Swedish prosumers in a 10-year perspective – what can we learn from a market in transformation?

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Abstract

This paper presents the reasons households have identified for installing or not installing photovoltaic panels in Sweden. It compares the results from interviews done in 2008–2009 and in 2014–2016 with homeowners in Sweden that had installed or were considering installing photovoltaic (PV) panels. The comparison focuses on the market and on what homeowners identified as motives and barriers for investing in PVs. The paper also discusses how the market for PV panels has changed over these years.

Between 2008 and 2014, the PV market has changed profoundly, with an increase in the numbers of PV companies targeting households, the introduction of subsidies for households for installing PVs, and changes in rules, which have made it easier for households to sell electricity they produce back to the grid. At the same time, the regulations have increased for the households. The reasons for homeowners installing PV vary. Environmental motives have been consistent over the years. Some reasons have changed over the time; financial incentives had become an important motive by 2014–2016. The investment costs have remained a barrier, even though they have been reduced. New barriers in recent years are, for example, problems relating to finding information about which companies exist and how much a household will receive when selling the electricity to the grid. Installation was no longer a barrier by 2014. In 2008–2009, households installed the PV panels on their own and installation was a major barrier. This had changed radically by 2014–2016, when most of the households studied had bought turn-key systems with installation included.

Introduction

Rapid growth in the adoption of renewable energy technologies is of great importance for a sustainable future. This paper presents the reasons households have identified for installing or not installing photovoltaic panels in Sweden. The share of photovoltaics (PVs) in the Swedish energy mix is not large; it was not even 1 % in 2014. But it is a market in transition, which makes it interesting to study. At the end of 2009, PV had an installed capacity of 8 MW (IEA PVPS, 2014) and most of the installations were off-grid. Since then the market has expanded and at the end of 2014, the installed capacity of PVs had grown to 60 MW (of which 10 MW were off-grid) (IEA PVPS, 2015). There has also been a change in Swedes' attitudes toward PV: it has gone from being seen as a technology for the enthusiast to one that many Swedes can see themselves investing in. For example, a survey carried out by E.ON in April 2016 showed that 73 % of respondents (out of 2,012 people interviewed) said that they wanted to install PV panels (2016).

Since 2008, we have followed the PV market through different projects, and have interviewed homeowners in Sweden interested in investing in PV panels and becoming prosumers (people simultaneously producing and consuming a product or service – in this case, electricity) (Toffler, 1980). We did the first waves of interviews in 2008–2009 and the second waves of interviews in 2014–2016. Analyses of the PV systems used by households often focuses on policy, market and financial

issues, while issues of motives, social networks, barriers and environmental behaviour are not studied (Luthander, Widén, Nilsson, & Palm, 2015). The aim of this paper is to highlight the sociotechnical context from the prosumers' viewpoint and to compare how households' motives for and barriers to adopting PV have changed over the years. The paper looks at which motives and barriers have persisted, which are no longer an issue, and new ones that arose over the period.

This paper is structured as follows: this section present the main evolutions in the context in which households are making their choice (policies such as regulations, taxes and subsidies, and the structure of the market), the next sections describe the study method and material, next follows the comparison of motives and barriers. The paper ends with conclusions and ideas for further research.

There were radical changes in the supply of PV panels in Sweden between the two waves of interviews. These include a significant increase in the number of suppliers and changes in the service they provide:

- In 2008–2009, there were mainly two companies that marketed small-scale electricity production to ordinary households: Egen El and Home Energy. On the one hand, Egen El (Own-produced electricity), attracted massive media attention in 2008–2009 (Palm & Tengvard, 2011). The company sells small-scale PV panels and wind turbines, allowing households to buy power plants that are easy to install and connect to their houses. It marketed its product as something designed for ordinary people. According to Egen El's website, their products were so easy to install that anyone could do it without expert help. On the other hand, Home Energy, in contrast, provided free installation of its products.
- In 2014, Lindahl (IEA PVPS, 2014) identified more than 100 companies that sold and/or installed PV modules and/or systems in Sweden in 2014. In 2014–2016, a number of companies had a business model in which they offered packages to households where everything was included: PV panels, contacts with the grid company, installation, feedback and monitoring systems.

There had also been sweeping changes in the policy support framework for PV panels.

- In 2009, a subsidy was introduced for the installation of PV panels. This support was available to all types of actors from individuals to companies. In the beginning, it was possible to get subsidies for 60 % of the installation cost, including material and labour costs. In 2012 the subsidy dropped to 45 % and in 2013 it was further lowered to 35 % of the installation cost. This was reduced again, and from 2015 onwards, the maximum level is 20 % for households. Funds can now only be applied for if the system costs are less than EUR 3,700 excluding VAT/kW_p (IEA PVPS, 2014). This new subsidy had a positive impact on the market. First, it affected demand. Although there is no data to assess that impact, one indication is that the subsidy is running out and the wait list is long. By December 2014, 8,000 households had applied for it, and 3,000 had received subsidies (Energimyndigheten, 2015). Second, it affected supply: several companies started marketing products targeting the household sector.
- The cost of paying for a mandatory new meter was shifted from households to grid companies. When a household wants to start delivering electricity to the grid, it needs a new electric meter. Until April 2010, households had to pay for the costs of changing meters. After that, the grid company had to make the change without charging the homeowner (Government Bill 2009/10:51).
- In 2015, a tax reduction of EUR 0,6/kWh was introduced for micro producers of renewable electricity. This cannot, however, exceed EUR 1,800 per year (Swedish Energy Agency, 2015).
- In 2013, households owning a PV system were obliged to register for and pay Value Added Tax (VAT). This happened because, according to a decision in the European court, "the sale of electricity from a PV system located on, or adjacent to, a private residence is an economic activity when the electricity produced continuously is supplied into the grid for remuneration. The PV system is therefore obliged to register for, and pay VAT, regardless of the amount of electricity that is sold" (IEA PVPS, 2015). The requirement to pay VAT was heavily criticized and this requirement was abandoned in January 2017.

In addition, between 2008 and 2016, the price for PV panels decreased. In 2014 a household had to pay a quarter of the 2010 price (IEA PVPS, 2014).

Method

This paper is based on new material and a re-analysis of datasets available from our previous research. In the first wave of interviews, which were done in 2008–2009, we interviewed 20 households. In the second wave of interviews, which were carried out in 2014–2016, we interviewed 43 households. Two adults were present during two of the interviews in the first wave and in three interviews in the second wave; in all other cases only one adult was interviewed.

INTERVIEWS OVERVIEW

In the first wave of interviews, participants were recruited through the customer records of the two companies that marketed their PV systems to "average Swedes" who did not have any technological expertise (Egen El and Home Energy). The opportunities for finding households for the first wave of interviews were limited. We sought to find households that wanted to install PVs on their permanent homes and not, for example, on their summer houses. The managers of the two companies contacted households and asked whether they wanted to participate in the study; the interested households either contacted us directly or we received their names and phone numbers from the managers. Altogether around 1,000 customers were contacted and all that wanted to participate were included in the study. In the first wave, we interviewed 20 households all together. Nine households had bought a plant, eight households were still considering buying one, and three had decided not to buy a plant (see Table 1 for a summary). At that time, Home Energy was new to the Swedish market. All but three households interviewed were Egen El customers and therefore needed to install the products on their own.

Table 1. The households interviewed and their decision-making phase.

Decision-making phase the interviewed households were in when interviewed	2008–2009	2014–2016, interviewed in first round	2014–2016, interviewed in the first and the second round
Under consideration to buy	8	5	
Bought but not installed (PV installation not included)	7		
Bought and will be installed (turn-key product with installation included)		17	
PV installed the same week as the interview		7	
PV installed for one year or more	2	14	17
Decided not to buy	3		2
TOTAL	**20**	**43**	**19**

By the time we did the second wave of interviews, the market had expanded so much that we could recruit participants in many different ways: through the customer register from 3 PV suppliers, through the public records of those that had applied for subsidies to install PV and through a call for participants published on a popular PV blog in Sweden, "Bengts villablog". We prioritized households that had not yet installed their PVs, because the idea with the project was to compare how the households perceived being prosumers before having PVs and how they perceived it one year after the installation. Again we were looking for households installing PVs on their permanent houses. It was hard to find enough households before installation so in the end we also interviewed households that had owned the PVs for a year or more.

We interviewed 29 householders before or during the installation phase. Of those 29, we returned to 19 households after a year to see if they did install PV panels and, if they did, how they had experienced one year as prosumers. Two households had not installed PV panels. The 14 households interviewed had owned their plant for a year or more when we interviewed them (see Table 1 for a summary).

The interviews were semi-structured and we used similar interview guides in the two studies (Alvesson & Torhell, 2011; Kvale & Brinkmann, 2009). The guides covered the following topics: (a) background data, (b) first contact with the concept of small-scale electricity production and the reason the households are interested, (c) barriers to and enablers of product adoption, (d) information received on the various products studied, (e) pros and cons of various studied solutions, (f) decision made or the decision-making stage they were in, and (g) energy use—awareness and efficiency measures implemented[1].

The interviews were recorded using an MP3 recorder/player and then transcribed. The interviewees are anonymized in this paper and will be simply referred to as household 1–20 (for the 2008–2009 study) and household 21–63 (for the 2014–2016 study). When two members of a single household were interviewed, we indicated this by appending "a" or "b" to the household's number.

1. The households that we interviewed a second time were also asked about flexibility and if they had changed their behaviour after the installation of PVs, but we have left the results from these questions out of this paper.

CHARACTERISTICS OF THE HOUSEHOLDS

On average, the households interviewed are middle aged; their income and education level is higher than the Swedish average.

Age: In the first wave, the average age of the interviewees was 47 and their ages ranged from 31 to 75. In the second wave, the average age of the interviewees was 58 and their ages ranged from 32 to 81.

Income: Earlier studies have demonstrated a relationship between household income and investments in PV systems (Abu-Arqoub, Issa, Shubita, & Banna, 2014; Gallegos, Tapia, & Romero, 2014; Jiang & Zhu, 2012; Schaffer & Brun, 2015). In our sample, the income was higher than the Swedish average. The average income for households with two adults in Sweden was around EUR 50,000/year for both periods (Statistic Sweden, 2014). Not all our household wanted to reveal their income. In 2008–2009 the 12 households who told us their income on average earned EUR 68,000/year. In the second wave, on average the 30 households had an income of EUR 85,000/year. When factoring in inflation, the households in the first wave earned around 10,000 Euros less than the households interviewed in the second wave. It is however not possible to draw conclusions as to whether the interviewees are representative of the general population of Sweden. The recent decrease in production costs and the introduction of policies to change the market (e.g. subsidies) made it possible for households with a different income status to invest in solar panels, even if that is not mirrored in our sample.

Social status and education: Fischer and Sauter (2004) suggest, in opposite to the authors above, that income is not the reason for the greater number of installations among higher earners, but instead that it is due to social status and education. In 2008–2009, 16 of the 20 interviewed had a university degree. In 2014–2016, 26 households had a university degree, 11 had a high school degree and 6 had elementary school or did not answer the question.

Energy consumption: In both studies, the households' total consumption of electricity and heat varied greatly from 3,000 kWh to 30,000 kWh per year. The differences were mainly due to the heating system installed, the size of the dwelling and size of the family. We could not detect any differences between households claiming to have a sustainable lifestyle and those not claiming this. In this sense, there was no difference between the households interviewed in the first and second waves.

Comparison of the results between the 2008–09 and 2014–16 survey

This section presents a comparison of the two sets of results on the motives and barriers that the households identified for adopting or not adopting PVs and what the installation process was like during the two periods.

HOUSEHOLDS' MOTIVES FOR INVESTING IN PV PANELS

The first interview wave: early adopters motivated by environmental reasons

In both studies, we asked the households why they wanted to invest in PV panels. The reasons mentioned in the first wave of interviews are presented first, followed those mentioned in the second wave and thereafter the similarities and differences are discussed.

In the first wave of interviews, all respondents emphasized the environment as a reason installing a PV panel. Statements included, for example: "it is the environment, we must think about it" (household 8). This was often combined with something about the family's lifestyle and the importance of living in harmony with nature. Household 17 gave an example of a common answer:

> In our family we discuss what we eat, who produces the food we eat, and all these things. We have had this environmental concern all our lives. We are members of Greenpeace and the Swedish Society for Nature Conservation and so on.

The investment in solar panels was described as having an important symbolic dimension, a way to set an example for others. It was a way to show neighbours and friends that it is possible to act and do something, even as an individual. Household 5 expressed this as follows:

> If other people see that I have bought a plant, then maybe they will follow my example. This way I can help spread the concept of producing one's own electricity and perhaps make it more common in the future.

The households also saw their investment as way to create a market for PV panels among ordinary people. Another common motive households had for making the investment was as a protest against big multinational energy companies.

> The choice to go ahead and produce my own energy is also a way to take a stand against the big electricity companies and the dirty energy they produce. It's sort of like "No, I just won't have that!" (household 4).

At the time of the first wave of interviews, the Swedish state was investigating whether it would be easier and cheaper for individuals to sell the electricity they had produced back to the grid. With a few exemptions, households were not prosumers at this time, and the households we interviewed planned to use all the electricity they produced. In line with this, most households expressed no plans to earn money from producing energy; one exception was household 14.

> What is so good about this [system] is that you can just send the electricity that you don't use back to the grid. In the summertime, you don't use that much electricity anyway and then I might just as well sell it back … And then, maybe in ten years from now, it will be like a form of retirement pension. But for now, I'm waiting for Parliament to decide what's going to happen.

Others were more pragmatic and stated that, from a financial perspective, the investment was not viable: "I probably have the most expensive electricity bill in this neighbourhood" (household 2).

A final motive that the households cited concerned the technology itself, the delight of actually producing one's own electricity. It was seen as a "fun" concept. They enjoyed watching their electricity meters indicating the kilowatts they produced themselves.

The second interview wave: the rise of economic motivations

In the second wave of interviews, almost all the households mentioned environmental concerns. Three households did not mention environmental aspects (households 21, 36, 50) as a reason to install PV. What was common to all households however was that they all saw the investment as a purely financial decision, as a way to earn money.

In the second wave of interviews, the households did not relate their environmental motives to lifestyle in the same way as those in the first wave. The concern for the environment was put more in a social change perspective and the importance of contributing to a common good. Lifestyle is not as mentioned in the answers, but the reflections related more to the household being part of a social change to develop a low carbon community:

> It is a positive thing for both the society and myself (household 46).

> I am interested for both reasons, my own consumption and production, but also, how to say this, in relation to a societal perspective. It makes you interested in… I also became interested in how electricity in society is produced (household 55).

The symbolic aspect, to set an example for others, was also mentioned in wave two. But more a common reason that the households mentioned was being inspired by others, such as neighbours or at an exhibition, or other event where PVs were shown:

> My neighbours have a big plant. And I was inspired by that (household 32).

> Last spring they showed PVs in Holbo. It was a company that showed the panels. Our intentions were not at all to buy PVs, but an electrical bicycle. But after this event we started to read about it and we realised that our house had a good location [for PVs] (household 39).

In the second wave of interviews, a more common motive was to become independent of the energy companies and go off-grid. This wish was related to another factor only present in the second wave and that was the availability of electrical vehicles (EV). At the time of the first wave, EV were not available, but in the second wave. one household owned an EV and seven households told us about their plans to invest in one in a near future. These families wanted to be able to charge their EV with electricity they had produced.

> The idea is to buy an EV that I can charge during the summer (household 23).

In the second wave, economic incentives, such as being able to make a profit out of the investment, were discussed much more than in the first wave. The households in the second wave did not need to pay to install a meter to measure both their production and consumption. All of the households sold or planned to sell their electricity to the grid. The households had also thought about pay-back time, and most expected that the investment would be profitable. In the second round, saving or earning money was a reality and the households expected to earn money by selling the electricity back to the grid or save money because they would be able to buy less electricity from their power company.

> It will pay back immediately. I will earn 50 Euros per month, even if you include the loan on the panels. And also, the value of the house will rise (household 26).

In the second wave of interviews, technological reasons for investing in PV, such as being curious about the technology or finding it fun to work with PVs, were also mentioned, but to a lesser extent than in the first wave.

Comparison of motives between the two interview waves

Between the two sets of interviews, there had been a shift in households' reasons for investing in PV. In the first wave, the households were pioneers, resembling early adopters, who invested in PV panels for environmental reasons. In the second wave, the households gave mainly economic reasons for investing in PVs. The new policies that allowed households to sell the electricity to the grid and that provided a subsidy, together with the lower prices on PV panels, made it much cheaper for households to invest in PVs. This made pay-back time and profit of interest for the households in the second wave.

In both studies, the investment in PVs was described as having an important symbolic value. In the second wave, several commented that they had been inspired by seeing PV in their surroundings. This was not the case in the first wave, simply because not many had been installed at that time.

Another change between the two interview waves was the introduction of EV and some of the households dreaming of having an EV charged by the electricity they produced. It was also more common in the second study to have a vision of going off-grid in the future.

PERCEIVED BARRIERS TO ADOPTING PVS

In both waves of interviews, householders talked about factors they perceived to be barriers to installing PV. Cost was a barrier mentioned in both studies. Administration and information were mentioned in the second waves of interviews. Technology and installation, which were mentioned as barriers in the first wave of interviews, did not seem to be barriers for households in the second wave.

Cost

For householders in both studies, high costs were a barrier to investing in PVs, even though the cost of panels had been reduced substantially between the two waves and a subsidy had been introduced. The low electricity price in Sweden also made the investment less attractive. The amount of the investment was, however, quite similar in both studies, although the households in the second study received much larger PV panels for the same amount of money as those in the first study. In the first wave, the installed PV panels were always a supplementary source of electricity, providing some of the electricity consumed by the household. In the second wave, all the households were micro producers (i.e. net consumers of electricity on a yearly basis with many households selling surplus electricity to the grid during the summer).

In the first wave, the cost of panels was so high that many households regarded installing them to be a rather bad investment, from an economic perspective:

> EUR 4,000 for a solar panel is very expensive per kilowatt hour. For people working with energy, this idea is probably quite stupid (household 16).

This household was still considering buying and had not made a final decision at the time. In the first wave of interviews, no one really expected to gain any money from the investment. The investment was done for other reasons, such as the environment, as discussed above.

In the first wave of interviews, a common reflection was:

> I probably have the most expensive electricity bill in this neighbourhood (household 2).

In the first wave, three households had decided not to buy PVs because of the high investment cost. Eight households were still considered buying PV but, thought the high investment cost was a major barrier.

In the second wave, the economic factors were less of an issue, though they were still mentioned. Most households had calculated pay-back time, but the results differed a lot depending on how they had calculated future electricity prices and the income on selling their electricity. Two households had decided not to install PVs due to the high investment costs (21 and 24). In both cases, the householders had academic education and had a higher than average income and reasoned in similar ways. They decided that installing PV was too expensive an investment, mainly because the pay-back time was too long. Both wanted a pay-back time of 8–10 years, but could not see that happening with current electricity prices. The reduction in subsidies to 20 % also made the investment less attractive for household 21. Household 24 thought that they would not receive a subsidy, because the money would run out.

Two other households (41 and 49) that had been sceptical about whether they could earn any money from the investment, had, however, invested in PVs and thought they would get the investment cost back in 20 years. The other households were convinced that they would earn money from the investment.

Administrative barriers

In the second wave, the most common barrier mentioned related to administrative issues. Before they could become prosumers, households needed to establish several contacts and fill in many forms to apply for subsidies, to change the meter, and to sell the electricity to a power company. Additionally, some had to require a building permit from their municipality. Some households also applied for a green certificate, a system introduced in 2003 by the government to increase the use of renewable electricity. The

basic principle of the green electricity certificate system is that producers of renewable electricity receive one certificate from the government for each MWh they produce. The average price for a certificate was EUR 196/MWh in 2014, which resulted in an average additional price of EUR 0,0027/kWh for the end consumers. Most micro producers do not apply for them simply because the income that certificates provide is not worth the added administrative burden (IEA PVPS 2014; 2015). In our study, seven households had the certificate or had applied for it, usually, because the installation company helped the household with this application as part of the turn-key system.

Most households had applied for subsidies and the process was long. After they had applied, they received no information about when to expect an answer and needed to repeatedly contact the authorities for updates. Around 10 of our households have chosen to use an ROT-tax deduction instead. "ROT" is a collective term for measures to renovate and upgrade existing residential properties. The ROT-tax deduction was 50 % of labour costs up to a maximum of EUR 5,000 for the installation of PV systems. The benefit of using ROT instead of subsidies is that the ROT-tax deduction scheme has no waiting time and households are sure of receiving it.

The administrative process most criticized related to the requirement to pay VAT for the electricity produced. To be able to pay VAT, households needed to start a company, which required filling in forms for the taxation authority. The forms were not adapted to households and householders found them complicated to fill in. They needed to contact the relevant authority several times. Households were frustrated as this generated a great deal of administrative work for a final VAT amount that was small (from 0,1 to 5 Euros per year). The VAT requirement will be abandoned in 2017, but when it existed, it created a lot of annoyance.

> I filled in three or four different forms and they were general forms that were not suited for micro producers. It was really awkward. Me and my wife had to start a company and become partners and then she had to sign a letter that said that I would be responsible for the company. It was so stupid. And there were no easy information to get, that applied for us. I had to call several times and eventually I reached someone at the taxation authority that could provide support (household 22).

In the first wave of interviews, the lack of applicable regulations and procedures for handling administrative requirements was a major barrier; rules and systems were not in place for households because the concept of them producing their own electricity was new. In the first wave, the households felt that the grid companies were trying to hinder the installation of new meters and that by not giving clear answers, they were prolonging the permission process:

> They cannot give a straight answer but refer to various paragraphs. It is very unclear … it is hard to move on in the process (household 17).

In addition, many households in the first wave of interviews were frustrated because the lack of knowledge among official agencies, such as local authorities and the Swedish Energy Authority. They expected the authorities to inform them about which opportunities they have to become prosumers, but usually they found it difficult to find anyone who knew more than the households themselves. In the second wave of interviews, households were less critical of the authorities and many said that they had received a great deal of support from the Energy Authority. However, several households thought the energy companies were a barrier for other reasons. One reason related to the meters that the households needed to have when they installed PV panels. The grid companies had to wait until after the installation to change the meters; sometimes it could take between six to eight weeks before the grid company changed the meter, and during this time the households could not use their panels.

Another barrier related to power companies was that not all of them buy micro produced electricity, and some required a household to be a customer before it would buy the electricity it generated. This is created a barrier for households that had signed a long-term contract with another electricity supplier:

> We have a contract with Telinet and they don't buy our electricity. But now we have made contact with some energy companies that do buy micro produced electricity but then we have to wait until our contract with Telinet ends (household 47).

Lack of information

In the second wave of interviews, a new barrier had appeared related to the quick development of the market. While many companies were marketing PVs to the households, households had trouble deciding between them; no evaluation existed of the companies nor was there even an easy accessible list of companies for households to choose from. No comparison existed of the companies and the products they offered. The quotes that households received from different companies were not standardized and so it was not possible to compare them. In addition, the quotes were often so technical that it was hard for the households to understand them.

Another perceived barrier mentioned only in the second wave of interviews was a lack of objective information. Almost all information the households found was from energy companies and companies that sold PV panels. An interesting finding in the second study was the influence of a blog, Bengt's Villablog, in which a professor writing as a private person tries to disseminate knowledge about everything concerning installations of PV panels. The blog covers most issues of interest for households and most of our households mentioned it when we asked how they had found information.

Another related barrier in second interview wave was the difficulty in finding information about which companies buy electricity and at what price. Households pointed to a lack of an information (especially on the web) on this and most households found it difficult to find companies willing to pay for the electricity they produce. And when they did find a company, the households did not have much bargaining power. This results in an non-functional market, where the price households are paid for their electricity varies from spot price minus EUR 0,005 to as high as EUR 0,2 + VAT.

Technical issues

In the first wave, households viewed the technology itself as a hindrance. They said that it was not advantageous to buy a product when it was new and not tested properly:

> It is a gadget. There is anxiety that it is there and can fall down and become damaged. What are we supposed to do if something happens? (household 1a)

This was not at all a case in the second wave: households did not identify technology as a barrier.

The design of PV panels was not a major issue in either rounds of interview, but a few households did mention it. Some households simply thought that having PVs on the roof looked ugly. In the second study, households had more designs to choose from, but several expressed surprise that most PVs were so similar in their design.

The installation process

Attitudes toward the installation of the PVs had changed between the two periods. In the first wave, many households had bought but not installed the panels when we interviewed them. They had ordered the products over the Internet, which was easy to do, but installation was not included. Households could find the information on the companies' websites; however, most households could not manage the electrical installation on their own because they lacked the required competence. And most households lacked information on how to install the PVs for optimal functioning. The households that had installed the PVs themselves all included a man who was a craftsman by profession.

In the second wave of interviews, the most households had bought a turn-key unit. In the first wave of interviews, we had spent a fair amount of time understanding how the households coped with installation issues; we could cover this quickly in the second study. It was clear that the market had matured in relation to installation practices.

In the second wave, some households had chosen a company that went bankrupt so they had to find a new installer. Several households also told us that the workers that installed the equipment did not speak Swedish and seemed to lack the right education. One household stated that they had to help the workers to install the equipment (Household 50). Several others said that there were problems with delays and that they needed to call several times before the workers showed up.

Conclusions

The market for PVs has expanded between 2008–2009 and 2014–2016. Many new PV suppliers targeting households have entered the market and turn-key equipment have been developed. More and more Swedes are interested in becoming prosumers, which, for example, could be seen in increased number of applications for subsidies. The introduction of subsidies had clearly contributed to an increased demand, even though the subsidies have a cap and it is not clear how many applicants would receive any money. Some households have chosen to use the ROT-tax deduction instead of applying for a subsidy to be sure to get some money back.

The subsidies, together with it becoming easier and more profitable to sell micro generated electricity to the grid, have probably contributed to the shift in who became prosumers and what motivated them to invest in PVs. The first wave of interviewees included many pioneers who had invested in PVs mainly for environmental reasons. In the second wave, the households were more motivated by economic reasons and most were interested in pay-back time. The financial profitability of a PV system was an important dimension in decisions about adopting, as has been discussed by, for example, Schelly (2014), Schwom and Lorenzen (2012) and Islam (2014).

The turn-key equipment has also made it much easier to become prosumers. The earlier installation barriers have disappeared. PV is, however, still a market under development and some suppliers have gone bankrupt and others have problems fulfilling their requirements.

The rapid increase in suppliers in the PV market has made many think about becoming prosumers. Information about different PV panels, suppliers and how to sell electricity has not, however, been developed at the same pace. Many rules exist for becoming a prosumer in Sweden today and there is a lack of "facilitators" who can help perspective prosumers to navigate the market. This suggests that acting as a facilitator could be included in a company's business model. However, many households in the second round wanted neutral and objective information, and it is a question for further research whether a company can fulfil this demand or if it would be better done by a public actor such as municipal energy advisers or the Swedish Energy Agency.

Because the market is still under development, more research is needed on how market dysfunctions and barriers can be addressed. The PV market in Sweden has the potential to grow and to support such development further, research will also be needed on how prosumers reason about becoming prosumers and how the learning processes occur in the prosumer community. Many other European countries are ahead of Sweden in this field, and further research could be done on so Sweden can learn from them.

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