Service interest and cluster membership – Who are the pioneering users in energy efficiency service markets?

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Abstract

This article studies the structure of the energy efficiency service markets in Finland. The research focuses on studying who are the most pioneering users of energy efficiency services. In a previous paper, consumer's interest in different types of innovative energy efficiency services was identified. Psychographic characteristics were found that describe people according to their leaduserness, skepticism and mass market following behavior. The aim of the present paper is to fill in the gap and deepen the understanding by studying how the most pioneering users differ from other consumers in the market. We draw on the background of lead user theory by von Hippel (1995) and of diffusion of innovations theory by Rogers (1995) and Moore (1991). The research is based on an empirical survey conducted in Finland in 2013. The results show that the most pioneering users differ statistically from the mass market consumers.

Keywords: *energy efficiency, services, leaduserness, market potential*

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1 Introduction

This article presents the results of an empirical market potential study of "smart" energy efficiency services in Finland focusing on finding out whether qualitatively different segments can be found in the electricity markets. If segments can be found, how do they differ from each other and who are the most pioneering users in the electricity markets? What are the implications our findings for the future development of energy efficiency services?

The need for the research originates from the necessity of the electricity companies to find new ways of doing business because of the ongoing change in the business logic of the electricity sector caused by the pressures of climate change mitigation. The Energy Efficiency Directive (EED 2012) requires companies to reduce their clients' electricity consumption yearly by 1.5 %. Therefore, electricity companies need to build new business enabled by the novel opportunities emerging from the "smart" technologies. Services focusing in energy efficiency have slowly emerged in the electricity markets, but most companies are reluctant to invest time and money in the development of services that for one have an uncertain demand, and second, would most likely not offer huge revenues at this early stage of the market development, even if they were well received in the markets. Even though most of the service concepts are still in a pilot phase, the future perspectives go much further than their current applications: new ideas can be expected to emerge when the markets for energy efficiency services mature. The challenge is that the market development of "smart" energy efficiency services is at a very preliminary stage and customers have not really found them yet. The industry is, thus, in need for information and analysis of the market potential of these services. Therefore, our research analyses the market structure of the novel energy efficiency services in Finland.

Electricity sector has however, remained a sector where the diffusion of service innovations have not been much researched or conceptualised before, which is quite surprising considering the framework and infrastructure in the electricity sector: Energy itself as a product is invisible and consumers do not buy electricity to have electricity, instead they buy electricity to be able to do something with it. Electricity therefore produces services to people, which is why it is surprising that the electricity companies have not evolved to service providers a long time ago already. Research until now has mainly focused on smart metering or the influence of different displays on energy consumption or conservation behaviour. International studies of smart metering use suggest that some consumers are more likely than others to have an interest in energy efficiency services (Hargreaves et al. 2013; Wallenborn et al. 2011; Klopfert and Wallenborn 2011; Gagnale et al. 2013). As von Hippel (2005) observes in his well-known theory, consumers with needs that precede those commonly encountered in the market could hence offer a 'lead market' or serve as 'lead users' for launching and developing new products or services. Previously, Heiskanen and Matschoss (2012) have studied emerging customer need for smart grid applications in Finland. They have observed that lead users can be identified even in such a "difficult" market as the energy market.

Some innovations diffuse from lead users to the mass market as has been empirically witnessed (Woesdorfer and Kaus 2011) but there is also evidence that innovation diffusion stops after the initial stage and that some innovations never manage to enter the mass market. As an answer to this problem, Rogers (1995) has proposed a most-widely quoted theory of the diffusion of innovations based on the structure of the markets, which builds upon qualitative differences between the market segments. Moore (1991) has developed this theory further claiming that there is a chasm between the innovators and early adaptors of a product or service and the mass market, which is based on the assumption that there are significant qualitative differences between the customers on both sides of the chasm. This would partly explain why some innovation never manages to succeed and to reach the mass market.

The obvious benefit that lead users can bring

to service or product developers is that lead users are often the first ones to find the new products or services. There is empirical evidence (Gruner and Homburg 2000; Lüthje and Herstatt 2004) that integrating lead users in the product development in the beginning phase has a positive effect on the product's acceptance and spreading in the market. According to the lead user theory of von Hippel (2005), lead users are ahead of trends as compared to average users and have higher expectations on the potential benefits. Lead users can be respected opinion leaders in their surroundings and therefore act as a channel through which the products or services can spread to others in the markets (Bloch 1986).

However, the electricity market is a difficult market for lead users as it is strongly controlled and there is very little previous research done in studying the suitability of the technology diffusion theory or the lead user theory to electricity markets. New innovations in the electricity market deal with new ways of combining existing services or products rather than with completely new products based on new technology (Matschoss et al. (in press)). Therefore, finding lead users is a difficult task in any market but especially in the electricity market. Our research aims to fill in this gap in knowledge. The effort of recognising the most pioneering users was made with the help of a survey conducted in Finland in March 2013. In this paper, we use the term pioneering users to broadly describe lead users, i.e. those users that are ahead of trends, make own innovations and act as opinion leaders in their surroundings.

The key question in our research is: are pioneering users principally different from the people in the mass market and how, or are there no real differences between pioneering users and the mass market followers? More specifically, our research questions are:

1. Can qualitatively different segments be found even in the challenging electricity markets in respect of the purchasing behaviour related to energy efficiency services?
2. If segments can be found, how do they differ from each other?
3. Who are the pioneering users in the electricity markets?
4. What kind of implications does this have for the future development of energy efficiency services?

This article builds on a previously published article by the authors, which presents the first part of the research results and where the survey data is presented in more detail. This paper deepens the understanding of the structure of the energy efficiency service markets and brings the research further. In the following, we first discuss the theoretical background of the research in section two starting with overview into service and service innovation literature and moving to theories about customer involvement and diffusion of innovation with an approach to market segmentation. The third section presents the applied methods and the research data. The fourth section presents the analysis and the fifth its results. We conclude by discussing the implications of the results and suggest further research.

2 Theoretical Background

There are many definitions to services, which have been studied e.g. by (Edvardsson et al. 2005) which has led them to define service as a perspective on value creation, while Grönroos and Gummerus (2014) have defined service as the use of resources in a way that supports customers' everyday practices and so facilitate their value creation. Recent discussions in the literature about services indicate a shared interest in orienting the focus toward the customer context and the process of the customer's value creation (Saarijärvi et al. 2014). In addition, the literature shows that new and innovative service-based business models have emerged, which make a better organisation of the firms possible to better meet, on the one hand, the evolving customer needs and, on the other hand, competition because these business models relate how the companies can facilitate customer value creation and capture value in

return. The literature further discusses the need for shifting from service-oriented business logic to service business logic (Grönroos and Gummerus 2014) and consumer involvement has been suggested to be a way to activate a service-centred view on new service development and a focus on value-in-use (Matthing et al. 2004; Vargo and Lusch 2004). Moreover, in case of electricity sector, novel business models based on services increase the momentum for a necessary transition of the electricity industry towards low-carbon energy industry.[1]

Saarijärvi et al. (2014) have researched the reverse use of customer data and its implications for service-based business models stating that in service business logic a firm takes a broader role in the customers' value creation process by supporting their everyday activities while the emergence of technological advances and empowered customers suggest the need for reverse use of customer data, which gets converted into information that is usable in customers' value creation processes. Moreover, approaching customer value as a customer-led process puts pressure on how companies can support customer's value creation in ways that go beyond the provision of good and adopt service business logic. One of the examples Saarijärvi et al. (2014) describe is a display that shows the electricity consumption in real time, which is a similar service that is been questioned about in our survey. The value proposition of this specific service is to shift focus from selling electricity to serving customers' energy needs, in this case involving the deliverance of feedback on actual real-time energy consumption aiming to educate the customers to become more responsible consumers of energy.

The theoretical framework until now has not conceptualised the service innovation point of view as well as the product innovations (Nijssen et al. 2006) although innovation can be defined as the generation, acceptance and implementation of new processes, products or *services* for the first time within an organisational setting (Thompson 1965). Gallouj and Weinstein (1997) have made an attempt to lay a foundation of a theory to interpret innovation processes in the service sector whereas Nijssen et al. (2006) have analysed the similarities and differences in product and service innovations. While the success factors for both product and service innovations are similar, in service innovation important is the creation of the pre-requisites for the service (Edvardsson and Olsson 1996). Because services are produced real-time, the service production innovation process goes hand in hand with modification of the service delivery process and therefore the interaction between them is high. Nijssen et al. (2006) suggest that influence of organisational inertia is more important in case of service innovations. (See also Grönroos and Gummerus 2014 for an innovation approach going through the whole organisation). Also Sundbo (1996) has studied the innovation empowerment within a firm although he does not focus on services in particular. Innovations on service delivery have been studied previously also by Chen et al. (2009) and this research has found out that innovations in service deliverance facilitate a superior financial performance. Electricity sector has, however, remained a sector where service innovations have hardly been researched or conceptualised although electricity itself as a product is invisible and consumers do not buy electricity to have electricity (for example like you own a car), instead they buy electricity to be able to do something with it (like to have light or listen to music from the radio). Electricity therefore actually delivers services to people, and probably mostly due to the traditional centralised nature of the industry electricity companies have not evolved to service providers already a long time ago. In addition, the material infrastructure of electricity networks is strictly regulated and the consumers are not allowed to make changes to the electricity infrastructure in their homes. Therefore, one would expect that the innovations in electricity business would have emerged precisely in services and that such services would have long been the driving force in the value creation in this field.

1 There is literature about the changing roles of system suppliers towards solution providers, which is however not the focus and therefore not discussed in this paper (see e.g. Helander and Möller, 2008a; Helander and Möller 2008b).

The market development of "smart" energy efficiency services is at a very preliminary stage. The industry is therefore in need for better understanding of the market structure of these novel services, because innovation in services is a central issue due to its increased and further increasing importance both socioeconomically and commercially (Sundbo 1998, 1996). Innovations in service deliverance have been found out to facilitate a superior financial performance (Chen et al. 2009). In addition, because different kinds of innovation require different kinds of policies (Geels and Schrot 2007), it is likely that there are also differences in the consumers targeted by the service innovations and it has been widely accepted that new service development relies on understanding and anticipating changing customer needs (e.g. Edvardsson and Olsson 1996; Matthing et al. 2004, Sundbo 1998). According to Chesbrough (2007, 13) a business model consists of parameters that are interlinked: value proposition, target market, value chain, revenue mechanism(s), value network or ecosystem and a competitive strategy. The focus of the target market approach is to identify and define important and relevant customer groups and segments (Saarijärvi 2014). On the other hand, there is literature that recognises also customers as possible innovators (e.g. von Hippel 2007, Rogers 1995, and others) and Sundbo (1998, 153) actually suggests that "innovation is driven by customers in the market". Moreover, literature also shows that innovativeness is domain specific, meaning that people who are innovative in one sector may be non-innovators in another (Goldsmith et al. 1998). In services and especially in a creation of novel services, the customers have a crucial role in the success of service supply because, for one, they need to be a part of the service production process (e.g. Edvardsson and Olsson 1996; Grönroos and Gummerus 2014; Saarijärvi et al. 2014) and, for the other, customer ideas are more innovative (Matthing et al. 2004). In addition, innovative service activity not necessarily includes any material technology (Sundbo 1998, 1996) even though the deliverance may be enabled by novel technologies as is the case with smart grids. Sundbo (1998, 156) suggests that "technology has simply become less suitable as an innovative driving force. Instead interpreting the market [...] have become the great challenges." Therefore, there is a need to pay closer attention to the potential innovators and first users of novel energy efficiency services. The problem is, however, how to identify the appropriate set of customers (Matthing et al. 2004). Our original research contributed to this aspect of business model creation of the energy efficiency services.

Our empirical research is based on the well-known diffusion of innovations theories of Rogers (1995) and Moore (1991) as well as on the renowned lead user theory of von Hippel (2005) even though these theories have not taken an interest in innovation in service (Peres et al. 2010; Sundbo 1996) and there is not much research done in the area of services and innovation theories and in particular not related to energy efficiency services. To the knowledge of the authors, researchers have not analysed on the basis of primary data the explicit nature of different customer groups in energy efficiency services before. Therefore, this paper presents the results of original and novel research and aims at incorporating insights from diffusion of innovations theory into analysis of the market structure of energy efficiency services.

According to von Hippel, Rogers and Moore, the first users are qualitatively different from other users in the market. However, Morrison et al. (2004) have suggested that there are no qualitative differences between the most leading edge users and the mass market, and that diffusion from lead users to mass market is only a matter of time. They have presented evidence for a concept of *leaduserness*, in which the lead user status is considered continuous, which means that consumers can have only little or much of it. It also means that consumers can evolve in time and develop more leaduserness e.g. as they gain more experience. This would imply different approaches for service developers on how to address consumers in the markets.

Lead users of von Hippel (2005) are individuals who are ahead of trends as compared to average users. They have higher expectations on the poten-

tial benefits brought by novel services (von Hippel 2005; Churchill et al. 2009). Therefore, lead users are the ones that usually are the first to find new services or develop them themselves. Because the needs of lead users are ahead of the market, they are willing to participate in the development of new products or services (Herstatt & von Hippel 1992; von Hippel & Riggs 1996) in order to obtain what they need. There is evidence that developing services together with lead users makes a positive influence on their acceptance in the early markets. This is the case especially in the preliminary phase of service or product development (Gruner and Homburg, 2000; Lüthje and Herstatt, 2004). Lead users can help to identify strong market opportunities and develop new concepts for products or services (Churchill et al. 2009). Lead users often act as opinion leaders for their surroundings and therefore they can enable the spread of products to other consumers in the markets (Bloch 1986).

Even though Oudshoorn and Pinch (2003) and Churchill et al. (2009) show empirical evidence that some innovations diffuse from lead users to the mass market, not all innovations manage to spread to the mass market and reach maturity. Moore (1991) suggests that there are several customer groups in the market depending on the time of adoption of an innovation. In his theory, the first group to adopt an innovation or even innovate themselves are innovators, followed by early adopters. The first larger group to adopt a novelty is called the early majority followed by the late majority. The final group to adopt are the laggards. Moore (1991) suggests that there is a chasm between the innovators and early adopters and the mass market. According to his theory, the most leading edge users are interested in technology and are seeking for novelties to be able to reach better performance than before. They expect high benefits for being the first to experiment with a new innovation. There is thus a theoretical overlap between the two concepts of lead users and innovators/early adopters. This paper will not make a distinction between the two concepts, because the aim is not to set the two theories against each other. In this research, the authors consider both innovators and early adopters (Moore 1991) and lead users (von Hippel 2005) to form together the group of pioneering users.

The mass market forms two thirds of the whole potential market of a product or service. The first group in the mass markets, the *early majority*, can be described with an ability to somewhat understand technology but who are dominated by strong pragmatism (Moore 1991). Consumers belonging to the group of early majority are not technology enthusiasts like the most leading edge users, but, if it enables them to make the same things as before except for easier, they are willing to try something new (Rogers 1995). They seek for advice and listen to experiences of their neighbours and friends before they purchase anything new. The *late majority* is very risk averse and interested in a new technology only after it has become the norm in the market (Rogers 1995). They feel helpless with new technology and want to be sure that their equipment really work. That is why they prefer buying a product from a market leader, so that they can be sure of the quality of service and of help in case of problems (Moore 1991). The last group of consumers adopting a new service or product are laggards. According to Moore (1991), they only purchase a product when it is included into another service or *product* so that they do not realise buying anything new or when it is sunk so deep within another service or product that it is impossible to avoid purchasing it.

There is previous empirical evidence also from the Finnish electricity markets that groups can be found in the market that show qualities that topically describe pioneering users. In an empirical study conducted in the Finnish energy markets in 2011, lead users (as understood by von Hippel) were found among people living in single family buildings and having an electric heating system (Heiskanen and Matschoss 2012). Lead users were also found among people who had changed their heating system or installed advanced home automation. In addition, lead users were among people who were concerned about the environment.

Our objective in this paper is to apply elements of the diffusion of innovation theory more system-

atically to the evolving energy efficiency service context to provide a more differentiated view of the qualities of the different consumer groups and an initial exploration of the managerial and research implications arising from this new understanding.

3 Methodology

3.1 Data

This article draws on a nationally representative *Energy efficiency in Finland* –survey conducted in spring 2013. The questionnaire that comprised of questions on adapting new technologies in terms of energy-efficiency services, the providers of these services, general attitudes on energy services, as well as the respondents' background, housing, and housing-related purchases was send to 5,000 Finnish citizens. A random sample of people aged 18 to 70, was drawn from the Population Register Centre's database. A total of 1,240 respondents returned the questionnaire with a response rate of 24.8 per cent.

The modest response rate may result from the topic being difficult to grasp for the respondents. In comparison with the whole population, the data has some small biases, which are probably connected to the subject matter of the questionnaire. Most substantial, and yet expected bias is the over-representation of respondents living in detached houses, in households with three or more people, in houses with either oil heating or wood or pellet heating, and respondents living in houses built after 1980 compared to the 2013 population census. Also respondents owning one or more holiday homes were slightly overrepresented in the data. In respect to socio-demographic background, 45-64 year olds, respondents with higher education, and respondents in working class occupations were slightly overrepresented as compared to the whole population. (For more detailed information about the data see Matschoss et al. (in press)).

3.2 Measures

The main challenge in conducting this study has been the operationalization of leaduserness and the development of measures that reflect the key constructs of the Moore's innovation diffusion theory. The difficulties lie in the structure of the electricity market, in the electricity as an immaterial commodity, in consumers' perception of energy efficiency and services and the topic of energy itself. The focal challenges in studying electricity efficiency services are related to the limited consumer knowledge on energy issues as well as lack of involvement of the consumers in energy discussions as well as negative attitude towards the new services, as the general understanding of reducing energy consumption is understood to cause discomfort (see Matschoss et al. (in press)).

In order to examine customer segments in the electricity market, questions concerning attitudes towards energy and respondents behaviour deriving from Moore's theory (1991), questions reflecting leaduserness, recommendation seeking as well as service purchasing behaviour were introduced in the survey. The survey made use of questions from a previous study on smart grid services (Heiskanen and Matschoss, 2012; Heiskanen et al., 2012) for identifying most pioneering users such as: "I have been interested in energy already for a long time", "I readily advise my friends about energy issues", "I monitor my energy consumption by keeping records of the electricity consumption in different years (e.g. Excel-tables)", "I like to follow technical developments in newspapers and TV", "I have developed some small technical inventions at home or at work", "I have actively looked for home automation to control appliances in my home", "If an electric appliance does not work, I usually know what the problem is" and "I would be interested in participating in the innovation work of my electricity company" (Matschoss et al. (in press)).

Metrics designed to reveal attitudes towards recommendation seeking and service purchasing from market leaders as well as scepticism were also included into the survey. We operationalized interest towards novel energy efficiency services

with survey questions such as "I like to take part into pilots and experiments because I would like to change the world", "I find it easy to grasp the benefits of new solutions", "I want recommendations from reliable sources before I purchase a new product or service", "I do not like to buy any new solutions, if there are no successful examples of real users in my close environment", "I would prefer buying an energy efficiency service only from a market leader" and "I am interested in buying an energy efficiency service only from large reliable companies" (Matschoss et al. (in press)). Also survey questions concerning the respondents' views on energy companies were introduced. These included "I trust that the services of my electricity provider respect the customer's privacy", "I do not necessarily trust in getting a fair deal from an electricity company", "I am dissatisfied with the possibilities to save energy offered by my electric company" and "the equipment offered by the electricity company is of good quality that does not break down or damage other appliances" (Matschoss et al. (in press)).

The respondents' interest in services was explored with questions concerning acquiring novel services, such as real time displays to monitor electricity consumption, equipment to control electricity consumption, services for installing energy saving devices (LED, heat pumps), micro-generation with solar panels or micro-wind power, micro-generation equipment (solar, wind) and installation via electricity provider, and on-site energy audits by experts. We asked how interested the respondents were in these services assuming the services would pay off as energy saving within the next 1-5 years. The respondents were inquired if they had already purchased the service, were considering purchasing the service, were interested in getting more information about the service, were not interested in the service or were not willing to get the service under any circumstances. A full listing of the items in the study and their distributions is presented in Matschoss et al. (in press).

3.3 Statistical methods and variables

In the past decades, segmenting customers and populations based on their lifestyles and psychological characteristics has been popular in market studies. In customer segmentation there has been a strong assumption of association between attitudes and behaviours obtained from psychological theories (cf. Nunnally 1978, Sjöberg & Engelberg, 2007). In our analysis the basis of the approach is to bear on attitudinal variables to derive segments.

We build the analysis on our previous examination depicting the psychological factors that are related to energy efficiency service market segmentation (Matschoss et al. (in press)). Attitudes and behaviours described above were originally measured with five-point Likert-scale anchored by totally agree and totally disagree. We found three factors that describe the structure of the markets in line with the technology diffusion theory of Moore (1991) and Rogers (1995) and represent three different orientations towards energy efficiency services. These factors were *leaduserness*, *following the market* and *scepticism*[2]. Variables for psychological characteristics were constructed with Principal Component Analysis (PCA).

The three factor variables were normally distributed in the data and the factor score derivation

2 The statements that were included in the construction process included a range of statements on respondents' attitudes and behaviour. The original statements presented to the respondents that were found to represent leaduserness were "I like to follow the technical developments in newspapers and TV", "I readily advise my friends about energy issues", "I have been interested in energy for a long time", "I have made some small technical solutions in my home or work", "I have actively searched home automatics that guide appliances in my home", "If an electric appliance does not work, I usually know what the problem is", "I gladly follow my energy consumption by making notes of the electricity consumption in different years (e.g. Excel-tables)", "It is easy for me to see the benefits of new solutions", and "I'm fascinated by the idea that consumers could produce electricity into the electricity network". The statements that were found to represent following the mass market were "I buy an energy efficiency service only from a market leader", "I am interested in buying an energy efficiency service only from large reliable companies", "I am interested in buying an energy efficiency service only if it is offered as a give-away with another service or a product", and "I don't like experimenting new products or technology". Scepticism was operationalized with statements that included "I am not interested in taking a new service in use until it becomes an established practice", "I do not like to buy any new solutions if there are no successful examples of real users in my close environment", "I am sceptical about solutions produced by multiple actors", and "I don't like experimenting new products or technology".

(Regression) and the rotation method used (Varimax) resulted in variables not being correlated with each other. The factor scores were coded, so that a higher factor score represents a higher level of characteristics. The three variables were measured in standard units (mean=0, std. deviation=1). The range for leaduserness varied between -2.62 and 3.07, for scepticism between -3.02 and 2.86 and for following the mass market between – 2.99 and 4.39.

K-means cluster analysis is a method that is often used to group customers into different sectors for marketing purposes to identify underlying structures in the data, to identify natural classifications in the data and to organise and compress the data through cluster prototypes (Arabie and Hubert 1994). The aim of cluster analysis is to group naturally a set of objects, which enables making quantitative comparisons on the basis of multiple characteristics. However, the negative side of the method is the inherent vagueness in the definition of a cluster (Jain 2010). We use cluster analysis to analyse different consumer groups and the structure of the electricity markets on the basis of factor scores to avoid the problem of unequal weighting. Since factor scores are weighted combinations of correlated variables, they are likely to be more reliable, and generally of higher quality than the individual variables. (Fiedler and McDonald 1993.) The challenges of using clustering methods are associated with defining what is a cluster, how many clusters are present in the data and which cluster method should be used (Jain 2010; Fraley and Raftery 1998).

In order to define the proper number of clusters, we lean first on Moore's theory of technology diffusion: Moore's (1991) theory depicts three major groups with different qualities in respect to their relationship towards innovation adaption: the most leading edge users, the consumers in the mass market and the passive laggards. Therefore, our starting point was that there are at least three groups of consumers in the markets that differ from each other. Second, we adopted the agglomerative hierarchical method to comprehend how many possible clusters would bring a plausible and proportionate solution reflecting the structure of the market as well as relating to the technology diffusion theory. We will first take a look at the clustering in the data.

In order to find out the characteristics of the different consumer groups, we examine the clusters by cross-tabulations with variables representing the respondents' background. We first take a look at the socio-economic background (gender, age, education, occupation and income) of different clusters. Thereafter, the clusters are scrutinized against variables representing housing (building type, year of construction, apartment size, location, and form of heating).

4 Findings

4.1 Cluster profiles

The psychological characteristics representing the orientation of the respondents in electricity markets are *leaduserness*, *scepticism* and *following the mass market* (for more information see Matschoss et al. (in press)). The hierarchical cluster analysis executed with these constructs describing the psychological characteristics of the respondents showed that there was no major added value of having more than seven clusters. Therefore, solutions with 3 to 7 clusters were tested. In the solutions with three clusters, the groups were too large for meaningful interpretation against Moore's scheme. Moreover, in solutions with 6 or more clusters, the cluster sizes were too small; the smallest cluster containing just 18 respondents (Janssens et al. 2008; Schmidt and Hollensen, 2006). The 4 and 5 cluster solutions were evaluated on the basis of the interpretation of different clusters, and from the viewpoint of substantial interpretation the 5 cluster solution was found optimal. Table 1 lists the sizes of clusters with a number of cluster solutions, whereas the table 2 below lists the final cluster centres and the sizes of the clusters with the 5 cluster solution. Table 2 presents the results of the five-cluster solution based on the combinations of the three underlying psy-

chological characteristics. The people belonging to individual clusters show different attitudes and have different level of expertise. Appendix 1 shows in more detail the construct of the psychological characteristics.

Consumers in the **first cluster**, *innovators*, score negatively in the "following the mass market" construct. They are the group with least orientation toward the mass market, which is in line with the innovation diffusion theory of Rogers and applies also to service innovations in energy efficiency. Their score is high in leaduserness, which entails e.g. following technical developments and interest in energy. They are also fairly sceptical, which fits fairly well into the theoretical profile of innovators as they do like to take a critical look at existing markets and like to invent their own solutions. In addition, every technology includes a possible threat that also innovators need to manage (Mick and Fournier 1998). When compared to the survey questions, innovators have expertise concerning electric appliances. They are dissatisfied with the services that their electricity company offers and would be in need of new ones as well as experience suspicions of joint services production by many business actors and doubt the profitability of services offered by others. The innovators would be a good group to be involved in a very early stage of new service development to gain their insights of some very new.

Consumers in the **second cluster**, *early adopters*, have a positive attitude towards new technology and novel solutions. They score positively in leaduserness and form the least skeptical group of all clusters. Early adopters are experimental and would like take part in pilots and in the innovation work of their electricity company. Their attitude towards energy and energy companies is positive and they also trust their energy company. These consumers would be the ones the electricity company should address at the early stages of service pilots because of their interest in energy, technology and because of their overall positive attitude towards novelties and energy companies. These consumers are typically active also in different associations such as nature protection, housing or condominium associations so their involvement would increase the possibilities of the novel service being accepted in the market and the chances of a fast diffusion would be enhanced. (See appendix 2 for social activism.)

Table 1 Size of clusters for three to seven cluster solutions (K-means cluster analysis)

NUMBER OF CLUSTERS	SIZE OF CLUSTERS
3	463 -491 - 286
4	425 - 195 - 345 - 275
5	267 - 292 -191 - 309 -181
6	238 - 273 - 18 - 224 - 216 - 271
7	287 - 231 - 18 - 254 - 165 - 11 - 274

Table 2 Final cluster centre, (K-means cluster analysis)

CLUSTER	1 INNOVATOR (N= 181, 14.6%)	2 EARLY ADOPTER (N= 309, 24.9%)	3 OPINION LEADER (N = 191, 15.4%)	4 FOLLOWER OF THE MASS MARKET (N = 267, 21.5 %)	5 SCEPTIC (N = 292, 23.5%)
Leaduserness	0.66	0.45	0.99	-0.78	-0.81
Scepticism	0.58	-1.06	0.70	-0.45	0.72
Following the mass market	-1.28	-0.26	0.96	0.72	-0.21

Consumers belonging to the **third cluster**, are an interesting combination of all psychological characteristics. They score the highest in leaduserness as well as following the mass market, although in theory these characteristics should be more or less opposite. They are also very sceptical compared to the other groups. The explanation might be that these people could be quite open to their surroundings, like to give advice to their acquaintances and to make own judgements critically. They are typically dissatisfied with their electricity company's service supply, although they tend to buy energy efficiency services from big, settled market leaders. They follow the markets closely, but are not among the first to purchase technical innovations. They share some characteristics with the sceptic cluster; dissatisfaction with the present supply of services and the interest in purchasing energy efficiency services only if they are offered as a give-away with another service or a product. On the other hand, these consumers can be considered to be *opinion leaders* due to their openness to energy issues, following the market critically and the ability to give advice.

The respondents in **the fourth cluster** can be addressed as the large *mass market*. They are not lead users, as they are not especially interested in energy; they have no expertise concerning electric appliances, energy, or technology. Thus, they do not score high on scepticism, and they gladly accept help in energy saving. We named the respondents in the **fifth cluster** as *sceptics*. They score the highest in scepticism and the least in leaduserness. They ask for recommendations and are interested in taking a service in use only after it has become an established practice or after there are successful examples of real users in their environment. The sceptics are not especially interested in following energy issues in the media. They are suspicious of new services and of their electricity company and they score negatively in following the mass market. They do not like to experiment and are no handymen at home. The sceptics have taken the least action to fight against climate change.

Consistently to the theory, the group of innovators is the smallest in our sample of respondents their share being almost 15 percent, while in innovation diffusion theories their share is expected to be 5-10 percent of the population. There might be a possible bias in our data, on the one hand, towards innovators and, on the other hand, towards the most sceptical respondents. We suppose that the "grey mass of normal customers" in the energy market might not have been reached as well as the other groups, because the most active and interested consumers often take the chance of responding to a subject that they find interesting but also the most sceptical and actively opposing consumers like to take the opportunity to make their voices heard because a an anonymous survey questionnaire offers an easy channel to give negative feedback and express mistrust and scepticism. The implications of this unverifiable respondent bias mean that even though in our sample the share of groups with a positive attitude altogether is almost 55 percent, it might not be a realistic market share of first customers for these services.

4.2 Characteristics linked to cluster membership

The socio-demographic background of the respondent by consumer clusters is presented in Appendix 3. The *innovator* cluster has male domination. Most innovators are middle-aged or older, and they have practical education (such as vocational schooling or high school degree) or a college degree. The majority has technical schooling. Their innovativeness can at least partly be explained by the expertise that they have gained in practice and in professional life. Majority of *early adopters* are also male. The profile of the group is younger than the profile of innovators. They are more educated, earn more and most likely have education from the technical field. *Early adopters* are also more often clerical workers or in a managerial position than respondents in other clusters. Therefore, one factor in addition to their open attitude that makes them early adopters is also their better financial standing. *Opinion leaders* are

also mostly men, middle-aged or older and they usually have gone through basic or vocational schooling. A third of opinion leaders have been educated in the technical branch. A half of the group is outside working force and a fourth work as manual workers. Opinion leaders have slightly smaller income, than the two groups presented previously.

Mass market followers are often women and more than 45 years old. They have either gone through vocational schooling or have a college degree. The majority of the cluster has a degree from health and social field or general education. They work in manual or clerical work or are outside the working force. The *sceptics* are mostly female and middle-aged or older. They have rarely university degree, and most often they have education from general or technical field, health and social branch, or services. A large proportion of sceptics are outside working life or work as manual workers.

The clusters differ also by housing (Appendix 4). Opinion leaders, early adopters and innovators most often live in detached houses larger than 80 m^2, which may explain their interest in energy services. In Finland, apartment buildings are usually heated with district heat and sometimes the electricity belongs to the rent, which is fixed, so there is no incentive to become interested in energy, because it just is not present in the lives of these people. Mass market followers, sceptics, and early adopters live in homes that are more often heated with electricity (either direct or storage). Opinion leaders and innovators have more often oil heating, wood or pellet heating and slightly more often additional heat pump than the respondents in other groups. Innovators have more often also electrified leisure apartment, than the respondents in other groups. Early adopters and innovators report having changed their electricity retailer more often than respondents in other groups.

The influence of the cluster membership on service adoption behaviour can be seen in table 3. The early adopters have been the first group to adopt new energy efficiency services. The table gives notions on the maturity of the energy efficiency services in the market development. According to the service interest expressed in the data, the real time home electricity displays are the services that have gained the most maturity because also the group of mass market followers have found them.

Table 3 Purchased and considered services by cluster (%, n)

	1 INNOVATOR	2 EARLY ADOPTER	3 OPINION LEADER	4 MASS MARKET FOLLOWER	5 SCEPTIC	TOTAL
Energy audit						
%	13	28	23	21	15	100
n	10	21	17	16	11	75
Real time home electricity display						
%	13	36	17	24	11	100
n	36	98	46	65	31	276
Home electricity guiding equipment						
%	14	36	16	23	11	100
n	36	96	43	60	30	265
Micro-production of electricity						
%	17	38	17	20	10	100
n	38	86	38	45	22	229
Instalment and purchase services of micro production of energy						
%	9	45	17	19	9	100
n	7	34	13	14	7	75

The micro production of energy services (including purchase and instalment of equipment) are at the beginning of their market penetration enjoying not surprisingly the most interest in the group of early adopters. The innovators have not purchased any of these services more than the other groups most likely because the services listed in the questionnaire were not radically innovative but services that already can be found in the markets. In addition, logically, the sceptics are the least to consider the purchase of these services.

4.3 Conclusions

Our initial findings suggest that there are qualitatively different segments also in the energy efficiency service market. The five clusters differed in relation to many characteristics in their behaviour in the electricity markets (Table 4). First, the clusters differ in their level of interest in energy efficiency services: the early adopters were found to be highly interested in energy efficiency services, whereas the interest among other clusters was lower. Second, early adopters and opinion leaders were distinctive in respect to their environmental attitudes. Third, interest in energy efficiency services correlated with adoption of energy efficiency services and technologies. The active stance towards technologies and services was also mirrored in customer relations, so that innovators and early adopters had also considered which electricity retailer to use.

The psychological cluster characteristics indeed fit well into the theoretical framework of diffusion of innovations in the market. We investigated whether we can find groups of customers that represent an emerging market trend enabling projections about the market potential of energy efficiency services. The fact that we found a group of early adopters that have been more active in purchasing energy efficiency services affirms that certain kinds of consumers have qualities that make them more adaptive to new innovations.

Our initial findings correspond to Moore's and Rogers' theory of diffusion of innovations rather well. There were groups that resemble the theory in their psychological characteristics and attitudes. Our analysis also suggests that there might be attributes that seem to be specific to electricity market that might influence especially the rejection behaviour or scepticism of the consumers. We suppose, however, that there might be a slight bias in the respondents towards in one hand people with much leaduserness and on the other with much scepticism. A survey is a way for both of these groups of people to express their views and e.g. their mistrust towards electricity companies. We suppose that the great majority has not been as interested in responding the survey. Thus, people "in the middle of the curve" are possibly underrepresented in our study. This is why the sizes of the groups should not be seen as direct customer potential. However, the finding is that there are people in the market that would have interest in novel energy efficiency services and that they have characteristics that make them different form each other. An interest in energy issues or technic is a typical feature of someone who might be open to new solutions in energy efficiency and these people should be the ones that the companies should be targeting at the early stages of service

Table 4 Differences in the clusters' behavior in the electricity markets (summary)

	1 INNOVATOR	2 EARLY ADOPTER	3 OPINION LEADER	4 MASS MARKET FOLLOWER	5 SCEPTIC
Interest in energy efficiency services	average	high	average	average	low
Environmental activism	low	high	high	low	low
Activism in home upgrading	high	high	high	low	low
Loyal to electricity retailer	no	no	yes	yes	yes

development because of their interest in energy, technology and because of their overall positive attitude towards novelties and energy companies.

5 Discussion

5.1 Managerial implications

Our research shows that the early adopters differ from other groups in the markets by having a more positive attitude towards new technology, pilots and experiments. Moreover, early adopters are interested in participating in the innovation work of their electricity company and their attitude towards energy and energy companies is altogether positive and furthermore they also trust their energy company. This means that companies can use these results to reach the most promising segments in the market as well as to develop selling features for the energy efficiency services. Managers are, hence, advised to adopt a proactive approach and involve these customers early in the innovation process. We are convinced that these consumers would increase the success of the service innovation if addressed at the early stages of service development. In addition, because these consumers are often active also in different associations such as nature protection, housing or condominium associations, many more potential new customers might be reached through them. In our data, the respondents with the most positive attitude towards energy issues were male, which might result from a masculine culture, in which it is more typical for men to have technical orientation and experience than women do. The profile of the most promising early stage customers is younger, more educated consumers with higher income. Most of these customers also have education in the technical field. In addition to the open attitude of early adopters, their better financial standing enables more experiencing and thus, there is a relationship between interest in novelties and income. It is quite interesting that our data revealed no large or striking differences in the background of the different groups in the markets. While our data indicates that the groups that are the most positive towards energy efficiency services often live in detached houses larger than 80 m^2, the attitudinal factors such as experimentalism, expertise in energy and following the own energy consumption might play a more important role.

The data also points to a conclusion that the energy efficiency services investigated in this research have reached different maturity in the market, which is based on an observation about the service interest expressed in the data that the real time home electricity displays are the services that seem to have reached the most maturity as also the group of mass market followers have found them. The micro production of energy services might be at the beginning of their market penetration, because they enjoy the most interest in the group of early adopters but our initial findings however indicate that there is a potentially growing interest in the markets for these kinds of services. Good interaction, network services, informative billing might therefore activate more of the customers to take interest also in other energy efficiency services. Energy efficiency services can thus be a new source for value creation in energy sector, because the can help customers to reduce their electricity consumption, create a new source of income to the electric companies. Furthermore, they help the electric company to profile and strengthen the customer relationship although the business potential to different kinds of companies differs in their premises. This leads us to point out that the development of the energy efficiency service market is a learning process, during which the users, companies and third parties learn while the services develop further.

The development of new services requires gaining new knowledge about the needs of the customers as well as about the supply of new services, which can be obtained through pilots and demonstrations while recognising, which parts of the service is worthwhile to produce by the firm itself and what should be purchased from other parties. We are certain that the most important in the development of energy efficiency services would be to solve real problems profitably by taking a user-centred or -driven approach and strive for practicality and ease of use. Committed par-

ticipants, good planning and resourcing as well as good inner organisation would increase the chances for success. In the present phase of the market development, we feel that different companies are best advised to follow certain indicators of the market development such as the demand for the home electricity guiding equipment, focus on developing the knowledge base, pilot services and invest in the creation of the market.

5.2 Future research needs

The timing of technology adoption may be linked to motivation of managing some paradoxes related to adaptation of novelties (Mick and Fournier 1998). Innovators are known to have the tendency to purchase cutting-edge advancements, whereas the motivations for adaptation of novelties by the sceptics is less clear. This would be a case for future research. Our results suggest that from the viewpoint of further research there might be more groups than the five selected in the analysis that might prove interesting in studying market segmentation. Thus, in our analysis the size of the data was too small and the groups too marginal to make it possible to study additional groups. The solutions with six or seven clusters however suggest that the group of sceptics could possibly be divided into smaller groups consisting of people with different reasons for their scepticism, manifesting in their attitudes and beliefs. Alternatively, there might be another dimension in the market in addition to much leaduserness (lead users) or much scepticism (laggards). This dimension could be described with (much or little) autonomy but this issue would also require additional research. Studying scepticism would enable service innovations to be better accepted in the markets.

From the viewpoint of developing and marketing novel energy efficiency services, it could be beneficial to focus on the marginal groups. As most of the research on technology diffusion has so far focused on leadusers, it could be beneficial to target attention to the other end of the markets; the late adopters and the sceptics. Goldberg and Oreg (2010) have suggested that the laggards of the first version of some technology may be the innovators of a much later technology generation, a phenomenon they call *consumer leapfrogging effect*. In other words, regardless of the sceptics' apparent reluctance of adopting a novelty, once they upgrade they may very well upgrade to the latest technology generation available. Goldberg and Oreg have estimated that if 1 percent of the sceptics adopted a later version of a technology among the first, the profits of the technology firms would have increased by 14 percent on average meaning that the financial implications would be significant. Moreover, additional research on these groups adopting novelties and innovations much later than other customer segments would enable a deeper understanding of the markets as well as developing service innovations in a more sensitive and democratic fashion. In future studies it could be interesting to carry out qualitative research, such as ethnographic studies, in-depth interviews or group discussions, which could be useful to gain more knowledge of the meanings of different types of services and product categorizations as well as the perceived differences between service providers. Further research is also needed to evaluate the consumption of different types of services. From the viewpoint of markets and also the environment, the development of energy saving products and services this kind of research could prove beneficial.

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Appendix 1 Construct of the psychological characteristics

LEADUSERNESS	SCEPTICISM	FOLLOWING THE MASS MARKET
I like to follow the technical developments in newspapers and TV	I am not interested in using a new service until it becomes an established practice	I buy gladly an energy efficiency service only from a market leader
I readily advise my friends about energy issues	I do not like to buy any new solutions. if there are no successful examples of real users in my close environment	I am interested in buying an energy efficiency service only from large reliable companies
I have been already long time interested in energy	I am sceptical about solutions produced by multiple actors	I am interested in buying an energy efficiency service only if it is offered as a give-away with another service or product
I have made some small technical solutions in my home or work	I don't like experimenting new products or technology	Outside help in saving electricity is welcome in my household
I have actively searched home automatics that guide appliances in my home		
If an electric appliance does not work, I usually know what the problem is		
I gladly follow my energy consumption by making notes of the electricity consumption in different years (e.g. Excel-tables)		
It is easy for me to see the benefits of new solutions		
I'm fascinated by the idea that consumers could produce electricity into the electricity network		

Source: Matschoss et al. (2015)

Appendix 2 Cross tabulation with cluster membership and social activism

	1 INNOVATOR	2 EARLY ADOPTER	3 OPINION LEADER	4 MASS MARKET FOLLOWER	5 SCEPTIC	TOTAL
Active membership in an environmental or nature association						
Not an active member	95.3	94.4	93.2	97.0	95.8	95.2
Active member	4.7	5.6	6.8	3.0	4.2	4.8
Total	100.0	100.0	100.0	100.0	100.0	100.0
Taken action personally to fight against climate change						
Not fought climate change	68.6	52.0	66.5	72.1	72.8	65.8
Taken actions against climate change	31.4	48.0	33.5	27.9	27.2	34.2
Total	100.0	100.0	100.0	100.0	100.0	100.0
Has changed or about to change the heating system of the home or leisure apartment						
No	75.9	75.5	75.4	87.3	91.5	81.8
Yes	24.1	24.5	24.6	12.7	8.5	18.2
Total	100.0	100.0	100.0	100.0	100.0	100.0
Has installed an advanced home automatisation system						
No	74.7	76.8	77.2	90.6	91.9	83.1
Yes	25.3	23.2	22.8	9.4	8.1	16.9
Total	100.0	100.0	100.0	100.0	100.0	100.0
Active membership in a housing or condominium association						
No	77.4	78.4	74.6	82.0	80.6	79.0
Yes	22.6	21.6	25.4	18.0	19.4	21.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Appendix 3 Clusters by socio-demographic background (%)

	1 INNOVATOR	2 EARLY ADOPTER	3 OPINION LEADER	4 MASS MARKET FOLLOWER	5 SCEPTIC
Gender (p = 0.000)					
Male	74.3	64.3	60.3	25.7	38.0
Female	25.7	35.7	39.7	74.3	62.0
Total	100.0	100.0	100.0	100.0	100.0
Age (p = 0.000)					
< 25	2.9	9.7	2.3	11.3	5.2
25–34	7.6	14.0	2.3	16.0	6.3
35–44	10.5	16.1	6.3	14.0	9.7
45–54	19.3	21.7	20.7	23.0	24.3
55–64	32.2	24.4	40.2	20.2	32.3
> 64	27.5	14.0	28.2	15.6	22.2
Total	100.0	100.0	100.0	100.0	100.0
Educational level (p = 0.000)					
Basic education	14.0	10.7	32.4	18.0	23.0
High school / vocational school	37.4	32.1	39.8	34.5	34.4
College / B.A.	34.1	33.1	23.3	31.8	32.0
University / M.A.	14.5	24.0	4.5	15.7	10.7
Total	100.0	100.0	100.0	100.0	100.0
Field of education (p = 0.000)					
General	12.0	14.1	26.6	22.6	20.5
Technical	58.7	42.3	30.2	9.2	16.6
Health and social	8.0	11.2	11.5	28.2	23.4
Services	4.7	8.7	17.3	15.9	20.0
Education, humanistic, art	5.3	12.0	5.8	14.4	12.2
Nature science, forest and agriculture	11.3	11.6	8.6	9.7	7.3
Total	100.0	100.0	100.0	100.0	100.0
Occupation (p = 0.000)					
Entrepreneur, farmer	7.3	9.5	9.5	6.2	6.9
Manual worker	22.6	22.9	26.3	23.9	25.7
Clerical worker	21.5	26.5	8.4	23.6	20.8
Managerial worker	4.5	9.8	5.0	5.4	3.8
Outside of working life	44.1	31.4	50.8	40.9	42.7
Total	100.0	100.0	100.0	100.0	100.0
Household gross income / year (p = 0.000)					
Less than 24 999 €	14.0	16.8	36.0	27.7	24.6
25 000–44 999 €	34.7	24.8	31.3	30.4	33.2
45 000–59 999 €	16.7	15.0	14.0	17.9	16.8
60 000€–79 999 €	15.3	21.3	9.3	15.2	16.8
More than 80 000 €	19.3	22.0	9.3	8.9	8.6
Total	100.0	100.0	100.0	100.0	100.0

Appendix 4 Clusters by housing conditions (%)

	1 INNOVATOR	2 EARLY ADOPTER	3 OPINION LEADER	4 MASS MARKET FOLLOWER	5 SCEPTIC
Building type (p = 0.000)					
Apartment building	22.3	32.0	24.3	37.9	35.2
Detached house	62.6	52.3	56.2	37.5	41.5
Terraced house or two family house	15.1	15.7	19.5	24.6	23.3
Total	100.0	100.0	100.0	100.0	100.0
Building, year of construction (p = 0.037)					
< 1939	6.8	9.1	5.3	5.6	5.1
1940–1959	14.2	15.9	13.4	8.3	12.7
1960–1979	27.8	23.3	28.9	31.6	32.9
1980–1999	36.4	30.1	39.0	38.0	33.6
2000 >	14.8	21.7	13.4	16.5	15.8
Total	100.0	100.0	100.0	100.0	100.0
Apartment size (p = 0.000)					
< 61 m²2	15.1	17.1	16.4	27.7	25.4
61–80 m²2	13.4	20.8	20.3	16.0	22.9
81–120 m²2	30.2	26.5	33.3	31.6	31.2
> 120 m²2	41.3	35.6	29.9	24.6	20.4
Total	100.0	100.0	100.0	100.0	100.0
Location (p = 0.010)					
City centre	16.9	16.9	16.5	15.2	17.2
Suburb	47.2	53.1	41.5	56.4	46.0
Population centre in the countryside	14.6	10.1	16.0	16.3	17.9
Sparsely populated area	21.3	19.9	26.1	12.1	18.9
Total	100.0	100.0	100.0	100.0	100.0
Main heating source (p = 0.003)					
District heat	35.3	44.8	37.6	48.8	48.3
Direct electric heating	25.9	23.3	21.5	25.6	19.6
Storage electric heating	6.5	6.8	9.9	5.7	4.4
Oil heating	14.1	8.2	13.8	9.3	13.3
Earth heat pump	4.1	7.5	3.3	5.7	3.0
Wood or pellet heating	14.1	9.3	13.8	4.9	11.4
Total	100.0	100.0	100.0	100.0	100.0
Heat pump (p = 0.029)					
No	80.9	82.1	79.6	85.8	89.0
Yes	19.1	17.9	20.4	14.2	11.0
Total	100.0	100.0	100.0	100.0	100.0
Electrified leisure apartment (p = 0.000)					
No	55.0	68.3	71.0	74.6	72.9
Yes	45.0	31.7	29.0	25.4	27.1
Total	100.0	100.0	100.0	100.0	100.0
Changed electricity retailer (p = 0.000)					
No	59.6	58.1	69.8	64.8	76.4
Yes	40.4	41.9	30.2	35.2	23.6
Total	100.0	100.0	100.0	100.0	100.0