

From consumer to prosumer. Enrolling users into a Norwegian PV pilot

Dr. William Throndsen

Department of Interdisciplinary studies of Culture
Norwegian University of Science and Technology (NTNU)
7491 Trondheim
Norway
william.throndsen@ntnu.no

Dr. Tomas Moe Skjølsvold

Department of Interdisciplinary studies of Culture
Norwegian University of Science and Technology (NTNU)
7491 Trondheim
Norway

Prof. Marianne Ryghaug

Department of Interdisciplinary studies of Culture
Norwegian University of Science and Technology (NTNU)
7491 Trondheim
Norway

Dr. Toke Haunstrup Christensen

Faculty of Engineering and Science
Danish Building Research Institute
Aalborg University
A.C Meyers vænge 15
2450 København SV
Denmark

Keywords

consumption dynamics, solar energy, prosumers, user behaviour, social practices

Abstract

Recent years have brought a shift in the discourse on the role of ordinary households in energy systems throughout Europe. A central aspect is a focus on prosumers; customers not only buying electricity, but producing and selling locally produced electricity back to the grid. This paper takes a closer look at the status of prosumers as they are enrolled into a solar PV pilot. The novelty of the paper is that it studies the process of enrolment from a user perspective. Through an analysis of around 1,700 applications by householders who want to become prosumers, we shed light on how these prospective users understand the role of the PV pilot as a sociotechnical project, as well as how they interpret their own future role with respect to this project. Thus, we explore both how technologies of prosumption are made sense of, and how prospective users try to attract the interest of the utility in order to be selected as pilot users in the project. We show how the applicants argue their case using the material qualities of the home, stress ownership or an interest in associated technologies such as electric vehicles, smart home technologies etc. Further, many frame participation in the PV pilot as being part of a broader life style project, where personal attributes such as education, occupation and environmental engagement are important. Our analysis indicates a high over representation of prospective participants with what we can call an engineer oriented habitus, where enthusiasm and interest in new technology serves as the main motivation for participation. This

highlights design challenges for future energy pilots, as well as more general challenges that needs to be handled if the goal is to engage broader segments of the population in this kind of energy transition activities.

Introduction

During the last century, the electricity systems has been relatively stable. The means of energy production have been in the hands of large centralized entities, transmitting electricity to consumers through centralized transmission grids. Many prophesize that this is now changing due to processes of digitalization and reduced prices on micro generation technologies such as photovoltaic solar cells (PV) and distributed energy storage (e.g. Ballo 2015, Oikkonen et al. 2016). This signals a potentially new technological era, but also potentially an era of new social, organizational and economic relations in the energy system. That ordinary householders morph into “prosumers” is a key component in this transformational story (e.g. Parag and Sovacool 2016). This paper studies how and why a sub-set of ordinary Norwegian householders works to become prosumers. We analyse around 1,700 application forms that prospective prosumers submitted to an energy provider in order to become part of a solar PV pilot. How do such prospective users argue to become part of the project? How do they see their own role in the project? What do they imagine to be the challenges and opportunities associated with such projects? In sum, we are interested in the ways that users imagine future socio-technical prosumer oriented futures, and the strategies they mobilize to become part of this future.

ASPECTS OF PROSUMPTION: CHANGING PRACTICE, COMMUNITY, NEW RELATIONS

“Prosumers” is a buzzword in the energy discourse, which has gained prominence in tandem with the German “energie-wende” (Gailing 2016). However, the idea is neither radical, nor very new. As Ellsworth-Krebs and Reid (2016) point out, microgeneration has been around for a long time, as an important strategy for many governments to bolster energy production. The term prosumer was coined by Alvin Toffler (1980) to cover instances where people would act as producers of their own goods. The classical example was the housewife, whose home-based production of a range of goods was severely undervalued. Prosumers could be found “making their own clothes, cooking their own food, rearing their own cars, and hanging their own wallpaper” (Kotler 1986, p 519), as opposed to acquiring such goods and services on the marketplace. In the digital era, the term has been frequently employed, for instance addressing consumption and production of digital content (Ritzer and Jurgenson 2010). Today we speak of prosumers in the energy system when energy users, with the aid of local production capacity such as solar panels or wind turbines, individually or collectively produce energy for their own use or for sale on the energy market through the local grid.

The energy variant of prosumerism is emerging together with the so-called smart grid, which is currently developed, tried and tested on a massive scale. Schemes to roll out smart metering infrastructure flourish, with different implications for different actors (e.g. Ryghaug and Skjølsvold 2015, Bertoldo et al. 2015, Nyborg and Røpke 2013). A key aspect of these trials are efforts to make energy users engage more actively with the system through feedback technologies (e.g. Hargreaves et al. 2013), new price tariffs (Friis and Christensen 2016), automated systems (Fell et al. 2015), often aimed at reducing or time shifting consumption (Friis and Christensen 2016). The element of electricity production adds another layer to the ideal of an engaged energy user. However, prosumers are still understudied in the socio-technical literature on energy. In the following, we will sketch how scholars have framed prosumers as characters that can reconfigure multiple aspects of the energy system from everyday practice to community aspects and new (market) relationships.

How can prosumerism change the role of ordinary energy users? Olkkonen et al. (2016) consider prosumers to differ from ordinary consumers in the sense that they are “individuals-as-stakeholders”. Their main means of engagement is through micro-production of energy, as owners or managers of local production capacity. The main drivers of prosumerism, they claim, are cheap solar panels, smart meter implementation and associated changes in behaviour and practices. When investigating the prosumer, they argue the importance of looking at the changing relationships between users and energy companies, which they claim are radically different for prosumers. One potential development is that prosumers come to see their own role and rationale in the energy system in a radically new way, for instance as a climate-political rather than an economic role. In other words, changing the role from consumer to prosumer might enable users to take on different kinds of responsibilities over their energy use. While this kind of ascribing of responsibility has been susceptible to critique (c.f. Throndsen 2016), it

has also shown to be of appeal to some users as it might create a new sense of societal responsibility (Throndsen and Ryghaug 2016, Bertoldo et al. 2015).

Other studies have shed light on how domestic production of electricity might enable new sensibilities and feelings of ownership that other “smart” energy technologies have yet to achieve. As an example, a recent study from Denmark (Christensen, Friis and Skjølsvold 2017) indicates that producing electricity incentivises some householders to shift certain aspects of their own consumption (typically laundry and dishwashing) to times when they expect solar conditions to be favourable. In such an example, the introduction of PV serves to re-configure and disrupt several established practices through links between new material elements (PV), new kinds of relevant knowledge (e.g. of the weather/solar conditions), and established ways of doing laundry and washing.

All of this suggests that “doing” prosumption is more than a single act, and that it is fruitful to consider it as a process or a practice. This is also stressed in a comprehensive review by Ellsworth-Krebs and Reid (2016), who underline the importance of including insights from studies of related practices, for instance that of co-provision (Chappells and Shove 2000, Van Vliet et al. 2005). In relation to the current study, it also appears central to look into how prosumerism feeds into or destabilizes existing everyday practices associated with energy such as washing/cleaning, cooking, mobility etc. Understanding which practices and which technologies lend themselves to bundling, and which practices and technologies that do not seem to fit together, might with time allow us to formulate more relevant policy and design recommendations.

The discussions above also hint at the importance of studying relationships between prosumers and broader institutional and societal structures, e.g. to probe how prosumption strengthens existing or create new power relations (Walker 2013, Welch 2015), or if it might lead to new kinds of inequalities or enable exploitative relations (Humphreys and Greyson 2008, Ritzer 2015). Related to this, one might ask whether or not users are actually getting a better deal from becoming prosumers, or if they are simply assigned more work and responsibility which might better belong to institutional actors.

However, prosumption does not necessarily lead to repressive power relations. Olkkonen et al. (2016) link prosumerism to ideas of grassroots community energy projects that focus on group action (Martiskainen 2016) or to ideas of energy citizenship that stress energy awareness and behaviour (Devine-Wright 2007). Wolsink (2012) and Goulden et al. (2014) have argued that since prosumers are energy producers that own their production capacity it is the personal ownership, which engages them as prosumers. Prosumers thus constitute an entirely new stakeholder in the energy system, since they are expected to behave differently than consumers. Even so, as Olkkonen et al. (2016) argue, most of the time they depend on the grid administered by a grid company. While this might change in time (see e.g. Parag and Sovacool 2016 for some hypothetical models) most prosumers cannot rely completely on their own production. For instance, a solar PV panel setup without any kind of storage will provide complete coverage of electricity only intermittently, creating a need for some other source like the conventional grid in other periods. Finally, prosumers need an infrastructure to sell excess energy. Thus, another way of

considering the relationship between the energy company and prosumer is by that of the symbiosis, which Bremdal (2011) has argued is an apt characterization when both are engaged in co-production and value creation.

However, the symbiosis is not necessarily interpreted as such by all parties. Olkkonen et al. (2016) found in their study of prosumers that the stance of the energy company was mostly reactive. Users were impatient and their impatience was felt at the energy company. In this case it was because the energy companies were slow to react to a move which mainly came from energy and technology conscious customers. The study also showed the relationship with prosumers was issue centric, rather than based on the old ways of organization centricism, adding to the role of prosumer a citizenship resulting in a hybrid consumer-producer-citizen. This might imply the citizenship is not what makes a prosumer, but that prosumers can become a certain kind of citizen. But for prosumers to be enabled, they must be acknowledged as co-producers. According to Olkkonen (2016) this interplay can be considered a kind of community action, as long as it drives technological development in part on the terms of the customer.

Theoretical perspectives: Imagination, domestication, translation

Within the field of Science and Technology Studies (STS) there is a long tradition of studying technology-user relations, e.g. by looking at how technology designers ascribe user rationalities through “scripting” (Akrich 1992). Many scholars also look at low carbon technology users through the lens of “social acceptance” (e.g. Wüstenhagen et al. 2007). These perspectives both ascribe key agency to the technology “production side”, while users are more passive: they are receivers of final scripts, or their role is to accept/reject defined solutions.

Arguably, our study is different. Rather than presenting another case of what Woolgar (1991) has described as ‘designers configuring users’, it constitutes a possible case of citizens configuring technology and design through a description of how they see themselves fit to be pilot project participants. Our study underscores the merit of looking at technology appropriation as domestication (e.g. Sørensen 1994), a process where users are not passive receivers of technologies, but actively shape what the technology is and what it could be. By analysing PV pilot project applications we get an idea of how the interested citizens preconceive a specific technological artefact, in this case the PV rig, and how it could create an artefact-user-incorporated actant that would to some degree satisfy what they perceive to be the technology design.

Thus, we see how householders work to connect ideas about the new technology and their own potential role as prosumers, as well as how they try to make this fit in existing socio-material configurations. In this way, our study analyses the self-construction of aspiring prosumers. This presents a rare occasion to study the formation of user identities before the user-technology relation is matter of fact, through looking at expectations concerning what it means to prosume, and about the future world in which prosumption practices are performed. This improves our understanding of prosumer recruitment processes, illustrating the role of collective visions in this process. Finally, it informs us on what the perceived

implications of this type of energy transition is from a bottom-up perspective.

When we study user’s future expectations, we draw inspiration from the sociology of expectations (Van Lente 1993; Brown and Michael 2003, Borup et al. 2006). This school highlights how expectations about the future feed into current action, influencing contemporary strategies. As an example, when technology users are imagined by technology developers, this tends to have implications for how they design technologies, as well as expectations for the technology’s performance. This perspective has implications for processes of technology domestication (Sørensen 1994). For instance, Skjølsvold (2014) highlighted how potential roles of technologies in particular collectives might be shaped long before the technological object exists. Through what he calls a process of “virtual domestication”, ideas about what technologies are, how they can be used, and what their key functions should be, might be established and gradually changed. Thus, the study of prospective PV pilot users is another example of how “virtual domestication” might look like. It illustrates perceived meanings of, competences associated with, and attributes ascribed to both a singular technology (rooftop PV), the role of a user (as prosumer) and the socio-technical collective this user-technology configuration is thought to be a part of (the PV pilot), as well as their broader societal context before they actually exist.

Given that only a few of the 1,700 applicants would be selected, it is pertinent to ask if the self-representations might work to establish interest for these customers as participants in the PV pilot. This kind of effort to interest someone else (‘interestment’) might be more or less strategic. In what follows we will also be interested in exploring if any respondents negotiated translations along the lines described by Callon (1986). Perhaps they try to establish instances of problematization and interestment – instances where common cause and the general interest of the pilot owner is attempted highlighted by the prospective user. What can these endeavours tell us about what today’s user imagine being a “good” prosumer entails? The following will delve into the findings which resulted from our analysis of the self-representations within the application forms which users submitted to the PV pilot.

Method and analysis

In June, 2016 local energy company Trønderenergi announced that they were about to launch a pilot project where the goal was to gather a group of ordinary households that were willing to install solar panels on their roof to produce their own electricity. The business model was based on the simple idea that the panels are rented from Trønderenergi. Participants pay a monthly premium of NOK 500 (roughly €45) for a solar panel rig which is estimated by Trønderenergi to produce about 4,000 kWh per year. Solar panels on Norwegian dwelling rooftops are a rare, but increasing phenomenon. According to the Norwegian Solar Energy Society, the total power delivered by grid connected PV in Norway is 13.6 MW, a small portion of the total capacity of 31.8 GW. The grid companies were as recent as 2017 obliged by the government to accept consumer produced energy into the grid, but there are few tariff schemes which yield more than spot price in return for domestic energy sold. Thus, the return on investment is still low. Norwegian so-

lar PV pilot projects like the one studied here, typically aims to understand how PV affects the grid, as well as how to deal with economic and regulatory issues. The studied pilot was the first of its kind in the region, and the announcement attracted significant local media attention. In addition to media coverage, the project was advertised at the website of Trønderenergi.

To recruit users for the pilot, the company established a website (<https://tronderenergi.no/sol>). This website contained a simple form that prospective users could fill out to indicate their interest to become part of the project. The form asked for information about name, address, e-mail and phone number. Further, it asked for information about three things. A) Type of roof (where one could choose: tiled roof, tin roof, roofing paper, shingle roof, shale roof, flat stone roof, sheet metal roofing or "other"). B) Approximate angle of the roof (options: flat, sloping 10–20 degrees, steep 30–40 degrees, other). C) The number of floors in your building (1, 2, 3 or other). Thus, the form provided basic information on the technical qualities and location of a prospective building to be included in the pilot, but beyond this, not much. The exception, that also provided the crux of this paper, was an open field where prospective users were asked to fill in "other information relevant for participation".

The company received what they have described as overwhelming response to the invitation. A total of 1,731 persons submitted an application. Out of these, only 10–15 persons would be selected for participation. The subsequent analysis is based on a qualitative and very basic quantitative analysis of the applications. The data consisting of the open answers filled out in the "other information relevant for participation"-box were first read manually to get an impression of their content. Following this, the statements were sorted in more refined categories. Thus, our approach was deductive rather than guided by clear hypotheses. The quantitative analysis was conducted using very simple frequency counts in excel. Not everyone wrote anything in the provided space; 1,158 wrote something, while about a third did not.

USING THE BOX TO ARGUE ONES' CASE

Many respondents used the open answers box to argue for why they should be selected as participants. Thus, the box was used to transfer or translate (Callon 1986) what was believed to be positive qualities associated with the applicants' household to the pilot operators. While doing so they often also revealed how the technology and associated technologies were made sense of in relation to other elements in the lives of the householders. The character of input differed greatly. The shortest submissions consisted of one or two positively charged words, e.g. "Pioneer" (no. 464), or "Very interested" (no. 648). Others gave relatively long statements. An example of the latter:

Hi! AND THANKS FOR A GREAT INITIATIVE! We had meetings back in 2012 with our electricity provider and Gtek (local PV supplier), ENOVA, Rambøll [a Norwegian contractor, auth. note] and our bank to design a plus house based on solar PV on the roof and solar collectors on the walls. We have done many energy efficiency measures, but ended up with a low energy "Funkis house" – with many solutions in energy savings and universal design. The house received energy technical advice and economic support

from ENOVA, and was finished in 2015. The house has a flat roof and a very sunny location. The PV can be installed facing south, or IF POSSIBLE – be installed to automatically turn with the sun, until it sets behind the mountains, as on larger PV installations. This place should have all it takes to be a success! I am therefore really looking forward to hear from you, to have a dialogue about possibilities and solutions (no. 1023).

In this example, the prospective prosumer established a relatively elaborate network of technical, social, natural and institutional elements that, in sum, is assumed to be favourable for participation in the pilot. Another example of a lengthy statement is the following:

Here is a brief solar CV from me. I have been following the solar scene both in terms of solar collectors and PV for 10 years. I have 20 years of PV experience from my vacation home. Have built my own MPPT charger-regulator to research the effect of separating voltage on panel and battery bank when charging. And the effects of shadowing parts of the panel. Have been in touch with Trønderenergi a few times over the last ten years to discuss becoming a "plus customer", and installing advanced metering early to become a plus customer. All this sounds exciting – I would like to know more about the project! (no. 291).

Beyond the fact that there were short and long statements, there were some patterns in what was highlighted as important. The diversity can both be read as different modes of virtual domestication (Skjølsvold 2014), highlighting how prospective users interpret what prosumerism is. The diversity might also be read as different strategic arguments meant to interest those reading the applications, more in line with Callon's (1986) notion of translation. The three most common elements highlighted were qualities of the households' roof, the sun conditions of the roof, or characteristics of the house as such (see Figure 1).

Many combined arguments about these three elements, or combined one of them with other elements. More than 500 applicants highlight what they considered positive traits of their own roof. Some typical examples are these: "15–20 m² garage roof, facing south. Not currently a customer of Trønderenergi, but will become if selected" (no. 5). "The conditions are great for this project since one side of the roof faces south" (no. 107). "The roof faces south with minimal shadow from trees" (no. 179). "On the top of a hill, so no shadow on the roof" (no. 271). "Big, flat roof. No buildings or vegetation shadowing" (no. 389).

In a similar way, close to 500 applicants highlighted the sun conditions of their property: "Good sun conditions" (no. 1088). "Great sun conditions during summer. Less so, in the winter" (no. 1060). "Sun conditions all-year round. No trees casting shadows. Have the opportunity to clean the panels" (no. 837). "Nothing blocking the sunlight, coming in from the south" (no. 742).

When it came to qualities of the house, many respondents highlighted the type or design of the house, the age of the house, or its size: "This is a new funkis house in bricks, facing south. Great for PV!" (no. 513). "We live in a passive house. Exciting to see how close to zero we can get :)" (no. 480). "It's the tallest building in the area. Great sun conditions" (no. 290). "The house was built in 2010" (no. 1,073).

The focus on roofs, sun and buildings is not surprising, but it highlights that the applicants envision a necessary network of elements around the solar panels, which are seen as needed to qualify as a prosumer. On the one hand, this is indicative of the ways that they make sense of PV rooftop panels in relation to other elements that are already present in their everyday lives. On the other hand, this sense making is used as advocacy of a kind of prosumer competence, as roofs, sun and buildings are mobilized as allies in the hope that the receiver of the message will be convinced. The use of positive qualifiers such as “great”, “perfect” or “exciting” in the descriptions are particularly revealing in this respect. Descriptions, it appears, seek to convince an imagined operator of a demonstration project about the benefits of including the particular site in question.

For many respondents, the relevant network of elements and qualities that the pilot project was interpreted in relation to extended far beyond the roof, sun or building. As an example, 110 persons highlighted the location of their own building as important. For some, the location was argued to correlate with favourable solar conditions. For others, however, location was highlighted as a favourable *social* condition. A PV pilot was interpreted not only as a testbed for new technical elements, but as a venue for communication or public engagement. Hence, locations were interpreted as attractive if they provided visibility, or other social-relational qualities that would add value to the pilot: “good exposure for the project at Tyholt. The building is one of the closest neighbours to the Tyholt Tower, so everybody will look down on the PV system” (no. 541). “I’M INTERESTED ☺ The house has a location which will make the project very visible. Can easily be seen from the passing trains, and from the road next to us” (no. 102).

Thus, some applicants interpreted the pilot presumption project as a practice or a set of practices, that extends beyond the realm of the private, into the public domain. On one level, this is indicative of relatively complex understanding of technology diffusion processes, which leads to the realization that mobilizing “the public” as an ally in the application is likely favourable. Thus, these are relatively complex expectations, both with respect to what they believe pilot project managers are looking for, the role of the future PV pilot in a concrete, social reality, and about the relationship between this future pilot and a future imagined public.

The themes above refer to material conditions rendered by the prospective users to be favourable for their participation in the pilot, and the ways that these material traits extend into the social world. If we look in more detail at the data, it is clear that a substantial share of the prospective users zoomed much further in to describe their own household’s socio-technical capabilities. Typically, they would in detail describe their own engagement with energy and energy technologies through highlighting that they already have installed technologies such as eco-efficient windows, smart energy/smart home technologies, water carried heat and heat pumps. Thus, PV appears to be interpreted as part of a broader cluster of related energy saving technologies. Mobilizing its technological “relatives” as allies seems to be a quite common strategy when trying to convince the project operators to be included in the project.

By far, however, the most referenced specific technology was not installed in the building; it was the electric car. Ninety applicants mentioned having an electric car. Thus, it appears as

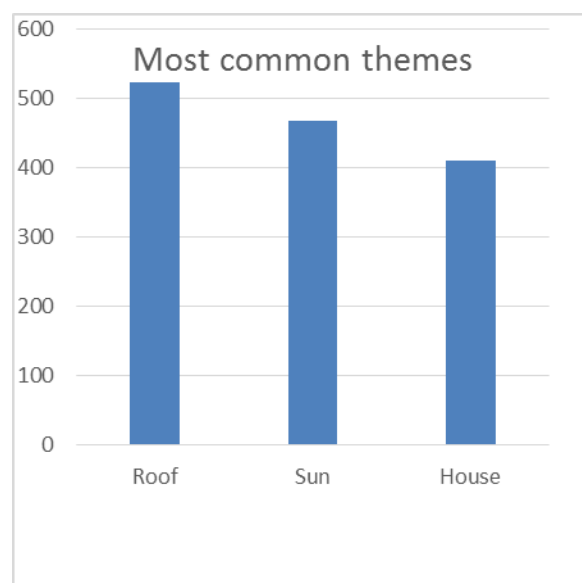


Figure 1. The three most common themes in the “other” box by total frequency of mentions.

if PV rigs are not interpreted and as stand-alone technologies, nor is presumption understood as an isolated practice. Rather, PV was expected to work together with a broader collective of associated things. The strong role of the electric car in such arguments is particularly intriguing, since they suggest a strong belief in the future integration of transport and electricity infrastructures. This substantiates work done to study electric car drivers, who often report that they become sensitized to energy consumption (by their car) to the degree that they want to acquire PV systems to be able to drive using their “own” production of energy (e.g. Ingeborgrud and Ryghaug 2017). We also find some very explicit variants of this argument in our data: “Very interested in generating our own electricity, because two EVs cater for our transportation needs” (no. 169). “We are very interested in this. We have an electric vehicle and it would be extremely motivating to charge it with our own solar power!” (no. 266) “I want to try more environmentally friendly energy technologies. This would be a great add-on to the EV” (no. 34).

The linking of PV to other technologies is also strongly associated with practice bundling (see e.g. Schatzki 2014), where existing practices and ideas of future practice are conceptually linked in prospective visions. As one applicant wrote: “advanced electricity management might be an option when it comes to charging the EV (Tesla), doing the laundry and washing the dishes, to ensure that this is done at an optimal time” (no. 1,049). Again, this is a complex vision of a socio-technical future where material elements are re-configured to establish new, bundled practice constellations. These bundled practice constellations come together, both in the sense that they are virtually co-domesticated, and as allies in the bid to become a participant in the PV pilot project.

Other applicants’ arguments mobilized a different set of perceived qualities than the building or related technologies. They focused on characteristics of the respondent, highlighting education, professional career and interests. Typically, such applications came from electricians or people in related professions. This gives some pointers to the self-recruitment

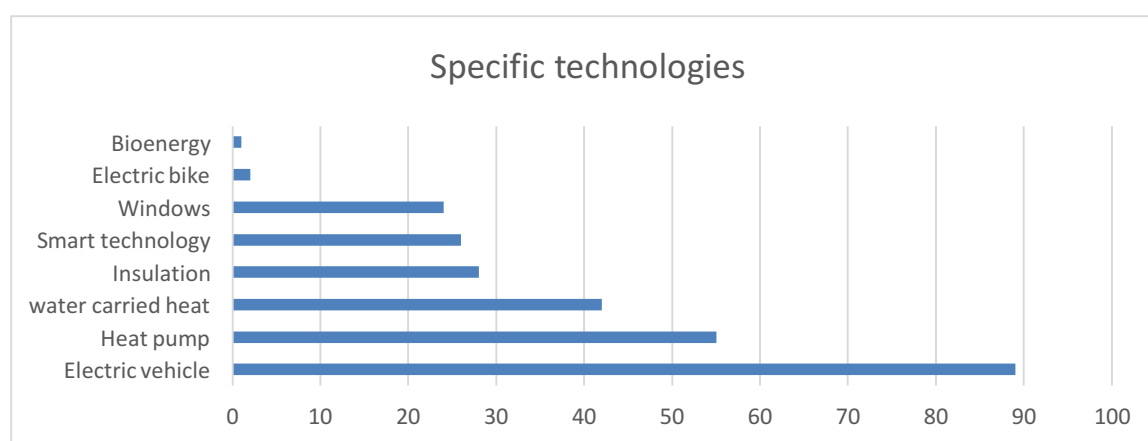


Figure 2. Mentions of specific kinds of technologies in the “other” box.

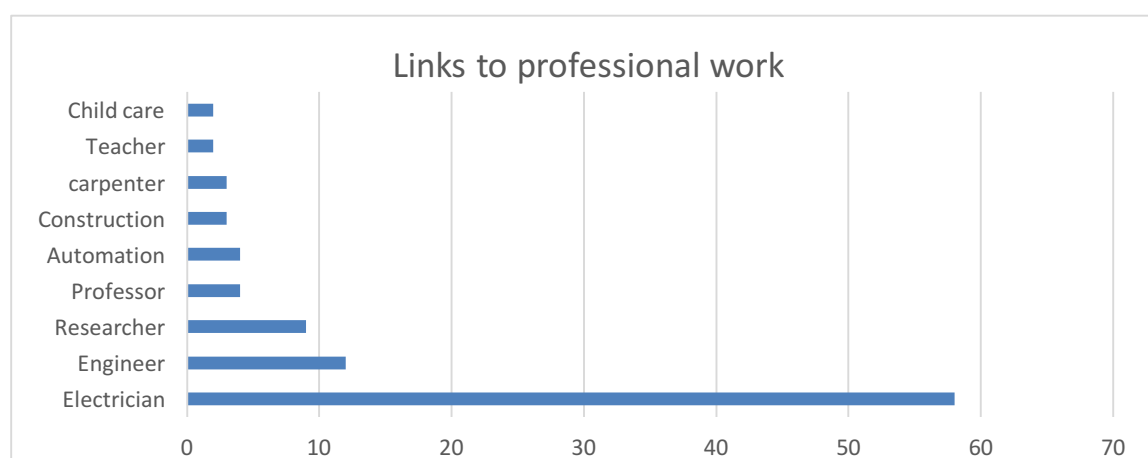


Figure 3. Mentions of own profession in the “other” box.

mechanisms in place in such projects, and highlights a notable challenge over the coming years if the goal is to engage broader sets of the population. One applicant noted: “I’m retired. Have worked with energy throughout my professional career. First at the hydropower laboratory at NTNU, with wind, hydro gas power and steam turbines. 25 years at the Statoil research centre” (no. 861), while another wrote: “I work as an electrician, and my heart is in this. I have many smart home components installed, and it would be fun to see if this could somehow be connected” (no. 348).

Prosumption, then, was interpreted by these applicants as a set of practices that is likely to require skills possessed by people with an engineering habitus. Thus, it should not be surprising that they mobilize this habitus as a means to convince others of how suited they are to be pilot participants. This result serves to strengthen past research which has found the current regime of energy transition activities by the energy industry to appeal mainly to others who share the values, ideals, and normative goals of the same industry (e.g. Strengers 2014).

Rhetorically, energy transitions are often tied up to ideas of sustainability, environmentalist attitudes and climate issues. Some applicants for the solar pilot also reflected this in a stream of argumentation. Alternatively, one might hypothesize that the prospect of becoming a prosumer would hold economic appeal for those responding to the call, but the data shows no promi-

nent mentioning of this aspect. When combining applications using the terms “environment”, “climate”, “green” or “sustainable”, there were 66 respondents arguing in this direction. Out of the more than 1,100 people who wrote something in the open answers box, only 15 mentioned the economy. This might be explained by the fact that TrønderEnergi had put some emphasis when presenting the project that it might not hold much promise of economic profit for users. The existence of a green mode of argumentation, on the other hand, does suggest that for some, prosumption is interpreted as a potential mode of political participation. That the prosumption enables a sort of mediation between abstract political problems and hands-on action. PV, then, is virtually domesticated, and inscribed into a story of a better and more sustainable future, that they want to partake in the shaping of. One applicant wrote: “I want to contribute for the environment :-)” (no. 48) while another highlighted: “Environmentally conscious household with children in school age. We have a hot compost. The house is from 1972, so no water carried heat, so solar collector out of the question! But PV is perfect!” (no. 1,147).

The quote above also indicates that for some applicants it is not trivial who lives in the house. Rather, prosumption is a prospective part of a network that also includes actors like children. Thus, this applicant underscores the merit of considering electricity consumption and prosumption as parts of other

more collective everyday life practices, rather than individual acts of “buying” e.g. (Aune et al. 2016). Whether respondents talk about themselves in singular, as “I”, or if they refer to the household in terms like “we” give a hint towards how most householders reason with respect to this. The applications showed a close to 50/50 distribution of the two alternatives. One example: “I’m extremely interested in technology and have been thinking about PV for a long time. This is a good opportunity” (no. 208). An example of the opposite: “We would like to try renewable energy” (no. 360).

In total, 19 applicants wrote in detail about the social composition of their household, mobilizing family members as allies in translation efforts: “We are a small family of three who think it would be exciting to do something like this to benefit the future” (no. 47). “This is a small family of four (kids 6 and 8 years old). We want to contribute for sustainable energy. Great sun conditions” (no. 1,016). There were also two other ways that respondents described social dynamics deemed relevant for the pilot managers’ decision. The first was to nominate not only their own home, but also an entire neighbourhood-housing cooperative (“borettslag”) for the trial. A total of 19 persons described such community dynamics. Some of those highlighted that this would benefit the trial: “We live in a housing cooperative with six units. We are interested in trying solar energy for our unit, and can also help look into if other units in the cooperative are interested” (no. 417). “Could this be an interesting project for cooperative housing? We are changing the roof soon. Could this be an opportunity? 48 units”. Others used the comment space to point out that it was not necessarily straightforward for them to install PV, because they lived in cooperative housing: “This is cooperative housing, so I would need approval from the board to do this” (no. 773). Thus, what we see here is the description of relevant networks that PV rigs and prosumer practices could become part of in the future, also highlighting some potential social challenges for a prosumer-oriented energy transition.

Another set of 19 respondents highlighted the importance of neighbourhood dynamics, relationships with close neighbours, highlighting both possibilities and challenges: “This is a detached house. There might be more neighbours who want to try this” (no. 220). Another example: “This is a vertically divided semi-

detached house. I would be happy to share the power with my neighbour but it is not a necessity” (no. 287). An example highlighting that they expected that social and economic dynamics of a building might cause problems was this one: “We live in a semi-detached house. We rent from our neighbour who is the owner, so we need to clarify things with them before we do anything. But they might also be interested? So this might be an opportunity to do a two-in-one thing” (no. 631).

Discussion

It is possible to read the analysis presented above in at least two ways. On the one hand, it shows how householders imagined themselves as “good” prosumers, using the open answer box strategically to interest the pilot operators. The result is a translation process (Callon 1986) where the story is not about recruitment and intersement of users to a project, but rather about the way prospective users tried to enrol the PV pilot project into their own life projects. To achieve this, many respondents engaged in impressive efforts to show what was perceived as relevant expertise regarding relevant technologies, displaying a kind engineering, or energy system sensitive habitus. One of the respondents tellingly called their response a “solar CV” (no. 291), which brings to mind the evaluative setting of seeking a job – a situation which is about convincing and interesting the prospective employer. The second, related way of analysing the situation described above, is to see the applicants’ accounts as sets of collective imaginaries about the role of prosumers in future societies: the networks, practices and meanings, that the particular PV pilot, and PVs in general, were expected to feed into, strengthen or destabilize. In sum, our analysis is suited to complicate stories of use as “social acceptance”, or of use as following pre-defined scripts. Our analysis grants the applicants agency in a broader sense, as they construct complex socio-material worlds around a seemingly simple PV rig.

At one level, PV rigs were expected to enter into networks of solar radiation, roofs and buildings. Further, the quality of the network was evaluated in relation to cardinal points and general location vis a vis surrounding vegetation and the sun. The house was often referred to as a culprit both in energy use when discussing ambitions of zero consumption, but also as

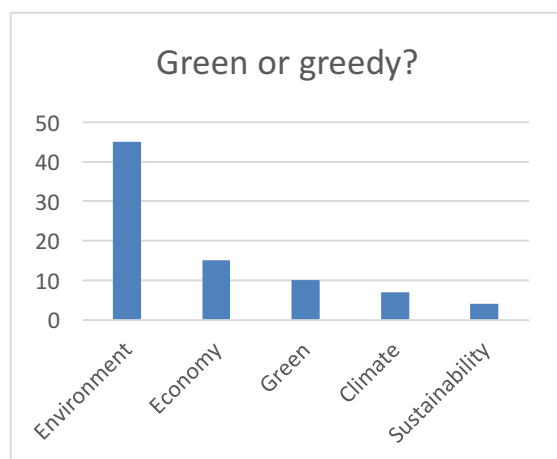


Figure 4. Mentions of motivating factors for self-describing as a “good” prosumer, also from the “other” box.

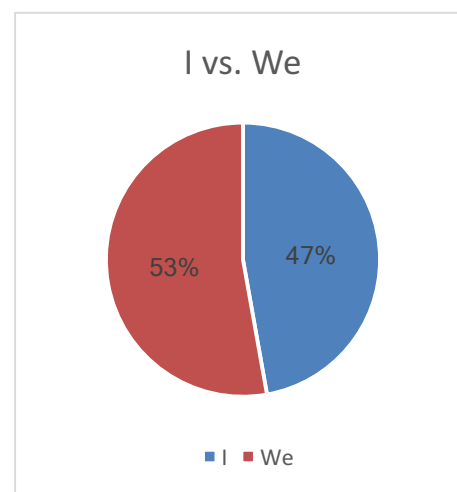


Figure 5. Who are they talking about in the “other” box?

already constituting an energy conscious ally on the team of the applicants. Typical examples include mentioning low carbon, passive- or “funkis” houses. Such buildings are apparently already imagined as belonging somehow to some tradition of PV fitting, and a PV rooftop system seems to be considered a natural extension of some already ongoing practice or existing quality related to these buildings. This is not unreasonable, as earlier studies have shown the way different building traditions in Norway is associated with energy efficiency and energy technologies (Ryghaug 2003).

Many seem to envision PV rigs as an extension of an existing network of related domestic “green” technologies such as heat pumps and smart control systems. It is also common to establish links between PV and vehicle technologies like bikes and electric cars (see Figure 4). Interestingly, this was a clear testimonial to the existence of a tangible relationship between users, their technologies, and their energy use. In other words, the users made a clear connection with the benefits of presumption for the appliances and the routines they have for plugging them in. Again, this might indicate sensitivity on behalf of the applicant to the need for a perceived techno-savvy habitus. On the other hand, studies show that this sometimes also work the other way around (Ingeborgrud and Ryghaug 2017): new mobility technologies and practices might spark an interest in new ways of generating energy. The identification of technologies and practices that are clustered and bundled in this way, might indicate fruitful pathways for future policy development. As an example, the current Norwegian energy policy regime treat EVs and PVs as belonging to different institutional spheres, with different incentive schemes attached. In practice, and in the collective imaginaries observable in our data, however, these domains are connected. Thus, perhaps one should rethink ways to integrate electricity production and transportation when formulating low carbon policies and transition strategies?

The analysis also revealed how some envisaged the PV pilot as a much more social, and perhaps political site of communication or public engagement. With this as a backdrop, they argued along the lines that they would constitute showcase opportunities of the PV because of the placement of their house (close to landmarks or in the midst of busy suburban life) something which undoubtedly was considered a value for the pilot from a PR perspective. In this sense, the PV pilot was not interpreted simply as a new way to generate electricity in stand-alone households, but as a way to communicate to the surroundings that an energy transition was unfolding.

Another category of mentions concerned the professional identity of the applicants. Many reported being electricians, engineers, researchers or professors working in energy field. This does not imply that other career groups did not respond to the form, but rather that of all the respondents who used the open answers box, many with careers that we can assume were seen as relevant for the PV pilot mentioned this. Thus, it is likely that this reflects some kind of perceived important competences, associated with a kind of engineering habitus found in this field. Subsequent analysis of the 10–15 household that were actually selected has also indicated that all selected households were part of such a collective (engineer-electrician) habitus (Koksvik and Skjølsvold, forthcoming). Thus, if advancing prosumerism and more active participation in the energy system by ordinary

householders over the coming years is a goal, finding ways to include and engage householders with other norms, values and identities will be a challenge.

An interesting aspect of our analysis was that relatively few applicants highlighted their motivation as belonging to abstract categories such as “green” or “economy”. For some, prosumer practices clearly represented an opportunity to act on environmental concerns, but the usual “go-to concepts” when concerning renewable energy issues, at least from a policy standpoint, were all but absent. These included buzzwords like “sustainability” and “climate”. This is interesting, because climate change and sustainability tends to be an over-arching narrative in energy issues. Here, however it was largely left untouched. Instead, everyday aspects like mobility and space heating, as mentioned above, was far more predominant. Thus, presumption was mainly virtually domesticated as a hands-on, practical technology, rather than as a “solution” to abstract global challenges.

Finally, we see traces of community thinking if comparing the use of the pronouns “I” vs. “we”. For instance, some would speak of their family as a whole, but more interestingly, several respondents mentioned community dynamics which related to for instance a housing cooperative. In these cases, of course, the board of the cooperative would have to be involved, and this was also mentioned. Others again mentioned how they pictured themselves in an energy cooperative with neighbours. This hints at the existence of at least a small space in the user imagination which includes a concept of a prosumer which does not function as an atom, and that the possibility of a community connection in regards to presumption is both closer, and – judging by the previous paragraph – more closely grounded to everyday life than we might suspect.

Conclusions and further inquiry

When analysing 1,731 online responses by prospective prosumers to an invitation to become part of a PV pilot project by the local energy company, this study found several ways in which respondents framed their already existing social and material configurations as especially suitable for presumption. Applicants interpreted PV as a potential part of existing clusters of technologies and practices. Examples were electric cars and space heating, often highlighted as culprits of energy use which could be mitigated by becoming a prosumer. Thus, PV panels were ascribed roles in existing networks of technologies and practice. Other important aspects were the direction and angle of roofs, solar radiation, size and character of the building and geographical location.

There was also a strong tendency for the users in the data to highlight technological competency, associated with a sort of engineering habitus. To some extent, this reverberates with the results of Strengers (2014) which has found the strong prevalence of the expert-imagined “Resource Man” within demo projects developing energy related technologies like smart meters. The Resource Man, a person with relevant technological skills and interest in energy issues has also been found to exist among end users (Throndsen 2016, Throndsen and Ryghaug 2015; Skjølsvold, Jørgensen and Ryghaug 2017), and expectedly we find these to be well represented in our data. Arguably, it could constitute a challenge for prospective prosumers if the template in the kind of project which has been studied here is

shaped after the Resource Man. The reason for this, as has been iterated by Strengers (2014) is that most users in everyday life is not of Resource Man calibre when it comes to dealing with energy and related technologies. This should be of concern for any future study of prosumers.

References

- Aune, M., Godbolt, Å.L., Sørensen, K.H., Ryghaug, M., Karlstrøm, H., Næss, R. (2016). Concerned consumption. Global warming changing household domestication of energy. *Energy Policy* 98, 290–297. doi:10.1016/j.enpol.2016.09.001.
- Akrich, M. The de -scription of technical objects, *Shap. Technol./Build. Soc.* (1992) 205–224.
- Callon, M. (1986) Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay.” pp. 196–233 in *Power, Action and Belief: A New Sociology of Knowledge*, edited by John Law. London: Routledge & Kegan Paul.
- Ballo, I.F. (2015): Imagining energy futures: Sociotechnical imaginaries of the future Smart Grid in Norway. *Energy Research & Social Science*, 9: 9–20.
- Bertoldo, R., Poumadère, M., Rodrigues Jr., L.C. (2015). When meters start to talk: The public's encounter with smart meters in France. *Energy Research & Social Science*, Special Issue on Smart Grids and the Social Sciences 9, 146–156. doi:10.1016/j.erss.2015.08.014.
- Borup, M., Brown, N., Konrad, K., and Van Lente, H. (2006) The sociology of expectations in science and technology. *Technology Analysis & Strategic Management*, 18 (3–4), 285–298.
- Bremdal, B.A., (2011). Prosumer Oriented Business in the Energy Market. IMPROSUME Publication Series #2. Narvik University College and Norwegian Center of Expertise for Smart EnergyMarkets, Narvik.
- Brown, N. & Michael, M. (2003). A sociology of expectations: Retrospecting prospects and prospecting retrospects. *Technology Analysis & Strategic Management*, 15 (1) pp. 37–41.
- Canzler, Weert, et al. “From “living lab” to strategic action field: Bringing together energy, mobility, and ICT in Germany.” *Energy Research & Social Science* 27 (2017): 25–35.
- Chappells H and Shove E (2000) Organising energy: Consumption, production, and co-provision. Available at: http://aceee.org/files/proceedings/2000/data/papers/SS00_Panel8_Paper04.pdf.
- Christensen, Toke H., Friis, F., Skjølsvold, T.M (2017) Changing practices of energy consumption: The influence of smart grid solutions in households. *eccee summer study proceedings, 2017*.
- Ellsworth-Krebs and Reid (2016) Conceptualising energy prosumption: Exploring energy production, consumption and microgeneration in Scotland, UK. *Environment and Planning A* 48, 1988–2005. doi:10.1177/0308518X16649182.
- Fell, M.J., Shipworth, D., Huebner, G.M., Elwell, C.A. (2015) Public acceptability of domestic demand-side response in Great Britain: the role of automation and direct load control *Energy Res. Soc. Sci.*, 9, pp. 72–84.
- Friis, F., Christensen, T. H., (2016) The challenge of time shifting energy demand practices: Insights from Denmark. *Energy Research and Social Science* 19: 124–133.
- Gailing, L. “Transforming energy systems by transforming power relations. Insights from dispositive thinking and governmentality studies.” *Innovation: The European Journal of Social Science Research* 29 (2016): 243–261.
- Goulden, M., Bedwell, B., Rennick-Egglestone, S., Rodden, T., Spence A. (2014) Smart grids, smart users? The role of the user in demand side management *Energy Res. Soc. Sci.*, 2 (0), pp. 21–29 <http://dx.doi.org/10.1016/j.erss.2014.04.008>.
- Hargreaves, T., Nye, M., Burgess, J. (2013). Keeping energy visible? Exploring how householders interact with feedback from smart energy monitors in the longer term. *Energy Policy* 52, 126–134. doi:10.1016/j.enpol.2012.03.027.
- Humphreys, A., Grayson, K. (2008). The Intersecting Roles of Consumer and Producer: A Critical Perspective on Co-production, Co-creation and Prosumption. *Sociology Compass* 2, 963–980. doi:10.1111/j.1751-9020.2008.00112.x.
- Ingeborgrud, I. and Ryghaug, M. (2017) User perceptions of EVs and the role of EVs in the transition to low-carbon mobility. *eccee summer study proceedings, 2017*.
- Koksvik G., and Skjølsvold T.M. (Forthcoming) Prosumers in practice. To be presented at Nordic Environmental Social science conference in Tampere, 2017.
- Kotler, P. (1986). The Prosumer Movement : a New Challenge For Marketers, in *NA – Advances in Consumer Research Volume 13*, eds. Richard J. Lutz, Provo, UT : Association for Consumer Research.
- Martiskainen, M. (2016) The role of community leadership in the development of grassroots innovations. *Environmental Innovation and Societal Transitions*. In press. doi:10.1016/j.eist.2016.05.002.
- Nyborg, S., Røpke, I. (2013). Constructing users in the smart grid—insights from the Danish eFlex project. *Energy Efficiency* 6, 655–670. doi:10.1007/s12053-013-9210-1.
- Olkkonen, L., Korjonen-Kuusipuro, K., and Grönberg, I. (2016) Redefining a Stakeholder Relation: Finnish Energy ‘prosumers’ as Co-Producers. *Environmental Innovation and Societal Transitions*. doi:10.1016/j.eist.2016.10.004.
- Parag, Y., Sovacool, B.K. (2016). Electricity market design for the prosumer era. *Nature Energy* 1, 16032. doi:10.1038/nenergy.2016.32.
- Ritzer, G., Jurgenson, N. (2010) Production, Consumption, Prosumption: The nature of capitalism in the age of the digital “prosumer.” *Journal of Consumer Culture* 10, 13–36. doi:10.1177/1469540509354673.
- Ritzer, G. (2015). Automating prosumption: The decline of the prosumer and the rise of the prosuming machines. *Journal of Consumer Culture* 15, 407–424. doi:10.1177/1469540514553717.
- Ryghaug, M. (2003) Towards a Sustainable Aesthetics. Architects Constructing Energy Efficient Buildings. PhD thesis. Department of Interdisciplinary Studies of Culture, NTNU, Trondheim.
- Schatzki, T. (2014) “Practices, governance and sustainability.” *Social Practices, Intervention and Sustainability: Beyond*

- Behaviour Change, Strengers Y, Maller C (eds). Routledge: Abingdon, UK (2014): 15–30.
- Skjølsvold, T.M., M. Ryghaug. (2015) Embedding smart energy technology in built environments. A comparative study of four smart grid demonstration projects. *Indoor Built Environ.* <http://dx.doi.org/10.1177/1420326x15596210>.
- Skjølsvold, Tomas Moe, Susanne Jørgensen, and Marianne Ryghaug (2017). “Users, design and the role of feedback technologies in the Norwegian energy transition: An empirical study and some radical challenges.” *Energy Research & Social Science* 25 (2017): 1–8.
- Staffell I, Brett D, Brandon N, (eds) *Domestic Microgeneration: Renewable and Distributed Energy Technologies, Policies and Economics*, New York: Routledge.
- Strengers, Y. (2014). Smart Energy in Everyday Life: Are You Designing for Resource Man? *interactions* 21, 24–31. doi:10.1145/2621931.
- Sørensen, K. H. (1994) Technology in use: Two essays in the domestication of artefacts. *STS-arbeidsnotat* 2.
- Throndsen, W. (2016) Response and Responsibility. Smart meters, end use, and the possibility of a green material public. PhD thesis. Department of Interdisciplinary Studies of Culture, NTNU, Trondheim.
- Throndsen, W. and Ryghaug, M. (2015). Material participation and the smart grid: Exploring different modes of articulation. *Energy Research & Social Science*, Special Issue on Smart Grids and the Social Sciences 9, 157–165. doi:10.1016/j.erss.2015.08.012.
- Toffler, A., & Alvin, T. (1981). *The third wave* (pp. 32–33). New York: Bantam books. Van Lente 1993.
- Van Vliet B, Chappells H and Shove E (2005) *Infrastructures of consumption: Environmental innovation in the utility industries*. Devon: Earthscan.
- Verkade, Nick, and Johanna Höffken. “Is the Resource Man coming home? Engaging with an energy monitoring platform to foster flexible energy consumption in the Netherlands.” *Energy Research & Social Science* 27 (2017): 36–44.
- Walker, G. (2013) Inequality, sustainability and capability: Locating justice in social practice. In: Shove, E. and Spurling, N. (eds) *Sustainable Practices: Social Theory and Climate Change*. New York: Routledge, pp. 181–196.
- Welch, D. (2015) Systems, actors, ends, narratives and identities. In: Foulds, C., Jensen, C.L., Blu, S., et al. (eds) *Practices, the Built Environment and Sustainability – Responses to the Thinking Note Collection*. London: GSI, DIST, BSA CCSG, pp. 6–9. Wolsink (2012).
- Woolgar, S. (1991). Configuring the user: the case of usability trials. In Law, J., ed. (1991) *A sociology of monsters: Essays on power, technology and domination*. London: Routledge (pp. 37–102)
- Wüstenhagen, R., Wolsink, M., & Bürer, M. J. (2007). Social acceptance of renewable energy innovation: An introduction to the concept. *Energy policy*, 35 (5), 2683–2691.

Acknowledgements

The study reported in this paper is part of the *ERA-Net Smart Grid Plus* funded project *Markets, Actors & Technologies – A comparative study of smart grid solutions* (MATCH).