations often involving multiple household members (Hargreaves et al. 2013). Following the lines of this critique new modes of theorising energy consumption, stressing the importance of the social dynamics of households, revealing how energy feedback must be "domesticated" (Aune 2007) or appropriated into a wide range of different households with different routines and practices have developed (Wallenborn et al. 2011). One example is Strengers (2008) study of smart meter technologies in the form of in house displays providing information about critical peak pricing, which illustrated how the displays actually enter into more complex social processes in the household than what is commonly discussed among designers. For instance, the study found that the meters appealed mostly to men in the household as the design was very data oriented, while normative messages on the other hand were more interesting for women.

Another study demonstrating the nature of domestic energy consumption as a social and collective rather than individualized process is a study of how UK householders interacted with feedback on their domestic energy consumption in a field trial of real-time displays or smart energy monitors. The study suggests that even early adopter households show strong resistance to energy saving and that smart energy monitors can lead to both greater co-operation and greater conflict among the members of the household (Hargreaves 2010). The study reveals that deeper engagement with smart energy monitors can promote feelings of empowerment, giving participants an increased sense of control and enabling them to take stronger action to reduce their own energy consumption. But more importantly, and testifying to the convolution of "effects" we can expect from introducing smart metering technologies in households, it also traces signs of *disempowerment*. The monitors appeared to make environmental and financial challenges seem larger and even more

insurmountable for some of the householders. A follow-up study was made (Hargreaves et al. 2013) with qualitative interviews revealing further that over time the smart energy monitors gradually became "backgrounded" by normal household routines and practices. This indicated that although managing to increase householders' knowledge of own electricity consumption, this did not necessarily encourage or motivate householders to reduce their levels of consumption. The study concluded that household practices actually may become *harder* to change as householders realise the limits to their energy saving potential and become frustrated by the absence of wider policy and market support (Hargreaves et al. 2013).

The strand of research on energy cultures has made a significant progress in opening up the "black box" of household energy consumption as well as underlining the complex social topography of shared households. Widening the scope further, Goulden et al. (2014) found that householders adopted two typical ways, or "personas," of dealing with household energy consumption either as "energy consumer" or as "energy citizen." The energy consumer persona was observed as easier to adopt, but also understood as more prone to criticism for being unsustainable on account of the passiveness entailed in such a role. Similarly, Strengers (2011) call for a stronger focus towards how to co-manage practices instead of just targeting how to manage resources that are to be consumed. The other persona of Goulden et al. (ibid) which was the energy citizen, is in line with Strengers' (2011) call – a persona interested in adjusting their household energy practices for instance in relation to managing local microgeneration, rather than just being a passive consumer. Based on this Goulden et al. (ibid) has made the point that in order for behavior change to occur, smart grid developments should be decentralised and co-managed with consumers as opposed to the "prices to devices" scenario mentioned earlier (Chassin, 2010) which conserves the role of the passive energy consumers. However, the welcome concreteness of these perspectives aside, they overlook an even more fundamental interpretation of what it could mean to be an energy citizen. In the following section we lay out a broader picture of what energy citizenship may entail; albeit one which by no means is mutually exclusive to the suggestions above. It is a picture that to a larger extent takes into account how smart meters may also afford political engagement in everyday practices and seen as a way to materialise public participation.

Theorising public participation - the smart meter as green political material engagement

The smart meter device itself is made to serve as a bridge between the global and abstract problems of climate change and the new green economy on the one hand, and everyday energy consumption practices of the household on the other. The smart grid arguably needs to be interpreted in the light of the climate change issue, which for about two decades has served as a frame by which political leadership has worked towards "greening up the economy." In this way smart grid technologies can be seen as contributing usefully to a "green" *material enactment* of the new political economic regime. In this regime energy efficiency measures and carbon emission reduction are intrinsic goals, and they are incentivised and catered for as such. The introduction of the smart meter can be understood as a technical response by way of governance which can support the enactments by citizens of such goals. The aim is to create some level of environmental or green economic engagement for households, making inhabitants able to join in by material enactment. Thus it could be argued that household practices, once viewed strictly by society as belonging to the private sphere, are being re-introduced by the new green political economic regime in such a manner that

they are granted influence on matters of public concern, i.e. "the climate." When household consumption of energy becomes a public concern, objects such as smart meters could be viewed as a way of locating a certain green political engagement in everyday practices and thus to *materialise* public participation in such concerns (Marres 2011). Such an object-oriented perspective provides "a way of attending to the variability of enactments of engagement afforded by everyday material devices – as something that is crucial to the politics of participation these technologies enable" (Marres 2011:527).

Marres (2010) has been looking at how the local authorities in the UK and Netherlands have been campaigning for a change in people's affectedness concerning such everyday objects as mobile phone chargers and energy saving light bulbs. Voiced within the frame of saving the planet from dangerous climate changes, small changes in practices related to these everyday technological objects have been encouraged by public messages from for instance the Mayor of London. Arguably, pulling the charger from the socket when it's not in use will not go a long way to save the planet as such. But the efforts of the authorities claim their purpose by exploiting the existence of already readily available artifacts and recasting them as relevant actors within the global climate issue. As such they could contribute incrementally to building awareness, knowledge and understanding of the larger issue: "These campaigns thus attribute special affordances to domestic technologies in terms of their ability to help bridge the divide between people 'in here,' in the home, and issues 'out there.'" (Marres 2010:179). This takes us one step further than the classic deficit model (see Wilhite & Ling 1995), where information and awareness input results in behavioral change. It also includes material objects with which a green (political) performativity can be enacted by people in the everyday setting[1]. Marres holds that this proves it possible to conceptualise a form of a *material public*, a public that is enacted by citizens and non-humans engaging in such specific political economic performances[2].

The smart meter regarded as a means to influence new political economic involvement of the citizen, can be understood in "traditional," foucauldian terms as an apparatus of security (Burchell et al. 1991). In this way trying to understand the smart meter turns into an effort of unmasking the political intentions inherent in the new technology, as it works under the surface to perform material politics (Marres 2010:185, see also Winner 1980, Latour 1992, Akrich 1992). Post-foucauldian perspectives on heterogeneous assemblages of humans and non-humans underline the important fact of such material politics, or subpolitics, that they be clandestine by nature. This means that the effectiveness of the politics they perform depends on their capacity to do it unnoticed. This has led to a realisation that material politics could pose some democratic problems, since if the public is unable to notice that politics is in fact going on, they will not be able to intervene should they wish to. A way of remedying such an undemocratic state of affairs would be to lift the material artefact into a discursive state. But according to post-foucauldian perspectives of heterogeneous assemblages

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[1] But in the strictest sense, perhaps we must include Wilhite & Ling's informative bill in such a framework as well?

[2] Crucially, this is only possible if a different understanding of the classic private/public duality is laid to ground, as the republican version regards the enactment of a public strictly removed, and indeed inhibited by, the material entanglements of the private sphere. Marres (2010:191, following Latour, 1994) borrows from John Dewey's pragmatism to materially meander across this classic divide, to where we can in fact consider publics as also material, in the way that every-day material enactments enters into public co-articulation.

this would undermine its political effectiveness. How do we retain the political performativeness as well as the overt character of material publics?

Marres advocates looking at material publics as a performative process as well as a discursive one, which doesn't necessarily demand that publicity be absent or the materiality clandestine. This makes for an approach that combines the old idea of the "informed citizen" basing opinion and decisions upon knowledge, with a citizen that also engages in specific material performances, specific normative practices. The duality between deliberative and informational conceptions of citizenship may be partially transcended, as they for instance share the facet of "knowledge" as important to the processes (Marres, 2012:159). To put it bluntly, citizens are held to be able to express their material engagements discursively at the same time as being deliberately materially engaged.

Method

The data was collected by focus group interviews undertaken with two groups of informants, both groups twice, early spring of 2014[3]. The informants were provided us by the Demo Steinkjer, a smart grid pilot located about 120 km north of Trondheim. Created in 2011 and headed by Nord-Trøndelag Energy it has enrolled around 1000 customers with smart meters, most of them households, 300 of which have voluntarily enrolled as "research households." We invited our informants from this pool of research households, and received a turnout of 13 respondents. The ages of the respondents varied from early forties to late seventies, and out of the entire group two were women. We have distinguished between age and sex in the material by giving older individuals (60 plus) the letter O, and the younger ones the letter Y, when citing them. In addition, each letter is combined with a number in order to keep informants apart, of which even numbers were designated to the men and odds to the women. Thus, "O3" designates a woman over the age of sixty. The interviews were conducted on two separate occasions for each group, providing us with four two hour long sessions of smart grid inquiries. The informants had been living with a smart meter for about a year at the time of the focus groups, but very little added value in the form of smart technologies to utilise smart meter information had yet been implemented in the households by the utility. Customers had a web site for accessing own consumption data, but this was not taken into consideration as very few informants had accessed it. This posed some problems for talking about every day smart grid enactments, and our attempts at solving those issues of method are detailed in the following.

The interviews were modeled such that the first session introduced the consumers to different scenarios and pricing models. The pricing models each had two variations. The first basic model was a real time pricing model, where the customer would pay the real time cost of energy at the time of consumption. This basic model had two variants. The first variant offered a volatile pricing scheme, where prices would vary every hour according to market supply/demand, and so would be able to change without much warning, *but* the hourly rates would be published the day before. In addition, a warning mechanism would be available to warn of eventual extreme shifts in price. The second variant of the first basic model offered a hypothetical model of fixed variation in prices, and the example provided was 0,40 kr/kWh in the mornings and evenings, 0,25 in daytime and 0,10 in evening/night time[4]. Information about the current price regime would in this scheme be indicated at all times by some unspecified provision. In both examples meter data for own consumption and

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[3] This data was collected in helpful collaboration with senior scientist Erica Löfström at SINTEF Building and Infrastructure, Trondheim, Norway.

[4] 0,10 kroner at the time of writing is about 0,013 €.

cost would be provided, again by some provision. The main difference in this model, and the insinuated topic for discussion, is of course articulations of the active vs. the passive consumer.

The other price model, aiming at exploring articulations of another possible smart meter enactment, was a power subscription model, where the customer is charged for a fixed power limit delivered to the household. Exceeding the power threshold causes an over-consumption fee to start "counting" cumulatively those kWh consumed while above the threshold, and adding them to the bill at a fixed unit price[5]. The two models here were somewhat similar as they both had a fixed price of 2375 kr plus 650 kr/kW per year[6]. The first model had a cheaper fixed price of 7 kr/kWh, but the "catch" for this was that the customer would need to allow the utility to remotely shut down appliances when "need be." The other alternative had a more expensive fixed price, but the only intervention from the utility was a simple request to shut down some appliances.

In the second session the goal was to widen the scope and attempt to "jolt" informants into thinking differently about their efforts to change energy consumption practices, something which because of ever available, abundant and cheap electricity is hard for Norwegians to do. The scenarios created for this second session explored hypothetical (but realistic) examples of the types of information users could be expected to engage with via smart meter technologies in the near future, i.e. the *content* of interaction. In order to facilitate a certain degree of open-mindedness, the models were purposefully left open-ended as to exactly *how* such information would eventually be obtained or how any consequent interaction should take place. Suffice it to say, the information discussed and which served as the "stimulus" of our hypothetical smart grid enactment was relevant to household energy consumption and its connection to more global aspects of for instance environmental issues.

The session problematized the access of energy by relating it to some recent crises that has taken place in Scandinavia, among them recent weather storms which brought down infrastructure causing disrupted services, and also the catastrophic fire in the Norwegian town of Lærdal this winter[7]. To set the mood, related images and news clippings were displayed by projector. The session also focused on the possibility of providing customers with other information than just the cost of energy, testing the viability of appealing to something other than the economic incentive. For instance, the session sought to explore consumer interest in linking consumption data to other "values" like the environment, or in fact the dependability of the grid and security of supply for society. Concrete messages related to this were incorporated in message mock-ups displayed with a projector, in the hypothetical event that the utility would contact users in case some opportunity to save either carbon emissions or provide aid in relieving a congested grid presented itself. For instance, one mock up provided a message asking "Right now it is necessary to reduce load in your area to ensure safe service in other parts of the country. We kindly ask you to switch off one appliance for a short while. What would you like to switch off?", and underneath a drop down menu with options like "freezer,"

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[5] A power threshold means that there is a limit to the number of appliances that can be used simultaneously. If the threshold is reached, appliances need to be shut down if you want to put others on. It basically encourages people to turn off power hungry service like space heating just when they are cooking, for instance, Christmas dinner.

[6] A common dwelling in Norway usually needs a limit of about 5 kW, which would mean this part of the tariff would cost 650 kr times 5.

[7] Not to mention all the homes the fire destroyed, the resulting damage more specifically brought down the main power line to the town while the temperatures crawled down towards -10 'C. If a disaster won't change practices, what will?

"water heater," or "out-door lighting." Another hypothetical appeal from the utility would propose a concrete opportunity for customer to alleviate the grid in order to avoid the necessity otherwise of the utility switching over to some fossil fuel resource in order to provide power. Other examples provided a concept of a limited number of free-cards to escape shutting down appliances, and simple warnings of price hikes in the near future related to for instance security of service.

To summarise, providing the focus groups with these scenarios was considered useful, because of the necessary specificity of the discussions we were aiming for, combined with most informants lack of actual every day experience with smart meters. Granted, our informants were volunteer participants in a demo project that has spent some time informing them of what they are enrolled in, and which has even held town meetings to explain the purpose of smart grids and the goals of the demo project. However, even though of course some informants were quite tech savvy and knowledgeable, this did not describe every one. Many joined the project out of the general idea that when the local utility calls on their aid in doing some "ground breaking research" then they join out of sheer community loyalty, and their opinions were freely given to us as a matter of course. The local utility is after all owned by and providing annual revenue directly to the county government, as well as being the employer of family and friends and a natural supporter of local kids' soccer teams (Steinkjer is a small community).

Articulations of material enactments with smart meters

In the next sections we analyse different articulations of smart grid enactment by our respondents, as we look closer at how the different modes of materializing participation outlined above could enable a wider politics of re-distribution within the green political economy and the consequent need to problematise the social redistribution of the work, costs and effects of environmental change. Materialisation is the result of an operation afforded by the device that de- and re-composes everyday material action and which codes this action in particular terms. As mentioned it was evident that the users are quite well informed about the smart meters and talk about it extensively in the context of everyday life, but also in energy political terms and in relation to the greater socioeconomic benefit of implementing new and expensive metering infrastructure nationwide. We found both enthusiastic and more pragmatic articulations toward smart metering, as well as prevailing skepticism. Even though some were wholly skeptical this *negative* articulation was to a certain extent shared with almost every one, as always underlying the topic of smart metering.

Negative articulations from the general to the specific

Often we returned to the question of "why one should be engaged with smart maters?" and informants were concerned about the cost/benefit for society in general. This included considerable skepticism concerning statements from network owners and authorities that "consumer will save money" and "new meters are socioeconomically beneficial." Some even claimed it was the technology itself that was the main driver behind smart meter implementation:

I can tell you one thing, which may be the driver behind this – and we people who are in this smart grid project notice this – it is the technology itself which is the driver of this. There is a great interest, there is a great industry, great undertaking, that is now working very hard to get on to the market, and we're talking about interests in relation with and related to new technology. So it's clear, we can't disregard the possibility that technology itself is part of the driving force, to get it on the market. (O2)

Some were of the opinion that smart meters wouldn't pay off for consumers at all, and that expectations about user involvement are too high. Many were concerned the ones really benefiting would be the network owners, rather than the consumers.

Yes well, I'm highly uncertain, as to what the effect of all these different technologies will be, and how we are going to get people to act in such a manner that we will gain the socioeconomic benefit goals with the smart grid. [… socioeconomic goals] are *important*, but I feel it's *unclear.* […] I'm feeling in a way that the network company is arguing in a way that says the benefit will befall the household, but what you save by doing what they say is a couple of hundred [kroner], and the large benefit goes to the network company. (Y2)

These concerns are related mostly to overarching, societal issues, but a large part of the skepticism articulated specifically aspects of everyday life in the household as related to "global" issues, such as environmental and equitability. A pervasive articulation was informed by the idea that customers don't care about price incentives because they are too well off, a legitimate concern in Norway also because the hydro power is cheap and abundant. Because of that informants were of the opinion we need to think differently. However, this does not mean concern for the environment. Several of the informants denied that their energy consumption harmed the environment, or that it would matter much if they went ahead and conserved energy. In this regard they were far more likely to point out larger actors as the real sinners, such as industry, shopping malls and the transport infrastructure, and the responsibility was concordantly forwarded to them. Informants were also undecided if it made sense at all to talk about the climate if all one does with the smart meter is to move consumption around, as opposed to actually reducing it. On the basis of such thinking, some suspected that smart metering had little to do with the environment despite the messages from network companies and authorities implying it, but indeed all to do with the availability of power in any given moment (which in the strictest analysis is quite correct). It was thought to be more, or at least, as socioeconomically beneficial to invest in measures that actually reduced consumption. The overall conclusion of such negative articulations was "I'll have my coffee when I bloody well feel like it!"

We had a meeting at the start of this with the demo group, and then it was in fact almost like some kind of hysteria, I'd call it, about that environmental thinking. You have to get up at five in the morning to make coffee in order to not strain the busiest hour [of the grid]. And you had to do other stuff at times which would be completely unreasonable. That is, the power works would turn up-side down on our entire weekday. Then I threw a fit, I did not accept it. […we] have a mobile which charges a bit, we make coffee, and it's *not* something which we can just *whoosh* reduce, maybe it's displacement eventually, and then the question is, are we willing to displace our *lives* because of what you're talking about, when we're so well off as we are? We've soon got money enough, all of us, to pay for whatever! (O4)

Another negative articulation was voiced with regard to the elderly, who because of a conceived lack of knowledge and interest in technology were considered unable to reap the benefits a smart energy system might provide. Here an articulation of the smart grid as *structurally* unfair is brought to the fore:

But when you discover that people need help to withdraw cash down town, are they supposed to keep track of something like that? Just to get the cheapest possible electricity? […] it's almost as if you'd expect them to choose a fixed price so they wouldn't have to avoid having anything to do with it, and then their trapped if something goes wrong, if the prices go up. (O6)

Older participants themselves also stated that they were quite happy with their life and rhythm as was, and that they weren't interested in changing it around as much at this point in time – an attitude that could possibly be related to a solid economy and the feeling of having "earned it." This informant expressed reluctance on behalf of himself and his wife, also present, to the thought of changing up the daily routine, perhaps joining in on the articulation of this particular anti-sentiment:

Is this more interesting for younger consumers? In fact? You know, we belong to a bit older group of consumers, and we think the rhythm we have, it's not so bad. […] I agree with O4 that we have enough to get by, and we think it's a good rhythm the one we have, of the day. So all this about tossing everything about and doing them differently, we don't think it sounds very tempting either. (O1)

Time and place was also an issue for other participants, who were worried that certain types of work might inhibit some to interact as well with smart meters as others, for instance practical work that didn't afford their employees regular access to computers, smart phones and Internet. This negative articulation then does not just entail disinterest or lack of knowledge, but also that some already given socio-technical material arrangements are perceived not to facilitate interaction with the smart meter. We see how co-articulation of smart meter enactment still brings into light many ways in which environmental engagement in not quite doable in practice, and all this skepticism adds up to a thoroughly negative co-articulation. Consumers think they lack both means and motivation to relate to smart meters, both economically (by incentives) and environmentally, but more interesting is perhaps the fact that some argue they lack even the *opportunity* to interact and relate to market incentives, both in form of technology and competence pointing out the social injustice inscribed in smart meters. This results in the suspicion that smart meters won't give everyone the same opportunity to partake as this ideal consumer that exploits fully the potential of the smart grid as it's described. Participants perceive attempts to shift electricity consumption of the households with smart grid technologies as fraught with articulations of material, social, technical and economic constrains and the inter-dependencies that constitute everyday life, and they receive the message from government and utilities with a big pinch of salt. This goes to show that a very negative, even somewhat subversive co-articulation of the smart grid is easily mobilised by our informants.

Articulations of pragmatism and "Resource Man"
We also found traces of pragmatic articulations of enactment of smart grid technologies. Pragmatic voices articulated the enactment of smart metering as a practice in collecting low hanging fruit, and the idea is that it's possible to gain some good benefits compared to relatively low effort, especially when dealing with thermal systems like water and space heating. The logic of it says that the price variation can be expected to follow a pattern which is relatively coherent from day to day, and hence would be unproblematic for consumers to relate to.

But, there will be a pattern, within each day, for when the power is expensive and when it's cheap, so you could say "ok, I'll turn off the water heater between seven and ten in the morning, and I can do that every day. […] So in a way there is- within each day it's interesting, really, and it's a predictable pattern, probably. (Y2)

This pragmatic line of reasoning says that it's feasible to reap most of the benefits when paying attention to very few of the domestic energy services, which in turn may be easily manageable with some simple technologies. This standpoint represents the "articulation of automation," in which the change enacted really isn't perceived as that big a change. It's more like a one-time effort, and then one can lean back and reap enough benefits to enjoy a healthy conscience.

So on *one* hand you can count what maybe uses seventy percent of the power. So if you've got a system here that you disconnect some of these in those priciest hours, when the greatest problems in the grid appear, then you've come a long way to solve some of these challenges. (Y2)

Taking it some steps further are of course the technology savvy ones, who are in possession of more knowledge and competences than the average. Here, as one might expect, a fair amount of enthusiasm may be traced. This of course represents "articulations of automation." Interestingly, this articulation holds that the closer the relationship is between supply and demand the better, and is this wholly supporting such market flexibility lingo so often found at the point of smart grid initiatives. This is because when market volatility, which this articulation is very fond of, is coupled with great interest, knowledge and technical aid, the consumption patterns in the domicile may be optimised. Hence the most feasible scenario for an enthusiast is one in which the pricing regime is the most volatile, since these are the ones in which the most benefit can be gained.

I think this model [the most volatile] is perfect for me, because I can attune the rhythm of the house based on it, with turning on and off the heat pump for instance, in those periods where it's expensive, and these are things you have to, it should be, we should after a while get technology with which we can manage it with the phone then, or the computer. And input it- when the prices are known the day before, then you've input a price level where it shuts down automatically, that's how I think it'll be, like I *hope.* But I don't really see those in the other end of the scale care to carry on that way. (Y4)

Apart from interest in and knowledge about technical solutions that could be helpful for collecting information and then acting on it, these Resource Men (Strengers 2013) articulate enactments of managing and saving resources as motivating by themselves. Conserving energy and optimising the systems under ones command turns into its own project.

How little energy cost can I get this household to run on? It can trigger looking at possibilities because it's clear that any household has possibilities to save energy, if you're creative. And saving energy is saving money. And if you take into account when in the day you use energy, it really turns interesting, right, for *me* at least. It makes you *even more* creative in ways to wring your consumption down. (Y6)

The above outlines at least three different but clearly articulated enactments of smart meter materiality. This is an indication that the experts' articulation of smart meter enactments by disinterested users, unknowing and unresponsive to the price signal might be somewhat unfounded. The lack of enactment based on price signal might sometimes be true, but the presence of users here as material public is clear nonetheless. Thus, in line with others we claim that eventual user disengagement is not a problem of "failure of literacy." There are a multitude of sentiments, different types of arguments, and a single informant was often the holder of several, making users both sceptics about the overall socioeconomic benefit for instance, as well as enthusiastic about the potential at home to save energy. The complex co-articulations of smart metering enactments goes to show that there is in fact a highly developed discursive relationship between consumers and the smart meter, and that there is potential for its mobilisation in the form of material public in the event of controversy. Explanations of disengaged users of smart grids must be searched for elsewhere.

Articulations of a "Political Man"

As we've seen in the above, consumers articulate enactments of energy consumption and smart metering that extends far beyond their own everyday context. Informants were readily able to raise the question of individual, household consumption to the macro level, in order to hypothetically

regard it as a social responsibility. In this respect, economic incentives "of the wallet" were negatively articulated. This informant insinuates that in order for interest not to wane over time, one has to add a bigger picture:

[…] you *do* conserve and you *pay* attention to it and it *could* be interesting but one has do ask oneself, how long can you keep up the interest? So maybe you are on board the first six months, maybe the first year, but then it wanes off. And is this just about me or is it an overall issue, that if one does, it and pays attention to it, well then it's *societally* interesting, to reduce the energy consumption in this nation. So that is one way of looking at it, to feel about it. (O8)

This social responsibility invokes enactments of idealism for some, which makes them think even outside the nation's border. For instance, it is an expressed desire to consume the resources at ones disposal in the "wisest" way possible, as a question of social equity and avoiding overconsumption:

[We] want to behave smart, that is to say as comfortable as possible on a consumption level of energy that is as wise as possible, that is the personal motivation, right? […] because there are quite a lot of people on the planet that want to live as comfortable as us, and have the same access to energy that we do. And then it's a challenge to get enough energy to everybody, to say the least. So that's one thing, I think that is one motivation to not squander unnecessary with what you've got – even if you could afford it. (O3)

The material gives a few indications about where such articulations come from: Many think it's "fun" to save energy, it's fun to "see the power" (O8), and that this is founded on the fact that some have a "more competitive mindset than others" (O3), that "you grew up during the war" (O10), or as another said "a fundamental pious attitude" (O12).

Such discussions led to talk about energy policy. We created and presented to the informants a hypothetical scenario in which we presumed that energy would not be as available as it is today, one in which the grid in some state of emergency would be vulnerable for a time.

How would the informants conceptualise their own consumption in the light of an emergency situation? Many were in agreement that this would be unfathomable in Norway, but not inconceivable when put in context of some kind of crises. We utilised for this context the rececnt occurrence of several severe storms on the west coast of Norway, and one catastrophic fire from the near past which made big headlines and resulted in rather extensive power outages for some rural areas. One of them pointed out that such a situation, should it demand an active consumer to contribute alleviation by non-consumption, would reveal an entirely different problem of a more fundamental nature:

[…] we've been told "you can do as you wish, because we'll deliver what you need". At the same time there are voices saying "no, now you're using too much" and it's always about the *wallet*. Sort of, now we're quarreling about the "energy in Norway is too cheap, it needs to be more expensive, because then we'll use less." What I'm concerned about is that we maybe make a society in which we can all be team players. This means that the power company needs to give us information that stands in relation to the actual state of affairs. (O2)

This resentment for the wallet argument quite clearly stemmed from a rising indignation about – or a counter reaction to – the long reign of market logic in the realm of private energy consumption (see for instance Karlstrøm 2012). The environmental argument is perceived as thin, and the price incentives as insufficient. On the other hand, the idea of conservation is agreeable, as long as the admonitions are honest and truthful, arise from situations that really demand it, and a certain

relation with this situation is actually forwarded to the consumer. Our informant here calls for entirely different measures for inciting smart grid enactments:

Well, how is the situation, how is the capacity? How *is* the production doing? How *is* the load on the main distribution, on primary and tertiary- and secondary distribution, for instance […] It's clear if you made it known to most people, I think they would be interested in kind of "wow, well [those grid conditions are] a bit ugly, maybe I need to turn off that heat pump just now, and maybe light the fireplace instead?" Because that won't cost us anything. And it's not the wallet that they would in a way be appealing to. (ibid)

This articulation voices a call for an honest approach within the smart grid discourse, where of course much of the message is related to green political economy aspects such as the "climate challenge." However, the smart meter is suspected of being more dedicated to reducing the citizen to a customer, instead of inviting knowledgeable citizens into the common project of the energy system which the top-down message in fact has invoked. In spite of his high level of competency this consumer feels himself disregarded and adjudged incompetent as citizen. Furthermore, the wallet argument is deemed "un-solidary", because it favors privileged consumers that are insulated against most price incentives on account of their relatively larger wallet size:

Now you know, when there is energy scarcity, we turn up the *prices,* so the old lady up in the valley she can't afford keeping up the heat when it gets cold. It's like, it's only those with spending muscles who can afford it. […] That is to say, it's not that it's the price *all the time* that's the regulating factor, because we *aren't* getting involved enough in this society. That's not just in relation to energy, it's in a lot of areas. It's the *professional* world taking over. And what we hear is, *we* will take care of you, sort of, and *you* can't take care of yourself, in many, many situations. "We'll take care you," kind of. "Now don't do that, because that's *dangerous*." And that's why I think it would be a good idea to maybe go with a more extroverted attitude, and inform about how the state of affairs are. (ibid)

This suggests that a sense of being misled on part of the consumer may be the smart grids real Achilles' heel. If several decades in which neo-liberal market logic has acted as the guiding principal in our thinking about energy have ended up giving the consumers the feeling of being made incapacitated, it is understandable that they react with skepticism when network owners approach them now, hat in hand so to speak, asking kindly for their "active participation". The informant seems to suggest a lacking sense of civic participation on part of the consumers. But not everyone was tempted by the idea of a greater individual responsibility for the nation's power grid:

Well, I'm sitting here thinking that I can't see us communicating with the network owner in this way, and that maybe if there's a national crisis, we'll see this. Other eventual problems with the grid need to be solved differently. […] I feel that playing on mechanisms like these […] well, you want the society to work, you want these- that is, the grid is a part of the infrastructure, and if you feel like the grid will collapse if I don't turn off then you create a kind of, uh, I'm sitting here feeling that this is *not* how it's going to be. (Y2)

This is probably a good point too; a situation in which our discontinued consumption will result in a collapse in the grid is clearly untenable. Indeed, it serves to show the difference between articulated enactments of an emergency situation versus a situation characterised by a continuous and responsible development of infrastructure. The latter is articulated as a governmental responsibility by the above informant, but such a simple articulation might not be good enough for some. Our example of an emergency situation in which some amount of social responsibility of the users might be invoked at least served to invoke some articulations of a material public, given that some conditions of interaction and communication was present.

Well if there is an acute situation like that time when that transformer suffered a breakdown down there, then people see that "wow, this is a crisis situation we need to do something" and pack in the freezer in a blanket and turn off the power, in order to lower the load in the area. Because people will do that voluntarily. […] it's back to what I said about my concern for society, that is to say the formal, professional part of society which involves the individual citizen a bit more. […] but to just be a means for the producers to maximise profits, well it's probably clear you won't get the same commitment. (O2)

The message heard by the consumers invokes public commitment on part of the green political economy, in which every little effort made by citizens armed with the latest in feedback technology will incrementally proceed to lowering energy consumption, reducing co2 footprints, and saving money. The suspicions voiced by some of the informants led to strong negative articulations about smart meter enactment practices, and it was subversively discredited as a tool to save money for the utilities. Some of these articulations were completely negative, but in this last section we have seen that they could also contain constructive elements. It also shows that there is not always something to be gained by smart grid proponents in invoking for instance the climate issue. If smart grid programs are not really interested in that aspect – this could very quickly lead to subversive co-articulations of smart metering in general, probably diminishing its effect in household contexts. But in parallel with this, our data shows that there could be much to gain in the way of transparency, and eliciting consistency of preaches and practice, effectively minimising the space within which negative articulations can thrive.

Discussion

Smart grid research often showcases two different and particular co-articulations of how smart grid participation may materialise in the household. The type of user participation which is perhaps most highly desired from the perspective of the experts is what we call "articulations of activation," where more of the flexibility outtake is allocated with the end users of electricity themselves. In this mode of articulation the installation of the smart meter will translate into a range of social, material and technical transformations and effects. Users will produce such effects by enthusiastically procuring, interacting with and responding to the smart meter and its complementary technologies, and actively shift consumption and practices such as cooking and washing to other hours of the day with less demand and more to gain. Importantly, this user is capable and competent enough to procure the enabling technology required to fully exploit the smart meter capabilities, and is willing to incur the cost of purchasing such tools to the household economy. In fact, this user enjoys all of this very much (resembling the resource man of Strengers 2013), and his enthusiasm is clearly present in our findings as well.

These enthusiasts are nonetheless a marginal entity. Engagement with smart meters is also conceived by some experts as minimal, and the participation mostly delegated to the technology or device itself. In such "articulations of automation" the technology will optimise the smartness of the house according to the principle of low-hanging fruit. For example, freezers or water heaters could be automatically controlled in periods of shortage, as long as it does not interfere with the activities of the house. This specific mode of participation resembles Marres' "involvement made easy" where environmental participation through material practices aims at the minimisation of effort, costs and disruption (see also "prices to devices" of Chassin 2010, and also "set and forget" of Harper-Slabopszewick et al. 2012). This mode seeks to enact the "change of no change" where the practices in the home can continue in the same way as before and there is "no change in the state of things,

settings or stuff involved." We find this kind of setup clearly articulated by the pragmatic statements in our data.

We would argue that both these modes of articulations frame public engagement with the green political economy in terms of material enactment of it through the smart meter, and that this in each way invokes material publics. We also found heavy traces of skepticism in our data, and it is possible that skeptic articulations will manifest anti-programs (Latour 1990) which will resist any invitations of engagements on part of smart grid technology. However, we argue that in the light of our current framework, we need to also acknowledge such anti-programs of dis-engagement as fundamentally political in nature, and not results of ignorance on part of the user. Finally, we argue there is yet another mode of articulation at work here, which compared to the pragmatic and enthusiastic articulations with their bottom-up perspective of everyday material entanglements, takes a much more metaphysical stand. It is articulated by a kind of "Political Man," who has wholly accepted the premise of the green political economy which re-locates his energy consumption into the public domain, but is disgruntled by what he sees as a lack in modern society of real possibilities of engagements as citizen. His contribution is critical *and* constructive, making it a particularly relevant articulation of smart meter enactments, and an indication that serious material publics are in fact invoked by smart meters.

This suggests that there are strong seeds of possible material publics present in co-articulations of smart meter enactments among our early users. Hence we were able to identify many different articulations of smart grid engagement, which all give insight into what may constitute eventual inputs to a political discourse of smart grid enactment. Our analysis shows that some people are open to being constructed as material publics. Many of the arguments of a possible user-public in relation to the smart grid evidently exist already in the population, ready to be mobilised in the face of controversy. Claims that users won't engage with smart grid on any meaningful level may therefore be misplaced. In fact informants widely recognise the political role of this particular artefact, and are expecting stakeholders and authorities to recognise their recognition of this. They clearly conceive of the smart grid technology as a technology with moral and politics, and they expect the issue to be treated accordingly by authorities and market actors. We believe this implies that various negative articulations are already poised and ready to be used, and any attempts to sub-politicise the role of smart meter (for instance by automation) is likely going to cause resistance by skeptical consumers and consequently hamper the implementation process. This has also been the case in several sites and countries where smart grids have been implemented with little or no regard to consumers (see, Darby 2010 about how the smart grid has been operationalised in different contexts). The various articulations clearly show that consumers are aware of the possible sub-political nature of smart grids, and that some are just waiting for an excuse to mobilise this knowledge into articulations of non-compliance. If experts working on implementing the smart grid on the other hand engage with the households and enter into a normative constructive dialogue about the role of their consumption and how to relate to it through the smart metering, the response will likely be more positive, as our evidence shows a strong presence of both pragmatic and enthusiastic sentiments among many consumers. Consequently, the potential for the creation of an *object oriented public* among smart meter users may be a way to allow positive articulations to take hold, rather than negative ones (for one such effort, see Burchell, Rettie & Roberts 2014).

Finally, our paper shows that the materialisation of this particular artefact helps generate critical analysis as part of the project of developing the smart grid itself. By engaging the households in the project, "hidden costs" of the smart grid are brought into the limelight and thereby problematised. Further development and implementation of the smart grid cannot expect easy engagement, and our results hint at various reasons why individual attempts at energy reduction are likely to become more costly in practice than anticipated. Similarly, Marres' (2011) analysis reveals that issues will be more constrained in terms of their geographic location, financial situation and access to information and services. We also notice that engaging the early users in discussions around their role in the smart grid have a performative effect: that of publicly raising the question of the wide societal distribution of the "costs" of developing and participating in the smart grid development and calls for more discussions on of the politics of redistribution related to energy and climate action that goes beyond the household, and that seldom is a part of the public discourse. In this way, we might conclude that the smart grid and the smart meter holds certain promises as a technology of participation in that it is an engaging device and a vehicle of democratisation at least in a discursive form.

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