ARTICLE

Motives for and barriers to household adoption of small-scale production of electricity: examples from Sweden

Jenny Palm & Maria Tengvard
Department of Thematic Studies, Linköping University, Linköping, 581 83 Sweden (email: jenny.palm@liu.se)

A new electricity-production concept attracted massive media attention in Sweden during 2008 when companies began marketing small-scale photovoltaic panels (PVs) and microwind turbines. The products were launched by their simplicity: the components are so easy to install that anyone can do it. How, then, do households perceive these products? Why would households choose to buy them? What do households think about producing their own electricity? Analysis of material from in-depth interviews with members of twenty households reveals that environmental concerns are the main motive for adopting PVs or microwind turbines. Some households have ecologically aware lifestyles and adoption represents a way to reduce fossil-fuel use. For others, this investment is symbolic and provides a way to display environmental consciousness or to set an example. For still others, adoption is a protest against “the system,” with its large dominant companies, or a step toward self-sufficiency. Moreover, some households reject these microgeneration installations because of financial considerations, respect for neighbors who might object, and/or difficulties finding an appropriate site.

KEYWORDS: electric power generation, solar cells, wind energy, electrical equipment, energy consumption, attitude measures, environmental awareness, renewable energy resources

Introduction

Renewable energy technologies such as solar cells and wind turbines are considered key to reducing the threat of global climate change. Such equipment is generally regarded as “sustainable” in the sense that it can be used into the future without causing irreversible damage to the Earth’s ecosystem. The Kyoto Protocol includes a provision that all ratifying states should increase their deployment of renewable energy technologies. The European Commission has further prioritized renewable energy issues and established the “20/20/20” goals: to obtain 20% of Europe’s overall energy mix from renewable sources, to reduce total primary energy consumption by 20%, and to cut greenhouse-gas emissions by at least 20% (all relative to the 1990 baseline) by 2020 (European Parliament, 2006; SOU, 2008). Another policy to encourage renewable energy technologies is the use of green certificates, a tradable commodity confirming that a specified unit amount of electricity is generated from renewable sources (SOU, 2008).

The rapid development of renewable energy technologies seems vital. However, these generating facilities face problems of becoming established market alternatives (Jacobsson & Lauber, 2006). This article focuses on small-scale electricity production from renewable sources in Sweden and looks specifically at systems in which households can buy grid-connected photovoltaic panels (PVs) and wind turbines for home-electricity systems. We examine motives for and barriers to household adoption of these microgeneration technologies and how they are perceived by actual and prospective adopters. What do households think about producing their own electricity and what constraining and enabling factors have they encountered?

The article first discusses earlier research into user adoption of green innovations, specifically PVs and microwind turbines. We then briefly describe the Swedish market for this equipment and outline the methods for our field study. The results of interviews with households at different stages of the decision-making process regarding the adoption of PVs and microwind turbines are then presented. Finally, we offer conclusions concerning various motives for and barriers to household adoption of these technologies.

Sociotechnical Transition and Household Adoption of New Technology

Frank Geels and his colleagues discuss how radical novelties develop in established sociotechnical configurations such as the electricity system. They suggest an evolutionary model for sociotechnical change, which focuses on the dynamics in changing artifacts, technologies, regimes, and overall society. Their transition model relies on the work of...
science and technology studies which argues that technological and social change are interrelated. Their model proposes a multi-level perspective for transition, in which researchers analyze past episodes of transformational innovation at the macro-level (landscape), meso-level (regime) and micro-level (niche). The multi-level perspective attempts to explain processes of radical development of novel technologies. The diffusion pattern of this development produces a new set of sociotechnical relations that comes over time to largely replace the existing social practice. From this perspective, the stability of existing sociotechnical systems occurs through interaction among material aspects, embedded actors and organizational networks, and the rules and regimes that guide perceptions and actions.

In this model, innovations evolve in special spaces, or niches, where they are sheltered from mainstream competition (Schot & Geels, 2008). These domains can be small market niches, which is the case here, or technological niches, where public subsidies provide resources.

Niches form the micro-level at which radical novelties emerge. The meso-level is the regime level, and includes routines, knowledge, problem definition, and so forth that are embedded in institutions and infrastructures. The macro-level is the sociotechnical landscape, which is the larger policy and political context that normally evolves slowly, but at certain times confronts quite abrupt change (Geeles & Kemp, 2007). Verbong & Geels (2007) describe the relationship between the three levels—niches, regimes, and landscapes—as a “nested hierarchy.” New technologies have problems breaking through and gaining widespread diffusion because of deeply rooted established regimes. Transition only takes place when all three levels align and reinforce one another.

From the standpoint of promoting innovation, niches need protection because new technologies initially have low price-performance ratios. Small networks of actors can shield the niches, so when initiating new technologies, it is vital to build insulated spaces (Verbong & Geels, 2007).

In our case, the niche actors are the modest-sized companies that have launched the concept of small-scale electricity production. To succeed, they need to enroll early adopters in their network. Spaargaren (2000) argues that individuals choose what products to consume within particular social arrangements and not in isolation; consumption thus must be seen in its social context. Spaargaren & van Vliet (2000) further claim that people seek to realize the partial integration of green practices into their daily lives. Actors prefer to bind their various social practices into a reasonably coherent unit. When a householder embraces a green lifestyle, this corresponds to a life story in which the actor is expressing who s/he is or wants to be; the life story serves to express this person’s identity and self-narrative. From this perspective, “lifestyle” is the degree of coherence found in a person’s behavior, though modes of action in one context may differ from those adopted in others (Spaargaren, 2003).

Rohracher (2003) discusses how consumers may communicate various meanings and lifestyles through their product purchases. PVs and wind turbines offer individuals the opportunity to make statements about their environmental beliefs. Earlier studies have demonstrated that the environment is becoming increasingly important as a symbolic issue. People want to show that they are environmentally aware and think about climate problems (Pedersen, 2000; Hedrén, 2002; 2009; Skill, 2008). Investing in a fully visible PV or microwind turbine can be a symbolic way for households to communicate their values to their communities. Kaplan (1999), in a study of the process of PV adoption, found that, aside from knowledge of the existence of PVs, motivation, technical understanding, experience, and familiarity (e.g., whether the household has previously installed a similar technology, such as solar heating) were other critical factors.

Faiers & Neame (2006) considered whether early adopters develop internal reference prices based on their knowledge and competence. In other words, the actual cost of an innovation is unimportant; what matters is what it is worth to the adopters as individuals. At the same time, however, Faiers & Neame have detected inconsistencies in green consumption; for example, consumers who recycle materials do not necessarily favor green energy products. In this context, Spaargaren (2000) has emphasized that consumers’ involvement in greening their lifestyles and domestic consumption patterns relate to more than the amount of money that they want to spend in specific ways. Additional aspects, such as material, social, and cultural efforts and rewards, are inherent in certain innovations. Sometimes people develop bottom-up forms of greener self-provisioning and want to be independent from the utility company, while in other cases they may simply want to be served, even though more sustainable arrangements are available.

If we see this new concept with small-scale electricity production as a niche market at the microlevel, then it is interesting to analyze how its advocates try to gain widespread diffusion and especially how early adopters are enrolled in the networks. In what context is the adoption done and how does this investment correspond to people’s life stories, symbolic values, and reference prices? These issues are analyzed below in relation to household motivation.
for and barriers to considering and adopting PVs and microwind turbines. The interviewees articulated an identifiable set of enabling and constraining factors with respect to these technologies that merit careful assessment. As the householders’ reasoning shows, these considerations are related to a willingness to uphold and mediate a green lifestyle. Before presenting the household-interview results, we first briefly outline the Swedish market for small-scale electricity production and then introduce the case study.

The Swedish Market for PVs and Wind Power

The market share of household PVs and wind power in Sweden is currently not very large. At the end of 2009, installed wind-power capacity was 1,440 MW, representing only 0.4% of total installed capacity, while PVs had an installed capacity of only 4.4 MW (SEA, 2010). However, the market is expanding and the installed capacity of both PVs and wind power continue to grow.

In Sweden, a “new” concept of small-scale electricity production, launched by companies such as Egen El and Home Energy, attracted massive media attention in 2008 (Palm & Tengvard, 2009). These companies market PVs and wind turbines to households, allowing householders to buy appropriately sized power plants that are easy to install and connect. What is new in this concept is how renewable sources of electricity are marketed as something designed for ordinary people. According to Egen El’s website, the company’s products are so straightforward to install that anyone can do it without expert help; in practice, however, this has not always been the case. While the concept launched by Egen El builds on the notions of simplicity and do-it-yourself ease, Home Energy, in contrast, provides free installation. The systems from Egen El and Home Energy both include transformers, meaning the electricity produced from the new household sources can be directly accessed from a standard electrical outlet. Both companies further emphasize that householders do not need to secure building permits to legally install the equipment.

To get a picture of the market for microgeneration systems, we interviewed seven PV and micro-wind-turbine retailers that target households. The household respondents had bought products from these retailers whose product lines are presented in Table 1.

A third company included in this study, Windon, has a larger wind-turbine niche, but households (in rural areas) are still the firm’s main customers. For its lower-priced products, Windon helps household purchasers negotiate contracts with installation companies, while systems costing over US$35,000 include installation. Egen El and Home Energy source their products from external manufacturers, while Windon produces its own wind turbines. This article does not focus on the interviews with representatives of these companies. Briefly stated, however, these companies saw cost as the major factor keeping households from adopting their products. In addition, the manager of Home Energy noted that customers often have difficulties understanding the amount of electricity the equipment actually produces. Even though the company provides exhaustive information on production capacity, customers often become disappointed when they discuss the matter in depth with a sales representative because this is generally the first time they realize that they will be able to produce only a small amount of the electricity needed to supply their household. The decision-making process often ends at that point as householders rethink the merit of their prospective investment.

| Company | Product | Inquiries and number sold to households in October 2008 |
|---------|---------|--------------------------------------------------------|
| Egen El | Balcony PV: 300 W, €2700 | Inquiries: 847 |
| | PV: 540 W, €4400 | Sold: 30 |
| | Wind turbine: 1000W, €5000 | 50/50 split between wind turbines and PVs |
| | Installation not included; no building permit needed | |
| Windon | Wind turbine: 10 kW, €25,000 | Inquiries: 12,000–13,000 |
| | Installation included; municipal building permit needed | Sold: 9 |
| Home Energy | Wind turbine: v100 350–600 kWh, €4000–4500 | Inquiries: data unavailable |
| | Wind turbine: v200 700–1200 kWh, €9000–9500 | Sold: v100 – homeowner = 1; companies = 7 |
| | Installation included; no building permit needed | v200 – companies = 7 |
Methods and Materials

The study was organized around semistructured in-depth interviews (Kvale & Brinkman, 2009). We interviewed representatives of seven retail companies, five grid companies, the industry organization (Swedenergy), and twenty households. This article focuses on our householder respondents who live in private homes and apartments throughout Sweden. The retail managers contacted them on our behalf and inquired whether they would be interested in participating in this study. Subsequently, the householders got in touch with us directly or we obtained their names and phone numbers from the managers. In general, we interviewed one family member per household, but on two occasions two adults were present. We normally contacted and interviewed the family member provided by the retailers; in some cases, however, the households chose a different adult family member to participate. Half of the interviews were done in the householder’s home and half were done by phone. We visited all households that had invested in a PV or wind turbine. The respondents were in different phases of the decision-making process, some having already decided whether or not to adopt the technology, while others were still seeking information about their options. At the time of the interviews, nine households had bought a plant, eight were still deliberating, and three had decided not to make a purchase. Of the nine households that had made a commitment, five of them had already installed the systems at the time of our intervention.

As mentioned, the interviews were semistructured and employed an interview guide covering the following matters: 1) background data; 2) first contact with the concept of small-scale electricity production; 3) reasons the households were interested; 4) barriers to and enablers of product adoption; 5) information received on the various products; 6) advantages and disadvantages of the various solutions under consideration; 7) the stage of the decision-making process that they were currently in; and 8) energy use—awareness and efficiency measures implemented. We recorded all interviews using an MP3 recorder/player and then transcribed the resultant recordings. Our respondent householders are anonymized for purposes of this article and are referenced as Householders 1–20. The householders were 30–75 years of age. The average household income was €65,000 (US$88,000) per year. A total of seventeen of the interviewed householders had university degrees. Three households resided in rental apartments and seventeen owned their own homes. Their total consumption of electricity and heat varied greatly, from 3,000 to 30,000 kWh per year. This is partly explained by the size of the homes and whether they used electricity for heat. But differences in lifestyle are also important in explaining these differences in electricity consumption. When analyzing the interviews, we discuss household perceptions of their energy use and stated motives for and barriers to adopting small-scale electrical production plants. Using an inductive method, we scanned the empirical material from the householder interviews to identify categories illustrating the various stated motives for and barriers to adopting such small-scale renewable energy technologies. While a household might express negative or skeptical opinions about such plants, it might have made the investment or still be considering it. In fact, and as shown above, at the time of the interviews only three households had definitely decided not to buy, while eight were still considering the pros and cons, which will be illustrated in these categories.

Motives for and Barriers to Householder Adoption of Small-scale Electricity Production

This section presents an overview of expressed household motivations for adopting, rejecting, or delaying an investment in small-scale energy production. We have categorized the material according to the main intentions identified in the interviews.

Motives for Adoption

Six partially interrelated motives were cited in the interviews and each is discussed in turn below. The motives were: concern for the environment, a way to set an example for others, as a protest against energy companies or the “Big Brother society,” to become independent, financial reasons, and technological grounds.

Concern for the Environment and Lifestyle Harmonization

“It is the environment, we must think about it” (Householder 8)—most respondents emphasized such a sentiment. Many stressed the importance of living in harmony with nature, including living as ecologically sustainably as possible in all everyday activities. This desire included avoiding long-distance travel and saving energy “fanatically.” Producing one’s own electricity was an important part of this sustainable way of life:

To me, it’s quite clear that we should not leave “ecological footprints” on the earth, but treat the environment with respect and dignity. Not steal resources from others, but

1 When two members of a single household were interviewed, this is indicated by appending “a” or “b” to the householder’s number.
use what is given to us. This is a fundamental value for me (Householder 3a).

This notion was shared by several householders, who saw the investment in renewable energy equipment as an important part of a lifestyle they wanted to uphold. One householder, for example, elaborated on the subject in greater detail. This individual considered buying a wind turbine and believed this would be in harmony with the family’s way of life:

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 (Householder 17).

**Own Production as a Way to Act and to Set an Example for Others**

Investing in a small-scale power plant is a tangible act. Householder 3a, who had purchased PV panels, described the decision this way: “To me, it’s like a manifestation of the thought.” For this household, the investment was a way to transform its environmental awareness into an environmental act. Householder 9, who was considering investing in solar panels, said, “It would just feel good, like you would actually be doing something.”

For other respondents, it was obvious that the investment was a social act and the emphasis was on its symbolism. It was a way to show neighbors and friends that it is possible to do something, even as an individual. Householder 5, who was thinking of investing in a balcony-mounted PV panel, expressed it in these terms:

If other people see that I have bought a [micropower] 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 investment was a way to set an example for others and to exercise “consumer power” (cf. Holt, 2002; Denegri-Knott et al. 2006). A common conception was that, if household demand for micropower plants that produce environmentally friendly electricity grows steadily, eventually there will be a smaller market for nonrenewable alternatives sold by conventional electricity companies.

**As a Way to Protest Against Energy Companies or the “Big Brother” Society**

Self-production of energy is a way for households to distance themselves from energy companies and to contribute to producing clean, green energy.

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” (Householder 4)! The investment was a kind of protest against the Swedish system, with its large, energy dominant actors: “It would be fun to score points off Vattenfall” [a major Swedish energy company] (Householder 6). Householder 8 said that his dream was to be completely disconnected from the grid company (cf. Spaargaren, 2000). Others saw their micropower investment as a statement against the whole social system:

Just to fight the “Big Brother” society. Definitely. Both Swedish and international power production and distribution are unfair, monopolistic, and counterproductive. The enterprises do not work in the interest of the people, but to earn money (Householder 1a).

Other households were more careful in their statements; for example, one respondent said that he just wanted to “annoy” the grid companies:

They are using our lifestyle in a speculative way that results in these big companies earning a lot of money from how we live and use our energy (Householder 9).

This individual apparently sees this dependency as something that the production of one’s own electricity can help put right.

**Own Production as a Way to Become Independent**

For some respondents who live in rural areas, a major reason for investing in a micropower plant was the possibility of using the natural resources available in their everyday surroundings to produce energy. This was an option they considered both logical and practical. They emphasized that they actively had chosen to live in a rural area to be able to live near nature and, for example, grow their own vegetables. They described investing in a micropower plant as part of their strategy to use natural resources. One individual, who had decided to buy a plant and install it near his house in the Stockholm archipelago, expressed it in these terms:
Since I have my own land with extensive access to wind and sun, then, to me, it seems sensible to produce my own electricity. It’s sort of like catching your own fish or growing your own potatoes. I find that awesome—it would make me more self-sufficient and I like the thought of that (Householder 12)!

Thus, producing one’s own energy was linked to becoming more self-sufficient. In fact, many respondents stressed the benefits of becoming more independent and less vulnerable in case of temporary power failure or longer periods of blackout: “I could handle a long-term siege using wood and this turbine” (Householder 8).

In contrast, some householders emphasized that a benefit of a micropower system was that one was still connected to the grid in case something should happen to their personal power plant. Others described the advantages in terms of wanting to exercise more control over their own energy situation.

**Financial Reasons**

Some households articulated the aim of being completely energy self-sufficient. At present, the Swedish government is investigating whether to make it easier and less expensive for individuals to sell the electricity that they produce back to the grid, a practice so costly today that it is typically not feasible for small-scale producers to do so. Most respondents expect a change in legislation that will benefit small-scale producers. For instance, one householder commented:

> What is so good about this [system] is that you can just send the electricity that you don’t use back to the grid. I get more out of it that way. Like 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 (Householder 14).

Despite the sentiments of this individual, most respondents expressed no intentions to earn money from producing energy; however, some still had financial motives. They reasoned that in the long run, the investment might pay off as electricity prices increased. The expectation is that the cost of measuring electricity delivered by small producers to the grid will decline substantially and it will become more beneficial for them to produce surplus electricity. Many households would welcome this as an extra incentive to invest in a micropower plant. In addition, some respondents noted that this opportunity would encourage them to invest in additional power plants, which suggests that economic factors are not insignificant. Other respondents 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 neighborhood,” explained Householder 2, due to the high investment cost of a wind turbine. This individual also noted that it was difficult to make the calculations connected with the investment because this entailed estimating the future electricity price—a methodologically challenging task. The respondents also said that they would rather invest in PVs and wind turbines than in luxury consumption items, such as swimming pools (an oft-cited example). One respondent even compared buying a PV panel to the purchase of a Mercedes, linking this acquisition with status and the symbolic aspects discussed above:

> Why do people pay extra for expensive cars? You buy a BMW or a Mercedes because you want to show something: you pay an extra 50,000 kronor (US$7,200) for that…Same thing with PV panels: in California they’re proper status symbols that show that you’ve got money. And in Germany, they say, “Why don’t you have PV panels on the roof? Haven’t you realized how good they are?” Next to your Porsche you’ve got to have solar panels on the roof, otherwise you’re not quite right in the head. Either you are not smart enough to know how good this is, or you are not environmentally aware enough or in tune with the times (Householder 16).

**Technological Reasons**

A final factor cited by respondents concerned the technology and the functioning of the power plant itself, namely, the delight of actually producing one’s own electricity. Many householders claimed that being able to generate electricity was a “fun” concept. They enjoyed watching their electricity meters show the kilowatts they produced themselves. The Egen El and Home Energy concepts appeal to people interested in new technology without being experts. Some said that they would never invest in a “real” PV panel because they were too technically complicated. According to the respondents, the systems provided by this new generation of companies are easier to understand, install, and operate: once the plants are plugged in, they do not need maintenance, and one only watches them produce energy.
**Barriers to Adopting Small-Scale Production Plants**

When we asked our respondents about their reasons for rejecting, or at least postponing, the investment, we received four more or less interrelated arguments.

**Investment Costs and Production Efficiency**

The most frequently cited hindrance was the high upfront cost of the power plants and their low production efficiencies relative to price: “36,000 SEK (US$5,200) for a solar panel is very expensive per kilowatt hour. For people working with energy, this idea is probably quite stupid,” said one individual (Householder 16) who eventually invested in PV. He thought that the energy companies evaluated the energy system on a different basis than households, and that the company only saw it as irrational to invest so much money for so little output.

Another respondent, who was delaying the purchase of a microgeneration product, said, “If you lose some money, that is no big deal, but this is very expensive” (Householder 6). Another individual decided to buy shares in a local wind-energy project and stated that regarding microsystems:

> The biggest disadvantage is the investment cost. To get a system that will produce any practical amount of electricity you will need to spend 45,000 SEK (US$6,500) and even then it will not produce many kilowatt hours per year. The investment is simply too big and the payoff time too long for me to dare to go for it (Householder 15).

As well, another respondent calculated that the installation cost would be double that of buying shares in a community-owned wind farm, and still another individual bought wind shares because he realized that he would need five turbines (and somewhere to put them) to supply his family’s electricity needs. Other householders thought that calculating payoff time and the like was at least very uncertain, because of the vagaries of estimating future electricity prices.

**Grid Companies and Regulations as a Hindrance**

A problem emphasized by several respondents was that the major energy companies have a monopoly on the grid and determine the connection fees. They thought that these firms were trying to hinder the installation of new net meters and that, by not giving clear answers, they were prolonging the permission process.2 “They cannot give a straight answer but refer to various paragraphs. It is very unclear…it is hard to move on in the process” (Householder 17).

Furthermore, respondents indicated that the new micropower concepts were so novel that the authorities had yet to develop routines for handling connection issues. One individual described it thus:

> Because this is a so-called pilot plant, there are many decision makers in both the municipality and the grid company who do not know how to respond when you ask something or apply for a building permit (Householder 19).

This individual felt that both the grid company and local authorities were major hindrances to the spread of microgeneration.

**Finding a Place to Locate the Wind Turbine without Risking Relations with Neighbors**

Several respondents observed that the major obstacle was finding appropriate locations for wind turbines. As one individual noted,

> Finances are not a problem for us…The problem is that the turbine needs to be installed near an electrical outlet. At the moment, we can’t see such a suitable place here. The most suitable location for us is several hundred meters away from an outlet. And if we put it on the roof, yes, then the mast will be really, really high. So right now we don’t know what to do (Householder 17).

Another problem was that the wind turbine could not be placed where the mast could fall into a neighbor’s property, which for one householder meant that it could not be installed in the optimal location determined by a wind test. This respondent could have placed the two-meter tall mast on the roof, but his female companion objected and said that this would be disrespectful to the neighbors. She remarked that the couple lives in an environmentally protected area in the middle of a village and neighbors would see the wind turbine as “visual contamination.”

Respondents who purchased shares in local wind cooperatives mentioned respect for neighbors as an important factor influencing their decision not to buy

---

2 The companies said, for example, that they would contact the household again, but never did, or that they were waiting for state policy in the area before deciding on net metering.
their own microgeneration system, but to invest in community-based production instead.

**Technology and Installation**

Even though the concept was launched as simple and viable for anyone, the technology itself was viewed as a hindrance. One respondent emphasized that, from a consumption perspective, it was disadvantageous to buy a product when it was new on the market, even for a good cause:

> 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 (Householder 1a)?

This householder meant that from a consumer’s point of view it is safer to invest in established products that many people have tried out. Then unexpected faults have already been found and corrected, they thought.

Respondents were also concerned that the power plants would need considerable maintenance, in spite of the companies’ promises that the products should be simple and not need any care. In general, individuals were unsure as to whether they would be able to install the products themselves. They also thought that they would need some expert help with the electrical installation:

> We would need to install the thing as well, and I am not a handyman and I don’t have the time for it either. It must be easy to install and preferably it should work instantly (Householder 17).

As we discuss below, some of these worries were justified.

**The Installation Process and Production Results**

As mentioned above, only five households had installed the energy systems. This section summarizes their experiences.

Egen El’s products, as previously discussed, do not include installation. The equipment is easy to order over the Internet, which the households in this study had done. Information about both the products and their installation was available on the company’s website. The description of the assembly process was clear according to the households, but some questions arose during installation. For example, some municipalities in Sweden require a building permit if a wind turbine is to be roof mounted, despite the manufacturer’s claim that such permits are unnecessary. Furthermore, none of these five households could manage the electrical installation on their own, as they lacked specific information about connecting the wires and running the cables. “Try to fiddle with it,” advised Egen El when contacted by one household. Cord lengths and missing parts were also noted as problems. In addition, the households lacked information on how to install the PVs for optimal functionality. For the wind turbines, raising the mast was difficult, not least because heavy parts had to be lifted high in the air.

**Conclusion**

We have seen that niche markets for small-scale PV systems and microwind turbines overall attract people who manifest strong environmental concerns and embrace a “green” lifestyle. The households that the firms enrolled in their networks understood the threat of climate change and that mitigating it would entail changing how energy is generated and used. The householders we studied also wanted to integrate electricity production into a green lifestyle, and self-production represented an alternative to buying green electricity from energy companies. Notably, however, not all households have extensive knowledge of either the energy system or the associated technologies: they are interested in the products for other reasons.

If we look at the households that adopted the equipment, we can see that their main reasons were that the investment gave the householders a “better conscience”; moreover, the investment is symbolic, offering a way to demonstrate an ecological lifestyle to neighbors and friends. In these cases, the installation decision has nothing to do with economic rationality. The investment is also seen as practical or sensible, mainly because the respondents often live in rural areas and have suitable locations for wind-turbine installation. Additionally, these individuals often have a lifestyle that includes self-production or local provisioning of many goods as possible; they had long wanted to try the technology, but thought that the PV panels sold on the market would be too complex to handle. Egen El’s and Home Energy’s products, in contrast, were seen as easier to understand and adopt, which gave the households the confidence to commit to them.

For households still deliberating over the purchase, the environmental argument was central. This rationale was the main reason for even thinking about adoption. Another frequently cited motivation for this group was to protest the monopolistic ways of the energy companies. To become independent and less vulnerable to power failure was also a common fac-

---

3 Sweden has around 70 wind cooperatives, with around 20,000 members; these facilities produce 10% of Swedish wind power.
to. The main hindrance at the moment was cost—microgeneration is expensive and the offered systems have low production efficiencies. Another recurrent obstacle concerned whether the respondents could correctly install the products on their own. Several of the households still considering buying the equipment were also awaiting new regulations in Sweden that would make it cheaper to sell self-produced electricity to the grid.

The respondents who ultimately turned down the opportunity to purchase small-scale PV systems and microwind turbines still think that such an investment was consistent with their desired lifestyles. The barriers to adoption, however, were viewed at the time as being too high, so they often tried to find other ways to contribute to green electricity production without investing in production plants themselves. These households rejected the small-scale equipment for economic reasons, because they had not found anywhere to install them, or did not want to annoy their neighbors. In relation to the economic aspects, these households viewed this investment as unduly expensive and concluded that economically superior alternatives were available.

Installation was an impediment in two respects: the households would either have to pay someone to do it for them or spend considerable time on their own (often with help from friends). Furthermore, the product retailers have different strategies when it comes to installation. Egen El requires customers to install the products themselves, which is a major barrier for households and may prove to be a significant factor for the company’s future sales growth. Some of our respondents also cited regard for their neighbors as the rationale for not adopting wind turbines. Though these households also saw many positive reasons for installing the micropower plants, the disadvantages were felt to be greater.

For the broader Swedish population to consider PVs and microwind turbines, both financial and institutional barriers need to be reduced. Sweden has long been reluctant to use financial assistance to speed up renewable energy adoption, but in July 2009 the government introduced subsidies for household installation of PVs. This measure has contributed to more general interest.

So far, promoters of the small-scale generation concept have mainly reached out to rural areas. To market the wind turbines to urban customers will probably be difficult because efficient use depends on placing the turbine high up in the air, and, at the same time, the equipment must not be at risk of falling into neighbors’ yards. However, in urban areas PVs are more suitable.

Another issue in appealing to the broad public is the regulatory regime; regulations need to be more widely disseminated so that people understand what to expect from existing grid companies when, for example, they want to sell electricity back to the grid. There is also a need for simpler regulations for measuring and selling such electricity, which would make the financial aspects more attractive and also appeal to customers who lack ecological motivations or an explicit interest in the technology. New regulations also need to address safety and insurance issues and a clause that forces the retailers of small-scale production to be up to date on, and to inform their customers about, existing rules.

The Swedish market for household PV systems and microwind turbines is still small, and there are no routine methods for marketing such products. One challenge of the current situation is manifest in the installation process, which the households are often expected to handle on their own. To reach wider markets, installation routines should be established in which households, when buying the products, are automatically offered professional assistance.

Although the amount of electricity produced by household-power plants might not be great in the near future, it is reasonable to suppose that they will become more common, not least due to rising electricity prices and greater demand for sustainable energy production.

Acknowledgement
This article derives from the research program “Self-produced Electricity for Sustainable Development,” funded by Elforsk and Göteborg Energi AB Forskningsstifelse. We would also like to acknowledge the comments of the three anonymous reviewers, whose insights were very helpful.

References
Denegri-Knott, J., Zwick, D., & Schroeder, J. 2006. Mapping consumer power: an integrative framework for marketing and consumer research. European Journal of Marketing 40(9–10):950–971.

European Parliament. 2006. Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on Energy End-Use Efficiency and Energy Services and Repealing Council Directive 93/70/EEC. Brussels: European Commission.

Faiers, A. & Neame, C. 2006. Consumer attitudes towards domestic solar power systems. Energy Policy 34(14):1797–1806.

Geels, F. & Kemp, R. 2007. Dynamics in socio-technical systems: typology of change processes and contrasting case studies. Technology in Society 29(4):441–455.

Hedrén, J. 2002. Critical notes on sustainability and democracy. In U. Svedin & B. Aniansson (Eds.), Sustainability, Local Democracy and the Future: The Swedish Model, pp. 17–48. Boston: Kluwer.

Hedrén, J. 2009. Shaping sustainability: is there an unreleased potential in utopian thought? Futures 41(4):220–225.
Holt, D. 2002. Why do brands cause trouble? A dialectical theory of consumer culture and branding. *Journal of Consumer Research* 29(1):70–90.

Jacobsson, S. & Lauber, V. 2006. The politics and policy of energy system transformation: explaining the German diffusion of renewable energy technology. *Energy Policy* 34(3):256–276.

Kaplan, A. 1999. From passive to active about solar electricity: innovation decision process and PV interest generation. *Technovation* 19(8):467–481.

Kvale, S. & Brinkmann, S. 2009. *Interviews: Learning the Craft of Qualitative Research Interviewing*. Thousand Oaks, CA: Sage.

Palm, J. & Tengvard, M. 2009. *Småskalig Elproduktion för en Hållbar Utveckling: Hushålls, Energibolags Och Återförsäljares Sfärenheter av Marknaden för Småskaliga Solpaneler Och Vindturbiner* (Small-scale Electricity Generation for Sustainable Development: Household, Energy Companies and Distributors Experience of the Market For Small-scale Solar Panels and Wind Turbines). Report 09:64. Stockholm: Elforsk. http://www.tema.liu.se/tema-t/medarbetare/palm-jenny/Publikationer/1.199148/09_64_rapportEgenEl.pdf (in Swedish).

Pedersen, L. 2000. The dynamics of green consumption: a matter of visibility? *Journal of Environmental Policy & Planning* 2(3):193–210.

Rohracher, H. 2003. The role of users in the social shaping of environmental technologies. *Innovation* 16(2):177–192.

Schot, J. & Geels, F. 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda and policy. *Technology Analysis & Strategic Management* 20(5):537–554.

Skill, K. 2008. *Recreating Ecological Action Space: Householders’ Activities for Sustainable Development in Sweden*. Doctoral Dissertation, Department of Thematic Studies, Linköping University, Linköping, Sweden.

Spaargaren, G. 2000. Ecological modernization theory and domestic consumption. *Journal of Environmental Policy & Planning* 2(4):323–335.

Spaargaren, G. 2003. Sustainable consumption: a theoretical and environmental policy perspective. *Society & Natural Resources* 16(8):687–701.

Spaargaren, G. & van Vliet, B. 2000. Lifestyles, consumption and the environment: the ecological modernization of domestic consumption. *Environmental Politics* 9(1):50–76.

Swedish Energy Agency (SEA). 2010. *Energy in Sweden*. Report ET2010:47. Eskilstuna: SEA.

Swedish Government Official Reports (SOU). 2008. *Ett Effektivare Sverige: Delbetänkande av Energieffektiviseringsutredningen* (Energy Efficient Sweden: Interim Report of the Energy Efficiency Inquiry). Report SOU 2008:25. Stockholm: Swedish Government Official Reports. http://www.sweden.gov.se/content/1/c6/10/01/76/9e6cf104.pdf (in Swedish).

Verbong, G. & Geels, F. 2007. The ongoing energy transition: lessons from a socio-technical multi-level analysis of the Dutch electricity system (1960–2004). *Energy Policy* 35(2):1025–1037.