Generic Customer Segments and Business Models for Smart Grids:
Empirical Evidence from a Cross-European Country Study

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Abstract

The implementation of smart grids – one of the urgent goals to meet international policy expectations for energy efficiency and CO2 reduction targets – is not a technological issue alone, as it also requires social acceptance by various stakeholders (Wolsink 2011). It is of particular interest that smart grid products and services provide value to the customer. On the one hand, customer value of smart grid technologies is crucial to customer acceptance. On the other hand, as customer value is a key driver for economic value creation and competitive advantage (DeSarbo et al. 2001; Porter 1985), it is also important for companies and investors and thus will affect market acceptance of smart grid technologies. In the literature, business models address the bridge between customers and company needs and serve as mediators between technology and economic success by providing a value proposition to customers and a revenue model for companies (Chesbrough and Rosenbloom 2002). However, we know from the literature that a one-size-fits-all business model may not lead to the best results as it might fail to address heterogeneous customer value perceptions (DeSarbo et al. 2001; Morris et al. 2005; Ruiz et al. 2007; Wiedmann et al. 2009). Thus, different business models providing different customer value propositions need to be developed to fit the different market segments in an optimal way. On the basis of a cross-European country study, we explore three generic B2C customer segments for smart grid products and services based on different value perceptions (Supporters, Ambiguous and Skeptics). Based on the segmentation we conceptually derive four generic business model designs with different customer value propositions best suited for approaching those segments (Saver, Smart+, Trader, Smart Camouflage). Implications for energy policy, research and smart grid management are derived from the findings.

Introduction

Exploring the question of how to develop the market for smart grids is crucial if CO2 targets within sustainable energy scenarios as demonstrated in Figure 1 (IEA 2010a) are to be met. "A Smart Grid is an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies" (ETP 2010). The integration of information and communication technologies (ICT) into the electricity grid plays a key role in ensuring a sustainable, economically viable and secure supply (Daoud and Fernando 2011). On the one hand, it gives the various market actors better and more accurate insights into consumption patterns, weaknesses in the grid, or available grid and storage capacities through a real-time, multi-level information flow. On the other hand, ICT provides better control mechanism through innovative products such as smart meters, which allow electricity consumption to be shifted to off-peak hours by remotely controlling smart devices, e.g. washing machines which only start running when they receive an electronic signal from the electricity provider (Daoud and Fernando 2011). Furthermore, ICT facilitates the integration of fluctuating energy resources such as wind or solar power by providing information about the available grid capacity to feed in these resources or by providing information about and connecting the energy flow to available storage capacities, e.g. electrical vehicles (Kranz et al. 2010). Thus, smart grids can reduce CO2 emissions both through better management of the grid and by facilitating the deployment of low-carbon technologies (IEA 2010a).

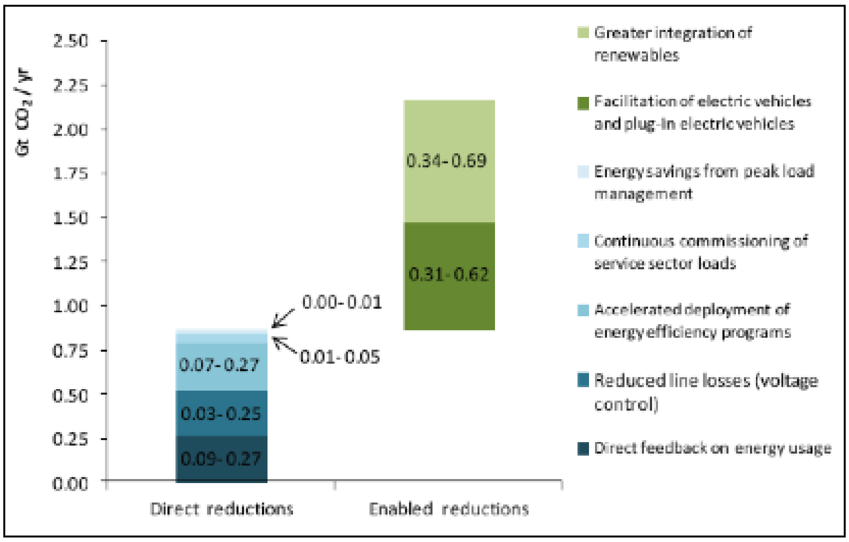

Fig. 1 Smart grid CO2 reductions in 2050 (Source: IEA, 2010b)

Different drivers push the process of smart grid development and implementation. They can be categorized into technological, political, and market drivers.

Technology drivers are, for example, the recent technological developments such as smart meters or the integration of a communication network into the electricity system (Daoud and Fernando 2011).

Political drivers are energy policies that make the implementation of smart grid devices (e.g. smart meters) mandatory in some countries, such as Sweden, Finland and soon Norway. Other political drivers are energy reduction and energy efficiency targets, such as those proposed by the European Commission, which call for smart grid technology (European Parliament and the Council of the European Union 2009).

Four different market drivers have been pushing the process of smart grid development. First, the introduction of flexible tariffs along with supply-demand models, which make energy prices volatile, require systems that allow consumers to buy energy at the cheapest point in time (Faruqui et al. 2009). Second, the shift in energy production towards renewable sources requires a mass-market diffusion of smart grids: “The increasing diffusion of renewable energies which underlie significant daily and seasonal fluctuations increases grid operations’ complexity. For the effective use of renewable energies, innovative information and communication technologies (ICT) and concepts are necessary to efficiently balance power generation and consumption” (Kranz et al. 2010). Third, new business models that rely on smart grid functionalities are being introduced into the market. The service provider Better Place has entered the market, for example, with a service for charging electrical vehicles that can serve as storage capacities for electricity (Better Place 2011; Johnson and Suskewicz 2009). Fourth, there is increasing investor interest in the topic. Established market players such as ABB, CISCO or GE are heavily investing in the field of smart grids (Bogoslaw 2010). According to Pike Research, investments totaling 200 billion dollars are expected in the field of smart grid technologies by 2015 (PikeResearch 2009).

The previously described drivers of smart grid development lack an important aspect: the customer value of smart grid technologies. Customer value is of crucial importance as it is the basis for competitive advantage (DeSarbo et al. 2001; Porter 1985; Ruiz et al. 2007). Researchers and practitioners agree upon that smart grid technologies can provide potential value to customers in various ways (Clastres 2011; Wolsink 2011). First, they can reduce or prevent outages and thus provide a more reliable energy supply to the customer. Second, with smart grid technologies consumers are able to better monitor and control their electricity consumption as well as related expenditures. Third, smart grid technologies can provide value to the customer through value added services, such as security or assistance services or home automation. Finally, smart grid technologies can provide value by enabling the customer to play an active role in the energy market, which might also lead to additional revenues for the customer, e.g. by participating in virtual power plants. (ibid)

With this paper we intend to contribute to the limited research on customer segments, based on different value perceptions, of smart grids and which business models are suitable to approach these segments by providing different customer value propositions (Forsa 2010; Kaufmann 2010; Kranz et al. 2010). For this paper we proceed as follows: In the theoretical foundation we explain the need for a value-based segmentation and for business models with different customer value propositions in the field of smart grids. On the basis of a cross-European country study, we then conduct a cluster analysis based on consumer value perceptions and explore three generic B2C customer segments for smart grid products and services (Supporters, Ambiguous and Skeptics). Based on the segmentation we derive four generic business model designs with different value propositions best suited for approaching these segments (Saver, Smart+, Smart Camouflage, Trader) on the basis of an analytical framework developed for that purpose. Finally, we discuss implications for energy policy, further research, and smart grid management.

Theoretical Foundation: Social Acceptance, Technology Acceptance Model and the Need for Business Models

The existence of various drivers of smart grid development and implementation as well as the potential customer value of this technology might lead to the conclusion that the mass-market diffusion of smart grids is only a matter of time. However, this conclusion does not recognize a potentially powerful barrier to the mass-market diffusion of smart grids: social acceptance (Wolsink 2011; Wüstenhagen et al. 2007). As in the case of renewable energy, the mass-market diffusion of smart grids is likely to be subject to socio-political, community, and market acceptance (ibid). The existence of policies requiring smart grids and the emergence of new business models from companies investing in smart grid technologies are indicators that a certain amount of social acceptance is already given, namely the acceptance of the technology and policies by key stakeholders (part of socio-political acceptance). However, looking at the different barriers that hinder the implementation of smart grid products and services, there seems to be a lack of market acceptance. From a company perspective, there is, for example, a high level of uncertainty about the economics of smart grids, as high upfront investments are necessary (Cometta et al. 2010). At the same time, the payback is uncertain, as consumer pressure is only rarely observable and understandings of customer value of smart grid products and services are still vague (ibid). Especially in the case of smart grids, market acceptance "or the process of market adoption" (Wüstenhagen et al. 2007) is of crucial importance for two reasons: First, customers are required on an individual level to install smart meters in their homes, and in order to do so they need to see a value from adopting the innovation. Second, investors (e.g. utilities investing in smart grids) also need to see a benefit in order to invest in the technologies. To investigate existing market acceptance in the field of smart girds, one can use the technology acceptance model (TAM). According to Davis, perceived usefulness and perceived ease of use are the most important factors to explain whether a technology is accepted or rejected in the market (Davis 1989). Customer acceptance studies in the field of smart grid technologies demonstrated by using the TAM that the perceived usefulness of smart grid technologies can indeed lead to an acceptance of these technologies (Kranz et al. 2010; Strategier et al. 2010). However, utilizing the TAM for smart grids in order to explain customer acceptance might not capture the whole picture. Especially it hardly highlights the importance of customer value for implementing smart grids. The TAM was developed and mainly used for investigating the technology adoption in an organizational context (Kim et al. 2007). Technology adopters within those studies were mostly employees and therefore only technology users, without any financial burdens. However, like in the case of mobile Internet or hedonic digital artifacts (Kim et al. 2007; Turel et al. 2010), adopters of smart grid technologies are individuals with a dual role as technology users and as service consumers. Thus, the adoption of smart grid products and services is based on personal purposes and the adopters carry the financial costs themselves (Kim et al. 2007). As the adopters of smart grid technologies are consumers rather than simply technology users, the perceived value is of great importance for customer acceptance of smart grid technologies. There is a variety of research, which aims at capturing the concept of customer value (e.g. Holbrook 1999; Rust et al. 2000; Sheth et al. 1991; Zeithaml 1988). The most widely accepted definition stems from Zeithaml (1988). According to Zeithaml perceived value consists of the overall assessment of the utility of a product determined by the perception of the consumer of what is given (sacrifice) and what is received (benefit) (Zeithaml 1988). The TAM does not include a construct of such an overall estimation of the adoption object (Kim et al. 2007). Therefore, Kim et al. (2007) developed it further and integrated Zeithaml's definition of perceived value the Value-based Adoption Model (VAM). In this sense technology adoption and acceptance is determined by perceived value, which in return is determined by benefits, such as usefulness and enjoyment, and sacrifices, such as technicality and perceived fee (Kim et al. 2007). In contexts where individuals play a double role of technology users and service customers, the VAM has major advantages compared with the TAM when explaining technology adoption and thus customer acceptance of the technology. Following this argumentation and the potential customer value of smart grid technologies as discussed earlier, it is surprising that smart grid technologies have not yet reached a broad customer acceptance in the market (Cometta et al. 2010). One possible explanation is that consumers up to now struggle to understand the potential customer value of smart grid technologies. To increase market acceptance of smart grids, a first step would be to find ways how to translate the technological benefits of smart grids into value for customer in the best way. A second step to increase market acceptance of smart grids and to overcome the above-mentioned barriers of the development and implementation of smart grids is to look at value for investors. We tie in with those considerations and aim at identifying business models of smart grids for the following two reasons. First, the value proposition to customers is an important building block of a business model (Chesbrough and Rosenbloom 2002; Morris et al. 2005; Wüstenhagen and Boehnke 2008; Zott and Amit 2007, 2008) and customers are said to play a central role in business models (Hedman and Kalling 2003; Morris et al. 2005). Second, business models can serve as "a mediator between a technology and economic value creation" (Chesbrough and Rosenbloom 2002) and therefore can translate technology into value to the customer. As customer value is a key driver for economic value creation and competitive advantage (Belz and Bieger 2006; DeSarbo et al. 2001; Parasuraman 1997; Porter 1985; Ruiz et al. 2007; Slater 1997; Woodruff 1997) this also of interest for companies and investors. Furthermore, the literature tells us that business models address the bridge between customers and company needs and it shows us that not only technology but also business models are relevant for the establishment and further diffusion of clean technology in general (DISTRES 2009; Frantzis et al. 2008; Loock 2011a; Loock 2011b; Schoettl and Lehmann-Ortega 2011; Wüstenhagen and Boehnke 2008). The business model literature in particular discusses the intersection between customer needs on the one hand and organizational aspects like configuration of resources, dynamic capabilities etc. on the other hand (Casadesus-Masanell and Ricart 2007; Chesbrough and Rosenbloom 2002; Chesbrough 2007a; Chesbrough 2007b; Johnson et al. 2008; Kagermann and Österle 2006; Magretta 2002; Miller 1986, 1996; Morris et al. 2005; Schweizer 2005; Treacy and Wiersema 1995; Weill et al. 2005; Zott and Amit 2007, 2008, 2010).

We know from the literature that a "one-size-fits-all" business model may not lead to the best results as it might fail to address the heterogeneous needs and value perceptions, and thus the potential differences in the willingness to pay, of the customers in the market (DeSarbo et al. 2001; Dibb et al. 2002; Kotler 1997; Morris et al. 2005). Several studies have analyzed the need for market segmentation based on the heterogeneity of value perceptions in a market (DeSarbo et al. 2001; Ruiz et al. 2007; Wiedmann et al. 2009). DeSarbo et al. argue that "there are indeed heterogeneous interpretations of customer-perceived value, and multiple customer segments may assign differential importance weights to the value drivers" (2001, p. 846). Thus, an analysis of customer value on an aggregate level might be misleading and faces the danger of failing to adequately address the different value perceptions (DeSarbo et al. 2001; Ruiz et al. 2007; Wiedmann et al. 2009). Additionally, a conventional market segmentation based on socioeconomic or demographic characteristics only might not capture the differences in value perceptions and thus lead to inappropriate segmentations, which do not result in competitive advantage (ibid). Therefore, a value-based segmentation of the smart grid market is crucial to better account for the heterogeneity of that special market (DeSarbo et al. 2001; Dibb et al. 2002; Kotler 1997; Morris et al. 2005; Ruiz et al. 2007; Wiedmann et al. 2009).

Following this and the perspective that customer value is the key driver for economic value creation and competitive advantage (Belz and Bieger 2006; DeSarbo et al. 2001; Parasuraman 1997; Porter 1985; Ruiz et al. 2007; Slater 1997; Woodruff 1997), we derive two major assumptions: First, the better the fit of the value proposition of the business models with the customer segments' value perception, the higher the customer value, which increases the customer acceptance of smart grid technologies. Second, the better the fit of the value proposition of the business models with the customer segments' value perception, the higher the potential of economic value creation and competitive advantage, which increases the benefits for investors and thus increases investor acceptance of smart grid technologies.

Customer Segments for Smart Grids

To investigate customer preferences and value perceptions in the field of smart grids and renewable energy, we conducted a survey in January and February of 2011. The survey was part of two different research projects. One examines the acceptance of renewable energy in the region around Lake Constance and the other focuses on stakeholder preferences in a smart grid based energy market. To

capture consumers' value perceptions of smart grids, we used the concept of smart metering, as this is the main field of application of smart grids for consumers (Faruqui et al. 2009; Forsa 2010; Kranz et al. 2010). Customers in four European countries (Austria, Germany, Liechtenstein and Switzerland) were asked to spend about 15 to 20 minutes to complete an online questionnaire. The regional focus was set on northeastern Switzerland, Vorarlberg, Liechtenstein and the southern German districts around Lake Constance. The survey was advertised in online and print media, through leaflets and in inserts to the electricity bill of a regional energy provider. In addition, in order to also reach consumers who do not have access to the Internet, customers in three shopping malls in Constance, Dornbirn and Friedrichshafen were approached directly and asked to fill in the questionnaire on a tablet computer.
837 energy customers participated in the survey and 570 of them completed the entire questionnaire.

Survey Design

The part of the survey regarding consumer preferences for smart grid products and services consisted of five parts. After a short introduction explaining smart meters and their functionality, we asked the respondents whether they had heard of smart meters before and whether they understood how smart meters worked. Only those respondents who understood the functionality of smart meters were taken further in the survey, leaving us a sample size of 497 respondents. With this selection we wanted to ensure that the later evaluation of the benefits and concerns relating to smart meters was appropriate.
In the second and third part of the survey we asked the respondents to evaluate ten benefits of and ten concerns regarding smart meters, to get an understanding of the perceived customer value of smart meters. Table 1 shows the benefits and concerns used in the survey. They are derived from a list of benefits and concerns that Kaufmann (2010) identified and validated through expert interviews and which base on previous studies on customer preferences of smart metering (Kaufmann 2010; Forsa 2010). The respondents were asked to indicate on a four point scale – ranging from "no advantage" to "very great advantage" or "no concern" to "very great concern" – to what extend they perceived respective held the benefit or concern. We also included an opt-out option "I don't know" in the event that the respondent did not understand the benefit or concern.

Table 1 Survey questions: benefits and concerns regarding smart meters

<table>
<tr><td rowspan="10">A smart meter could bring me the following benefits:</td><td>More transparency because of a more detailed electricity bill</td><td rowspan="10">no advantage (1)
-
a small advantage (2)
-
a great advantage (3)
-
a very great advantage (4)
-
I don’t know (5)</td></tr>
<tr><td>A reduction of environmental pollution due to energy savings</td></tr>
<tr><td>Eliminate the need to arrange a meter reading</td></tr>
<tr><td>An improved understanding of energy consumption due to the visualization of costs and CO2 emission</td></tr>
<tr><td>Improved and real-time monitoring of energy consumption</td></tr>
<tr><td>Greater comfort due to intelligent household appliances</td></tr>
<tr><td>I can reduce my electricity costs</td></tr>
<tr><td>Grid incidents and electricity black-outs can be rectified more quickly</td></tr>
<tr><td>Greater safety in households, e.g. due to warnings via SMS</td></tr>
<tr><td>Renewable energy (solar, wind, biomass etc.) can be integrated into the grid more easily.</td></tr>
<tr><td rowspan="10">I have the following concerns about the use of a smart meter:</td><td>I have to adapt my habits</td><td rowspan="10">no concerns (1)
-
minor concerns (2)
-
great concerns (3)
-
very great concerns (4)
-
I don’t know (5)</td></tr>
<tr><td>I could loose control over my household appliances</td></tr>
<tr><td>Additional expenditure of time and work</td></tr>
<tr><td>I do not want another technical device</td></tr>
<tr><td>Additional costs could emerge</td></tr>
<tr><td>The energy supplier might profit, but not me</td></tr>
<tr><td>The topic is too complex for me</td></tr>
<tr><td>I am not in control over what happens to my consumption data</td></tr>
<tr><td>I am more strongly bound to the energy supplier (e.g. by longer periods of notice)</td></tr>
<tr><td>The electricity is so cheap for the smart meter to provide a real benefit</td></tr>
</table>

In the fourth part of the survey we asked the respondents about their assessment of the overall usefulness of smart meters and whether they would pay more for new metering equipment.

In the remaining part of the survey we asked respondents to indicate whether they had seen a smart meter before, whether they owned smart meter compatible devices (e.g. smart-grid-ready home appliances), whether they would be willing to change their behavior and whether they had tried or would be willing to try smart meters.

Sample Characteristics

The statistical evaluation of the 497 respondents who completed the entire part of the survey regarding consumer preferences for smart grid products and services reveals the following insights: First, consumers are highly interested in obtaining information on their electricity bill about individual consumption of their domestic appliances. Second, the expected advantages of smart meters greatly outweigh the concerns of almost all respondents. Third, a reduction of environmental pollution and a reduction in costs due to higher energy efficiency are seen as the greatest benefits of smart metering. Fourth, a great willingness to change behavior exists: 77.7 percent of consumers can imagine using their washing machine at another time of day. Fifth, 26.2 percent of consumers have great concerns regarding security and privacy; 24.8 percent are very concerned that they will have to pay for a smart meter. Finally, and in contrast to the aforementioned group, one third of the consumers are willing to pay for a smart meter. Voters of social democratic and conservative parties are slightly underrepresented in favor of voters of green parties (13.3 percent Social Democrats, 15.9 percent Greens, 14.7 percent Green Liberals, 11.5 percent Liberals, 18.9 percent Conservatives, 19.3 percent others)[1,2]. Furthermore, a high proportion of male respondents characterizes the sample, which is often observed in surveys regarding energy issues (71 percent male, 23.1 percent female)[3].

Cluster Analysis

In order to create an understanding of existing customer segments in smart grid markets, we conducted a cluster analysis based on different customer preferences, which can be related to different perceptions of customer value of smart grid technology. Cluster analysis is a useful method to identify customer segments based on different value perceptions (Wiedmann et al. 2009). The analysis is based on three questions put to customers relating to the advantages of using smart meters: the possibility of improved transparency regarding household energy consumption, less environmental pollution due to decreased CO2-emission, and cost reductions for individual customers. Three further questions were chosen relating to customer concerns: concerns about additional costs, data privacy reasons, and lack of individual benefit. Whereas advantages can be seen as benefits, concerns can be translated into sacrifices. Thus, both relate to perceived value (Zeithaml 1988). Table 2 represents the six items selected for the cluster analysis. We decided on these six items for two reasons. First, they represented the three highest perceived benefits and concerns respectively in our study. Second, these items are considered as most important by experts (Kaufmann 2010) and were also found to be very important in previous studies and in the literature (Faruqui et al. 2009; Forsa 2010; Kranz et al. 2010; Strategier et al. 2010). All respondents who chose the opt-out option "I don't know" in one ore more of these six items were not used for the cluster analysis. Thus, the cluster analysis is based on a sample of 359 respondents out of the 497 respondents.

Table 2 Questions used for cluster analysis

A smart meter could bring me the following benefits:			I have the following concerns about the use of a smart meter:		
More transparency because of a more detailed electricity bill	A reduction of environmental pollution due to energy savings	I can reduce my electricity costs	Additional costs could emerge	The energy supplier might profit, but not me	I am not in control over what happens to my consumption data
No advantage (1) - a small advantage (2) - a great advantage (3) - a very great advantage (4)			No concerns (1) - minor concerns (2) - great concerns (3) - very great concerns (4)		

A hierarchical clustering based on Ward's method on SPSS was used to identify three clusters. Ward's method was chosen because it is reported that this technique is consistently more accurate than others in grouping items of a given population (Backhaus 2003). The resulting clusters 1, 2, and 3 contained 152, 119, and 88 cases, which corresponded to 42.3, 33.1, and 24.5 percent, respectively.

The three-cluster solution was selected based on inspection of the measure of heterogeneity and the dendogram. The clarity of clusters was tested in calculating variances and identifying the F-Value ($F = V(J,G)/V(J)$). The amount of variance ranges between 0.29 and 0.88 in cluster 1 and 2. In cluster 3,

[1] There is no unique solution on how to allocate party preferences across national borders. In this study, parties were chosen that are similar to political groups in Switzerland and in the European Parliament.
[2] The remaining 6.4 percent did not provide information.
[3] The remaining 5.9 percent did not provide information regarding their gender.

however, it is higher than 1.0 in three cases. In order to identify significant differences between the cluster variables, the Pearson chi-square test was performed. Significant differences were detected at P < 0.001 for all cluster variables. Table 3 illustrates in more detail the means, F-Values and chi-square of the three clusters for each of the six items.

Table 3 Cluster characteristics I

		Advantage 'improved transparency'	Advantage 'less environmental pollution'	Advantage 'cost reduction'	Concern 'additional costs'	Concern 'no personal benefit'	Concern 'privacy'
Cluster 1 (N=152)	Mean	3.03	3.39	3.32	1.73	1.26	1.40
	F-Value	0.75	0.80	0.88	0.61	0.29	0.35
Cluster 2 (N=119)	Mean	3.29	3.44	3.37	2.37	2.30	2.59
	F-Value	0.74	0.54	0.56	0.79	0.64	0.72
Cluster 3 (N=88)	Mean	1.86	2.52	2.39	2.63	2.40	2.45
	F-Value	0.41	1.18	0.79	1.09	0.87	1.06
	Chi-Square	0.000	0.000	0.000	0.000	0.000	0.000

In a further step, the clusters were compared to different variables using the cross table function in SPSS. Using the Pearson chi-square test, significant differences were detected at P < 0.001 regarding the willingness to pay for a smart meter, the age group and the use of green energy. No significance could be detected for customers' place of residence (P < 0.798). The different composition of the clusters regarding age group, willingness to pay, use of green electricity, and place of residence and the respective chi-squares are represented in more detail in Table 4.

Table 4 Cluster characteristics II

	Willingness to pay	Age Group			Use of green electricity				Place of residence			
	existent	Young (15-30)	Middle-aged (31-55)	Senior (>55)	for a long time	for a short time	maybe in future	Never	Germ any	Austria	Switzer land	Liechten stein
Cluster 1 (N=152)	52.0%	26.3%	46.7%	27.0%	22.4%	29.6%	44.7%	3.3%	25.4%	24.7%	29.5%	29.6%
Cluster 2 (N=119)	30.3%	31.9%	56.3%	11.8%	14.3%	42.9%	41.2%	1.7%	28.6%	35.0%	26.7%	24.4%
Cluster 3 (N=88)	5.7%	19.3%	50.0%	30.7%	15.9%	20.5%	54.5%	9.1%	31.0%	23.7%	26.6%	29.6%
Chi-Square	0.000	0.007			0.007				0.798			

In the following, we discuss the three different market segments derived from the cluster analysis in more detail. Figure 2 illustrates the different preferences of the clusters by showing the means of the six items used for the cluster analysis.

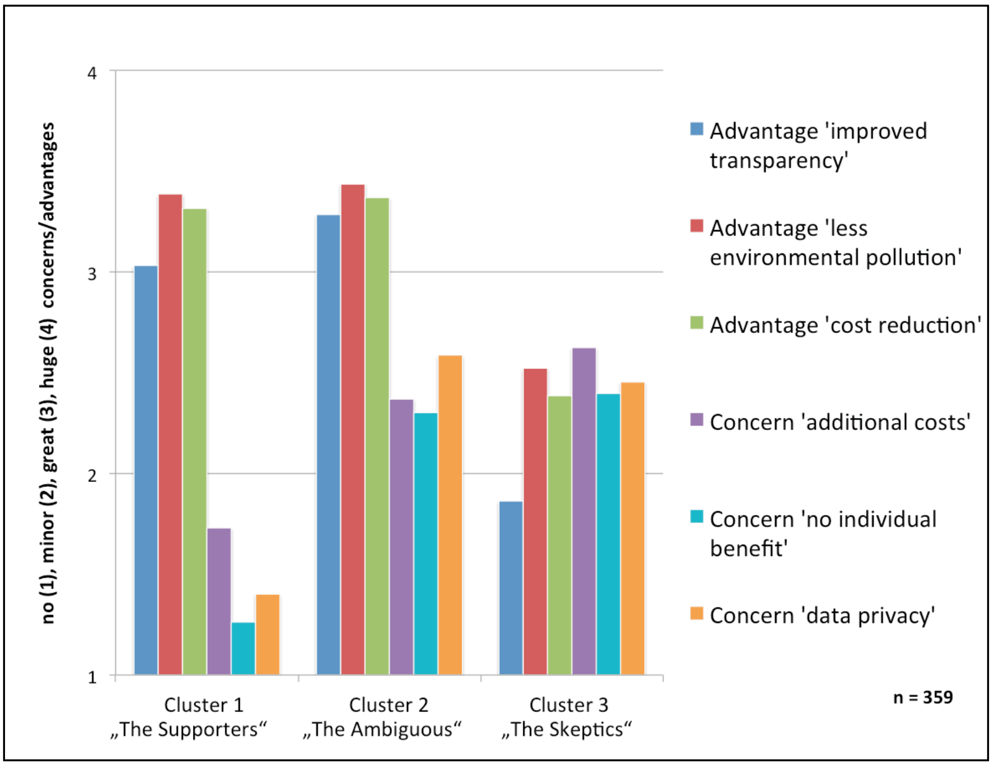

Fig. 2 Cluster characteristics III

(1) The Supporters: Cluster 1 is characterized by a large number of customers who expect great benefits from the use of smart meters. Very few people in Cluster 1 have concerns about the use of smart meters. Thus, it can be assumed that people in this segment would widely support the adoption of smart meters, as their perceived value of this technology is high. Looking more closely at the specific characteristics of this segment reveals that customers are spread over different age groups and state more often than the average that they have already been using green electricity for a long time (22.4 percent). Remarkably, fifty-two percent of customers in this segment stated that they would pay more for new metering equipment.

(2) The Ambiguous: Cluster 2 represents customers who expect great benefits from the use of smart meters on the one hand but who have huge concerns on the other hand. Thus, as perceived sacrifices are higher in that cluster than in the first one, we can assume that the perceived value of smart meters is smaller that the one in the previous cluster. The segment reflects a stereotype of comparably young customers (just 11.8 percent are more than 55 years old) who are concerned about the environment (42.9 percent recently changed to a green electricity provider) and have deep reservations concerning data security. About one-third of customers in this segment show a willingness to pay for smart meters.

(3) The Skeptics: Cluster 3 is the smallest segment and characterized by customers who have comparably deep concerns and expect to receive small benefits from the use of smart meters. Thus,

compared to the other two clusters, the value perception of smart meters is low. As a consequence they are reluctant to pay for a smart meter (only 5.7 percent of the customers in this segment would be prepared to do so). On average, customers in Cluster 3 are older than customers in the reference groups. Presumably, environmental issues are of no great concern to this group, since 9.1 percent state that they would never consider changing to a green electricity provider.

Generic Smart Grid Business Models

Once different customer segments are identified based on the value perception, the question arises which business models and according value propositions are suitable to approach them. For this purpose we conceptualized a cross-table to serve as an analytic frame of reference with generic customer segments on the one axis and generic business models on the other axis. Figure 3 illustrates our approach.

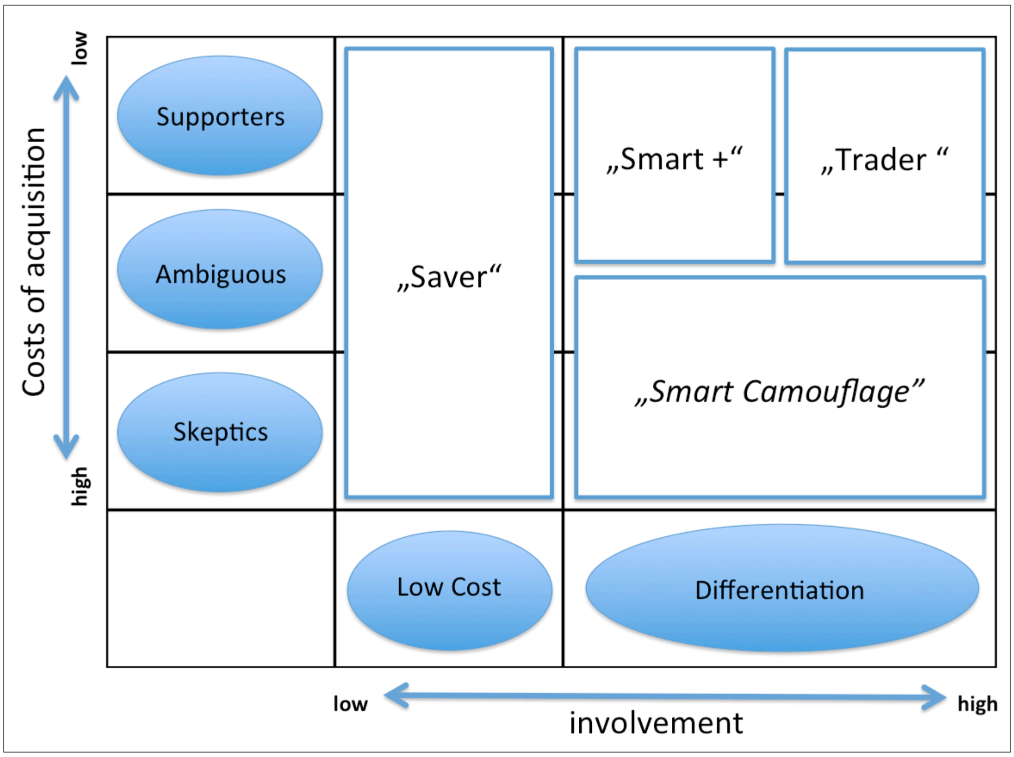

Fig. 3 Generic clusters and generic business models for smart grids

The y-axis presents the three generic customer segments we discussed earlier. Along with the findings from the value-based segmentation, we very basically assume that companies will incur different costs per segment to get customers involved in their smart grid products or services. While supporters would only require marginal investments, the costs to convince the skeptics may exceed the potential revenue that can be earned by targeting this segment. The middle segment may hold for both.

The x-axis refers to the generic differentiation between low cost (e.g. efficiency) driven business models on the one hand and differentiation (e.g. innovation) driven business models on the other hand.

This differentiation has been prominently addressed in the business model literature by Zott and Amit and goes back to Millers work on configurations (Miller 1986, 1996; Zott and Amit 2007, 2008). For a discussion of this differentiation and the applicability of it in the context of energy related business models we refer to Loock (Loock 2011b). Furthermore, we assume a different degree of involvement that is required by customers to participate in each of the generic business models. Whereas low cost business models require only low involvement on the one side of the spectrum, business models that are built around a differentiation approach require a relatively higher level of involvement from customers.

Based on our analytical framework, we propose four generic business models with different value propositions for smart grid customers: “Cost Saver”: proposes lowest costs, “Smart +”: proposes added value related to the topic of smart grid, “Smart Camouflage”: proposes added value not directly related to the topic of smart grid, “Trader”: proposes buy-off services. We arrived at the business models as a result of an analytical process in which cost of acquisition and involvement with topics around smart grids are important determinants. The rationale is that business models that only require low involvement are suitable to attract all customer segments, even those that are skeptical about smart grids. For example, if smart grid business models would help customers save enough money, even the smart grids skeptics could be attracted by that value proposition. On the other spectrum, business models that require high involvement are either suitable to attract customer segments that are exposed to and interested in the topic of smart grids (such as Supporters or part of the Ambiguous group) or need to address other topics than smart grids to get customers involved in their value proposition.
It is important to note that these business models are conceptualized as a generic frame of reference and modifications and even combinations are conceivable. In the following, we discuss value propositions of the business models in more detail.

(1) “Saver”: The generic business model “Saver” proposes to help customers lower their energy costs. Several sub-value propositions can be imagined, such as helping customers in reducing their energy consumption, buying at cheaper tariffs, or even saving taxes or avoiding fines if, for instance, the usage of smart grid applications (like smart meters) is mandatory. According to the “Saver” business model, people would buy products or services that help them to lower their costs related to energy consumption. Examples are, for instance, devices that visualize energy consumption, devices that enable consumers to buy energy at cheaper tariffs, or devices that help people control their energy consumption more efficiently. The value proposition of lowering costs is easily understandable for all customer segments, which makes the “Saver” business model potentially suitable for all generic customer segments, even those with a small perceived value of smart grid technologies. However, addressing all customers only with this business model might lead to suboptimal results as the differences in needs and value perceptions of the customer segments and thus potential differences in the willingness to pay might not be considered (DeSarbo et al. 2001; Dibb et al. 2002; Kotler 1997;

Morris et al. 2005; Ruiz et al. 2007; Wiedmann et al. 2009). As the “Saver” business model relies on just one selling argument – cost savings – and thus no additional information procurement is needed (e.g. information procurement about other product or service characteristics), the business model requires only low involvement from the customer (Lastovicka and Gardner 1978; Laurent and Kapferer 1985).

(2) “Smart +”: The generic business model “Smart +” proposes smart grid products or services that offer a value added to customers. For instance, a smart gird device, such as a smart meter, would provide metering services to customers, which would be the basic offer. In addition, such smart meters could provide added value in the form of home automation as well as additional features like fire alarms, burglary prevention devices, steering applications for appliances, heating or cooling systems, or other electronic devises. In contrast to the “Saver” model, the primary value proposition to customers is not to save money but to acquire a value added. Examples are technical applications (e.g. smart meters with enhanced features over and beyond pure metering and other value added services). In our survey, participants stated that such value added could include smart grids that enable the integration of renewable energy into the grid. Other responses related to issues like safety and convenience. “Smart+” business models focus on the customer segment Supporters and partly on the Ambiguous group with a higher perceived value of smart grid technologies. They require medium involvement, as customers need to engage in the value added (e.g. by seeking information about it).

(3) Smart Camouflage: The generic business model “Smart Camouflage” also offers value added. However, in contrast to Smart+ it targets other customer segments, especially the Skeptics and the Ambiguous group. Thus, this business model, although it is designed to serve the purpose of smart grid implementation, should not be built around a value proposition to customers that is related to smart grids, as the two segments include customer with a lower perceived value of smart grid technologies. Moreover, “Smart Camouflage” business models follow a product bundle logic. In this context, the initial value proposition is not directly related to smart grids. Examples could be electronic devises with built in smart grid functions (e.g. home appliances, IT devices like computers and routers, home-automation systems, smart phones or electric cars), where the value proposition is build around other aspects than smart grids, e.g. innovative technology or electronic gadgetry. As customers need to engage in the value added, this business model requires at least medium involvement. If the value added products or services demand high investments from the customer and are more complex (e.g. expensive electric vehicles), the required involvement from the customer might as well be high because the need information procurement for complex and expensive products or services usually is higher (Lastovicka and Gardner 1978; Laurent and Kapferer 1985).

(4) “Trader”: This generic business model provides customers with the opportunity to trade different “products” and to earn a suitable value in exchange. In particular, “Trader” business models come

with several sub-value propositions and provide the opportunity to trade electricity (e.g. customers feed in electricity produced by their own renewable energy devices), to trade flexibility (e.g. provision of storage capacity or flexible energy usage and buy-off), and provision of capacity to achieve economies of scale (e.g. within Schwarmstrom concepts). The "Trader" model requires high involvement from customers, as they need to e.g. invest in power generation or collect extensive information about market mechanisms to participate in the energy market place. Further, costs of acquisition are high, as the business model requires distinct contracts to organize the trading. Based on these aspects, the trader model will most likely attract Supporters and consumers from the Ambiguous group with a higher perceived value of smart grid products and services.

Discussion and Outlook

This paper contributes to theory by demonstrating the close link between social acceptance, – specifically market acceptance – the technology acceptance model, perceived customer value, and the need for business models in the field of smart grids. Furthermore it contributes to the research on value-based segmentation and demonstrates its importance in new markets, such as the smart grid market. Our research follows the initial assumption that market acceptance (a part of social acceptance) of smart grids by customers and by investors can be enhanced through a better fit of the value propositions of the business models with customer segments' value perception, as this leads on the one hand to higher customer value and on the other hand to higher benefits for investors due to higher value creation and competitive advantage potential.

There are several opportunities to increase the degree of fit. First, one could consider a one-size-fits-all model. However, we maintain that this approach will only lead to suboptimal results as the different customer value perceptions and potential differences in the willingness to pay are not taken into consideration. For instance, it might be too expensive to educate all skeptical customers; likewise, it would be a waste of market potential to approach supportive customers with a higher perceived value of smart grid technologies and thus a higher willingness to pay for smart grid products and services with a cost saving value proposition only. However, having too many different business models does not seem to be efficient either, as it could be too expensive for companies or could cause market confusion. We therefore argue for an optimal number of business models. To derive a conceptual framework, we proceeded as follows: First, following an explorative survey to gauge customer value perceptions of smart grids in several European countries, we found three generic customer segments: "Supporters", "Ambiguous" and "Skeptics". Second, we cross-tabulated these three generic customer segments with generic business models as discussed in the literature and third, we conceptually identified four generic smart grid business models with different value propositions: "Saver", "Smart+", "Smart Camouflage" and "Trader". These business models serve as a generic analytical frame of references.

Based on this research we see important implications for energy policy and smart grid management. In order to accelerate the implementation of smart grids, a segmentation approach based on different value perception of smart grid technology might be advisable.
Energy policy should bear in mind that market acceptance of smart grids – and thus further smart grid development and implementation – cannot be increased by a one-size-fits-all business model. Different customer segments have different value perceptions and thus require different value propositions. Energy policy should therefore support the development of a portfolio of business models and value propositions that is suited to increasing market acceptance and thus the implementation of smart grids.
As for the managerial implications of our research, we encourage managers to approach smart grids beyond a purely technology-based perspective and especially to adopt a more customer-oriented view by investigating the differences in value perceptions in the heterogeneous market. We further highlight that there will be no single business model to facilitate the success of smart grids. In this regard our proposed set of generic smart grid business models might serve as reference points to further develop and innovate value propositions of business models for smart grids that fit the market heterogeneity and the different customer segments in an optimal way.

We are aware of the limitations of our work, but we also see the possibility of our study opening up new avenues of research. First, our sample approach comprises some biases. Due to the online survey we only reached people who have access to the Internet and have a certain interest in the topic. We tried to overcome this shortcoming by also asking customers in three different shopping malls to complete the survey. Although this approach for the sample collection might not lead to a fully representative sample, the approach is common practice and can be justified from the point of view of conducting economic research. Thus, and due to the small number of participants in our survey, we consider our segmentation approach explorative in nature. Further work should draw on a larger sample. Additionally, other segmentation approaches, such as the finite-mixture methodology (DeSarbo et al. 2001) could be used to validate our findings. Furthermore, we only measured willingness to pay by directly asking the respondents whether they would pay more for new metering equipment. This simple approach was used in order to keep the questionnaire at a reasonable length. Further research should measure the differences in willingness to pay between the different segments by using more sophisticated methods, such as conjoint measurement, which might be a more accurate indicator of actual willingness to pay. Additionally, we came upon relevant research questions for the single segments. For instance, for the Ambiguous group and the Skeptics, it would be of interest to know which activities would be suitable to get them involved in smart grid products and services and thus increase their perceived value of smart grid technologies. How effective and efficient are different push and pull strategies and how can their impact be compared? For instance, is customer education more beneficial than incentives or fines? What kinds of incentives or fines have what impact and how do these relate to other contingency factors like cultural differences between countries? An interesting question relating to Supporters is whether the market potential has already been effectively leveraged and whether this target group has already been targeted effectively enough. Of further interest would be how to engage them as promoters?

Second, the goal of this paper was to conceptually derive a set of smart grid business models that can serve as an analytical frame of references for both managers and researchers. This approach was presented to and discussed with managers in a workshop at the St. Gallen Forum for Management of Renewable Energies in March 2011 and with researchers at the 34th IAEE International Conference, “Institutions, Efficiency and Evolving Energy Technologies” in June 2011. The next step would be to empirically validate and test our findings. First, each business model and value proposition need to be validated and tested separately. This can be done using further qualitative data from e.g. expert interviews or focus groups. Furthermore, case studies can provide additional information and insights to refine and validate the generic business models and value propositions, and they provide a framework for investigating the different perspectives of the various stakeholders in the field of smart grids. Additionally, we see several interesting research opportunities to refine and enrich the individual business models. For instance, for the saver model, what is the revenue model for the supplier? What is the most successful way of visualization? What is the optimal tariff structure? For the Smart + business model it would be interesting to understand which services are of value to mass markets and not only to some segments? The Trader business model raises questions like, what is the value and the price of different sources of electricity at different times? What unit of flexibility (e.g. capacity, load shift) is of what value at different times, and what is the price for flexibility? How can flexibility be used? What capacity is how tradable at what value?

In a second step, the fit of the validated and refined business models with the different customer segments needs to be empirically tested in future research. Future research could also test the optimal number of business models empirically. Both should be based on quantitative rather than qualitative data. Finally, research could address the question which policies are best suited to promote the business models and related value propositions.

It should be obvious that the value-based segmentation approach and the typology of business models for smart grids is also a valuable tool to structure research and set up a research agenda.

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