Do Default Electricity Mixes Correspond to Customer Preferences?

Empirical evidence from choice experiments in Germany

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Abstract

Most European countries, amongst others Germany, have liberalized their electricity markets which enables customers to choose their preferred electricity provider and select among a variety of different electricity mixes. The ongoing liberalization processes of electricity markets has dramatically changed the importance for marketing strategies in building customer relationships as well as in creating product awareness. Thus, a thorough understanding of the underlying mechanisms of consumer choices are important in order to successfully market green electricity and expand its market share. This paper aims to investigate individual preferences of German consumers for green electricity in order to show that the kind of electricity mix that is delivered to consumers as the default does not correspond to consumers preferences. Based on a stated preference survey investigating a representative sample of 414 German consumers, the results of this study show that the "electricity mix" had the most important influence on choice decisions, followed by "monthly electricity costs" and the "location of the electricity generation". Findings of this study reveal strategic options for product design, positioning, and marketing for a liberalized electricity market.

Structure of the paper:

1. Introduction

Prior to the opening of energy markets for competition in many European countries, most consumers have been served by a monopoly utility. Through market liberalization, customers have now received the possibility to choose between electricity suppliers and among a variety of different electricity products (Markard and Holt, 2003). Many studies with German consumers show that consumers have very positive attitudes towards renewable energy and a majority of consumers report a willingness to buy electricity generated from renewable energy sources, even at a premium (e.g. Gerpott and Mahmudova, 2009, Menges et al., 2004). Nevertheless, the high level of reported willingness-to-pay is poorly reflected in actual market share of green electricity products as penetration levels among the population are still very low (Bird et al., 2002). Although many consumers are interested in the environment, there is still only a rather small segment of consumers in the marketplace who put their interest into purchasing practice. In other words, even when consumers have a positive attitude towards environmental issues, they are passive in their purchase decisions to a large extent. In literature, this is called the “attitude-behaviour gap” or “value action gap” which is the recognition of a disparity between stated attitudes and actual behaviour and thus claims that attitudes alone do not only influence consumers decision-making enough to turn into a sustainable consumer purchase (Chatziddakis et al., 2007; Kollmuss and Agyemann, 2002; Maiteny, 2002).

By analyzing how individuals make decisions, human behaviour on energy use can be better explained by drawing on behavioural decision models from the field of behavioural economics which provide another look on why consumers do not adopt sustainability innovations such as green electricity, despite their positive attitudes towards the environment. The behavioural economics literature is influenced by psychology aimed at understanding how a consumer decision takes place (Rabin, 1998; Gillingham et al., 2009). A very important set of research in behavioural economics implies that consumers' behaviour can simply be influenced through a different setting of the default option. Rational choice would imply that individual decision making is not influenced by the default (Gigerenzer, 2010). However, the power of defaults is well known for different kind of fields (Goldstein et al., 2008; Polak et al., 2008) and is described as being the option that consumers receive if they do not explicitly ask for another option (Brown and Krishna, 2004). Anderson (2003) and Sunstein and Thaler (2003) have shown that, when applying defaults, consumers tend not to select another alternative (e.g. Anderson, 2003; Sunstein and Thaler, 2003). That is why Lowenstein (2008) argues that "soft" paternalistic interventions are becoming more important as it is more and more recognized that many people are not acting in a way what seems to be best for them.

Real life shows that it seems that customers often are inhibited to switch power providers and to opt out of defaults in favour of green power products. By changing the default of the standard electricity mix to a greener option, electricity companies could better correspond to customers' needs.

The study addresses whether standard electricity products (default) in Germany meet the preferences of private consumers. To determine customers' preferred electricity product, we conducted computer-assisted personal interviews with 414 German private household consumers. Using hierarchical Bayes estimation we determine customer preferences and the importance of individual product attributes in product choice. It is the aim of this article to contribute to filling gaps by (1) analyzing preferences of private household customers in Germany for a large number of specific product attributes, (2) determining the preferred energy sources for electricity production, and (3) discussing implications for policy-makers, power providers, and utilities.

2. Decision making-process and customer preferences for electricity products

Although the electricity market was not in the focus of publicly available marketing research, market liberalization induced a series of studies on customer behavior and preferences. A successful marketing of electricity based on renewable energies (green power) requires a good understanding of the decision-making process of customers. Purchase decisions can be disaggregated into several phases: problem or need recognition, information search on products and power provider, evaluation of alternatives, selection, and purchase. The search for a new power product or a new power provider can be initiated and motivated by various reasons. Watson et al. (2002) determined price, environmentally sound electricity production, and incentives for new customers as the most important motives for switching the power provider. Rowlands et al. (2004) identified price, reliability of power supply, and service quality as the most important factors when choosing an electricity company, followed by environmental aspects, reputation of the power provider, and the location of the electricity generation. A study by Goett et al. (2000) analyzed preferences from small and medium business customers for 40 attributes of electricity products. However, the findings of this study cannot be applied to private household customers directly. Roe et al. (2001) and Bird et al. (2002) analyzed preferences of private household customers and found that they are willing to pay a higher price for green power than for the basic electricity mix.

On the other hand, time-consuming and complicated purchase processes, complex products, nontransparent price models, as well as long-term contracts inhibit switching behavior (Rommel and Meyerhoff, 2009; OECD, 2008). The willingness to switch the power provider was overestimated in the beginning of electricity market liberalization. A recent study by Accenture (2009) states that only 22% of all private household customers in Germany had ever switched to a new provider, and of those, one-fifth chose a green power product. As far as reasons for not switching to green power products are concerned, 83% of the 527 survey participants identified higher prices for green energy, lack of information (73%), and a lack of green power products (68%). In all European countries with liberalized electricity markets and also in countries where green electricity products are widely available for private household customers, only a small share of consumers actively switched to green power products (Wüstenhagen et al., 2003). Most consumers stay with their power provider and the product they are used to, and hereby avoid transaction costs.

3. Theoretical background and hypothesis development

The power of defaults provides an explanation as to why individually stay with defaults they know, even though there would be alternatives on the market which would meet their preferences even better. Johnson and Goldstein (2003) have explained the effect of how defaults influence the decision-making process of individuals in different ways. On the one hand side, defaults can be perceived as being recommendations by the Government. On the other hand, making an active decision requires physical effort (Samuelson and Zeckhauser, 1988). In connection to this, one explanation is the existence of human inertia, which has been explained by a number of behavioural economics studies. Thaler and Sunstein (2003) explain this effect as any change from any status quo or present state requires the individual to invest time and effort. Many people are refrained to do that, in particular in case when they tend to procrastinate things. Especially when people have to deal with a complex decision-making process, they shut off and don't make any decision or delay it to a later point in time. This problem of inertia and procrastination is related to the theory of "bounded self-control" (Mullainathan and Thaler, 2000). Bounded self-control describes individuals who have the right intentions or beliefs but prove to be limited in their capacity or lack the willpower to execute their intentions to change the behaviour. Although people would like to change their behaviour or buy a product today, they are too often too busy. Thus, although individuals comprehend the consequences and advantages of a specific behaviour and have the right intentions to change, they lack the energy to implement their intentions. Thus, the existence of inertia also explains the fact that default rules tend to be "sticky" (Thaler and Sunstein, 2003). In a fully rational world, setting the default differently should not have any impact on consumer choice as consumers still could simply go for the option which suits their needs best, independently of the default (Thaler and Sustein, 2003).

One prominent example in the field of green electricity has been discussed by Pichert and Katsikopoulos (2008). The authors present first empirical evidence showing that these cognitive biases and mechanisms also hold for default electricity mixes. With two laboratory experiments among 65 students and persons younger than 35, they showed that participants are more likely to choose a green power option when it is presented as default product than when it is presented as an alternative. Most of the respondents would stay with default electricity mixes even if they cost more than the cheapest electricity mix. They also show that the willingness to accept (WTA) an imposed price premium for green power in the default electricity mix is higher than the willingness to pay (WTP) for the same green electricity mix, when customers have to actively choose and order. This implies that once a green default is established, people are either reluctant to move away from this reference point or expect a relatively large incentive to do so.

To sum up, transaction costs and cognitive biases, such as status quo bias, seem to

inhibit customers to switch power providers and inhibit them to opt-out of defaults in favor of green power products. As various studies clearly indicate that costumers prefer renewable energies (Borchers et al., 2007; Farhar, 1999) and most utilities sell and produce a majority of non-renewable energy, the following hypothesis is set up for test:

Hypothesis: *Current default electricity mixes in Germany do not correspond to average customer preferences.*

4. Methodological considerations

4.1. Design of study and methodological approach

4.1.1. Objective

To determine detailed and up to date consumer preference for very specific product attributes, we were obligated to rely on an assessment of stated preferences. To determine customer preferences for electricity products, we chose a survey approach including a choice experiment with real customers, which allows assessing customer preferences with hypothetical, yet realistic product purchase decisions. Choice experiments allow one to simulate choice situations for which no market data is available. They also allow one to determine customer preferences for various product attributes and for products that are not yet available on the market. In summer 2009, we carried out computer-assisted personal interviews with 414 German customers conducting a choice experiment. Results from a hierarchical Bayes estimation allow one to compare the importance of various product characteristics. We also computed part-worths for each attribute level; this enables one to derive implicit willingness to pay estimates.

4.1.2. Choice experiments und conjoint analysis to measure customer preferences

Choice experiments and conjoint analysis belong to the family of conjoint measurement methods. Conjoint measurement is one of the most important achievements of marketing research over the last 40 years (Gustafsson et al., 2007; Simon, 2008; Netzer et al., 2008). A very important field of application for conjoint measurement is product design. It answers the question on how to design a product to best satisfy market demand. Conjoint measurement determines the contribution of attributes to the total utility of a product. This research is based on stated preference surveys (choice experiments) to determine indirectly the importance of product characteristics on consumer decision-making. In choice experiments, the information flow can be controlled and it is possible to provide information to respondents in order to anticipate and simulate specific choice contexts or certain stages of market maturity in a realistic way. This is particularly interesting for the analysis of consumer preferences regarding new products or product features where no market data is available (Louviere et al., 2003).

For the analysis of discrete choice data assessed with choice experiments, different methods exist. Discrete choice models are based on random utility theory. It is assumed that each respondent faces a choice amongst J alternatives in each of T choice situations and chooses the alternative with the highest utility (Huber and

Train, 2001). The newest method is based on hierarchical Bayes estimations (Rossi and Allenby, 2003; Orme, 2007; Allenby et al., 2004; Teichert, 2001) or random coefficient choice models. Within a Bayesian framework, the distribution of part-worths (coefficients) across the population is estimated and combined with the information on individuals' choices to derive posterior or conditional estimates of the individuals' values[1]. Revelt and Train (1999), Huber and Train (2001), and Scarpa et al. (2008) show that results from hierarchical Bayes estimation and mixed logit estimations (random coefficient estimations) are very similar. The importance of hierarchical Bayes estimations for quantitative marketing approaches is increasing steadily (Rossi and Allenby, 2003; Allenby et al., 2004). With hierarchical Bayes estimations, it is possible to determine individual part-worth values to assess heterogeneity among customer segments. This is an advantage in comparison to traditional conjoint approaches based on aggregated preferences measures.

4.1.3. Selection of decision-relevant product attributes

The relevant attributes were selected based on a study by Burkhalter et al. (2009) conducted in Switzerland. Based on the literature review and expert interviews, the attributes were discussed and adapted to the German market. The attributes and attribute levels that were used for the choice experiments are listed in Table 1:.

Table 1: Choice experiment design: attributes and levels

Electricity mix	60% coal, 25% nuclear, 15% origin unknown	60% coal, 25% nuclear, 5% water, 5% wind, 5% biomass	60% coal, 25% gas, 5% water, 5% wind, 5% biomass	50% wind, 30% water, 15% biomass, 5% solar	100% wind
Power provider	Big, national power provider	Medium sized, regional power provider	Municipality	Specialized power provider	
Location of electricity generation	In the region	In Germany	In Switzerland	In Eastern Europe	
Monthly electricity costs	50 Euro	55 Euro	60 Euro	65 Euro	70 Euro
Certification	ok power	TÜV	Grüner Strom Label	- no certification	
Price guarantee	None	6 months	12 months	24 months	
Cancelation period	Monthly	Quarterly	Semi-yearly	Yearly	

[1] See Rossi and Allenby, 2003; Huber and Train, 2001 for a more detailed discussion of hierarchical Bayes modeling.

The different **electricity mixes** serve two purposes. On the one hand they represent a continuum from ecological damaging to "green" electricity offerings with a high portion of renewable energy. On the other hand they also represent several plausible scenarios for the future of the German electricity market and we can see how attractive these scenarios are to the electricity customers: ***Electricity mix 2*** represents the current German electricity mix. In Germany, all electricity suppliers must deliver electricity from renewable energy sources, which is part of the quota that every supplier must deliver by law determined by the Renewable Energy Act (German: EEG-Gesetz). ***Electricity mix 1*** represents the same mix without any renewable energy. Mix 3 represents the possibility of replacing existing nuclear power plants with natural gas fired plants. Currently, there is a heavy debate regarding phasing out nuclear power in Germany. Mix 4 and mix 5 only consist electricity produced from renewable energy sources. Whereas mix 4 contains of different kinds of energy sources (e.g. solar), mix 5 is purely based on wind power.

The levels of the attribute **power provider** should determine how willing private household customers are to switch between different power providers and how important it is that the electricity company is based locally. The findings from the attribute **location of electricity generation** should show customer preferences for power with different geographic origins. The levels of the attribute monthly electricity costs allow for estimates of private household customers' implicit willingness to pay for the different electricity product attributes.

The levels of the attribute **certification** include the three eco-labels for electricity that existed in Germany at the time of the survey along with a level for electricity products that are made up of non-certified power. The attribute price guarantee tries to identify how much value consumers place on price security. Using the attribute **cancelation period** we can determine how long private household electricity customers are willing to commit to their electricity providers.

For this study the attributes and levels were presented using a full-profile design. This means that products were shown together with all their attributes at the same time in each of the choice exercises in order to get as close to a real-life decision-making situation as possible. Every survey participant was given 12 choice tasks to complete and each choice task included three randomly-generated product options.

4.1.4. Method of data collection and data pool

The respondents were recruited by a professional marketing research company (GfK), who conducted computer assisted personal interviews (CAPI) in June 2009 with 414 respondents. The target population of the study consisted of the general German population. The sample was drawn by quota sampling, taking into ac-

count distribution of the target population by state (German Bundesland), city size, household size, and sex. Setting quotas using these indicators is a standard procedure to draw representative samples in professional market research. Table 4 in Annex I shows how the sample compares to the overall population. A typical choice task is shown below in Figure 1.

Figure 1: Example of the choice experiment on electricity products: A choice task

If you had to choose between the following electricity products, which one would you most likely choose? (please click on the preferred product).			
Electricity mix	60% coal, 25% nuclear, 5% water, 5% wind, 5% biomass	60% coal, 25% gas, 5% water, 5% wind, 5% biomass	100% wind
Power provider	Municipality	Medium sized, regional power provider	Big, national provider
Location of the electricity generation	In the region	In Germany	In Eastern Europe
Monthly electricity costs	€50	€60	€70
Certification	ok power	-	TÜV
Price guarantee	None	6 months	12 months
Cancelation period	Monthly	Semi-yearly	Yearly
	○	○	○

5. Results: Empirical findings

In this section the detailed results of the choice experiments and the survey will be presented. They encompass primarily the part-worths values of the individual attribute levels and the importance of the attributes to the product selection decisions made by the survey participants. Private household customers' implicit willingness to pay for certain attribute levels can be estimated based on these results. Segment-specific analysis can also be conducted in connection with, for example, social-demographic characteristics.

5.1. Estimation of logit and hierarchical Bayes models

Table 2: Hierarchical Bayes model estimates for the selection of electricity products (N=414 survey participants) summarizes the results from the choice experiments with the coefficients of the estimated standard logit and the hierarchical Bayes model as well as the corresponding standard errors and standard deviations.

The coefficients describe the influence that a change in the attribute levels has on the total utility of a product. They are dependent on the selected range of the attribute levels. They should primarily be used to compare the part-worths of different levels of a given attribute. The standard deviation from the mean of the coefficients shows the variance of the individual preferences. The larger the standard deviations in comparison to the difference between the maximum and the minimum coefficients of the given attribute are, the more the preferences of the individual respondents differ regarding the respective attribute level. The standard error tells us about the quality of the estimate. The ratio between the coefficient and the standard error (t-statistic) shows the significance of the coefficient. The higher the absolute value of the t-statistic, the more certain we can be that the estimated coefficient are accurate.

Table 2: Hierarchical Bayes model estimates for the selection of electricity products (N=414 survey participants)

Hierarchical Bayes estimation						
Sample Germany						
Attribute level	Model 1: Logit estimation[i]			Model 2: HB Estimation[ii]		
Electricity mix				Coeff.	Std. error	T-value
Mix 1	-0.868***	0.044	19.940	-4.576***	0.108	42.541
Mix 2	-0.603***	0.041	14.888	-2.661***	0.079	33.519
Mix 3	0.001	0.036	0.035	0.369***	0.068	5.420
Mix 4	0.727***	0.035	20.923	3.357***	0.085	39.544
Mix 5	0.743***	0.034	21.656	3.511***	0.093	37.638
Power provider						
Specialized provider	-0.019	0.031	0.615	0.003	0.051	0.065
Municipal	0.049	0.030	1.626	0.200***	0.049	4.047
Middle-sized, regional provider	0.050	0.030	1.654	0.011	0.049	0.217
Big, national provider	-0.080***	0.031	2.588	-0.214***	0.046	4.662
Location of electricity generation						
In Eastern Europe	-0.363***	0.033	11.142	-1.679***	0.063	26.611
In Switzerland	-0.171***	0.032	5.408	-0.595***	0.054	10.470
In the region	0.266***	0.030	8.996	1.182***	0.053	22.255
In Germany	0.268***	0.030	9.081	1.093***	0.054	20.069
Monthly electricity costs						
70 Euro/month	-1.027***	0.046	22.372	-4.958***	0.092	53.821
65 Euro/month	-0.462***	0.039	11.826	-2.005***	0.065	30.668
60 Euro/month	-0.020	0.036	0.553	0.247***	0.057	4.310
55 Euro/month	0.535***	0.034	15.515	2.531***	0.066	38.088
50 Euro/month	0.974***	0.035	28.225	4.185***	0.080	52.482
Certification						
No certification	-0.079**	0.031	2.572	-0.482***	0.051	9.442
ok power	0.007	0.031	0.238	0.037***	0.048	6.363
TÜV	0.038	0.030	1.253	0.139***	0.046	3.006
Grüner Strom Label	0.033	0.030	1.093	0.305	0.046	0.800
Price guarantee						
None	-0.179***	0.031	5.750	-0.883***	0.052	16.917
6 months	-0.017	0.031	0.543	0.040	0.048	0.835
12 months	0.059	0.030	1.941	0.303***	0.050	6.071
24 months	0.137***	0.030	4.546	0.540***	0.054	9.991
Cancellation period						
Yearly	-0.058	0.031	1.900	-0.130**	0.050	2.602
Semi-yearly	-0.038	0.031	1.230	-0.111**	0.049	2.237
Quarterly	0.019	0.030	0.620	0.059	0.050	1.169
Monthly	0.077***	0.030	2.557	0.182***	0.050	3.596

* Significant at 90% confidence interval, ** Significant at 95% confidence interval, *** Significant at 99% confidence interval.

i) The standard logit estimates are based on the aggregate data from the entire sample. Log-likelihood for null model=-4094.05, Log-likelihood for estimated model=-5457.91

ii) The hierarchical Bayes method allows for the estimation of individual part-worths for every respondent and thus allows for heterogeneous preferences to be considered (Orme, 2007). The means of the coefficients (part-worths) are listed in this table. All coefficients are normally distributed.

5.1.1. Importance of attributes

The different attributes have varying levels of influence on the product choices of the electricity customers. The importance of an attribute mirrors the portion that the attribute can contribute to the utility of the product. If the design of an important attribute distinguishes itself due to a level that is favored by the customers, this has especially positive influence on the total utility of the product. Conversely, a level of an important attribute that is not preferred by the customers can greatly lower the total utility of a certain electricity product. In order to calculate the importance of individual attributes, the difference between the highest and lowest part-worths of each attribute was divided by the sum of the differences of all the attributes for each respondent. The mean of the ratios, which were calculated in the manner described above, can be interpreted as representing the importance of the individual attributes. Since the attribute levels were combined without restrictions in the choice experiments, the coefficients can also be used for this calculation. Thus it is clear that the derived importances are dependent on the selection of the attributes and the definition of the attribute levels.

In Table 3 the different product attribute importances are listed in descending order. The table contains the importances that were determined using the model based on the hierarchical Bayes estimation.

Table 3: Importances of the attributes of electricity products

Attribute importances	
Attribute	
Electricity mix	31.8%
Monthly electricity costs	31.5%
Location of electricity generation	12.5%
Price guarantee / price model	7.6%
Certification	5.6%
Power provider	5.5%
Contract length	5.5%

The indirect estimates of the importance of the different attributes for the choice decision assign the highest importance to the attribute electricity mix, followed by the monthly electricity costs and the location of electricity generation. This means that these three attributes had the greatest influence on the product selection behavior of the respondents. This finding differs from the results of studies conducted in North America and Great Britain (Promit, 2004; Rowlands et al, 2004; Watson et al., 2002), in which private household customers assigned the price of electricity greater importance than the electricity mix and the environmental and energy supply security issues associated with it. This difference is probably related to the high support levels of the German population of an extension of renewable energy consumption (Kuckartz and Rheingans-Heintze 2006; Christ and Bothe 2007). Additionally, during the years that lie between the studies conducted in North America and those in Germany, the awareness about energy

and climate issues has increased globally. Yet in the present case the importance of the electricity mix compared to the monthly electricity costs can be easily put in perspective for three other reasons. First, the attribute electricity mix received far more weight optically, because its attribute levels occupied up to four lines, while the levels of the other attributes could be displayed on single lines. Second, social desirability also cannot be completely excluded, even though this effect, when compared to direct queries about individual attributes, tends to be moderated by the holistic decision-making format of choice experiments. Third, a segregate framing of costs (e.g. in monthly costs as in this study) decreases the importance of costs in comparison to an aggregate framing of costs such as costs per year (Kaenzig, 2009).

The location of electricity generation is also assigned higher importance in the present study compared to earlier studies from other countries. The rest of the attributes including power provider, price guarantee, contract length, and certification exhibit less importance comparatively. Contract length and price guarantee are both presumably ranked as less important because, following the Kano model (Kano, 1984), these are viewed as fundamental or basic factors, which the respondents will not consider as personal needs unless they fail to fulfill their obligations. If certain basic requirements are viewed as self-evident, such as a long price guarantee or the ability to terminate the contract on relatively short notice, then these attributes will not contribute any additional utility to the overall product. However, if these basic requirements are not met, then the total utility of the product decline (Herrmann, 1992). The attribute certification played an insignificant role in the choice decisions made by the electricity customers. This may be due to the relatively low level of familiarity of the eco-labels in the population. However, credible eco-labels can both play an important supporting role when communicating with environmentally-conscious customers or critical target groups, as well as help with quality assurance (Markard and Truffer, 2006).

5.1.2. Part-worths and implicit willingness to pay

It is easier to compare the importance of different attributes if the coefficients are depicted graphically or converted into monetary units.

The monetary units could be interpreted as representing the consumers' implicit willingness to pay for a relative change in the level of the attribute. These amounts can be calculated by dividing the coefficient for each attribute level by the coefficient of the attribute monthly electricity costs. In this way the monthly electricity costs are included in the estimate as a continuous variable. Caution is advised when interpreting these results because there is a tendency for choice experiments to overestimate willingness to pay (Orme, 2006).

The results of these calculations are depicted graphically in Figure 2 using zero-centered part-worths. For the calculation the individual coefficients from the

hierarchical Bayes estimation are averaged (Orme, 2007). The scaling is arbitrary and any scalar can be used to, for example, calibrate the model with revealed willingness to pay.

Figure 2: Part-worths of product attributes and levels of electricity products

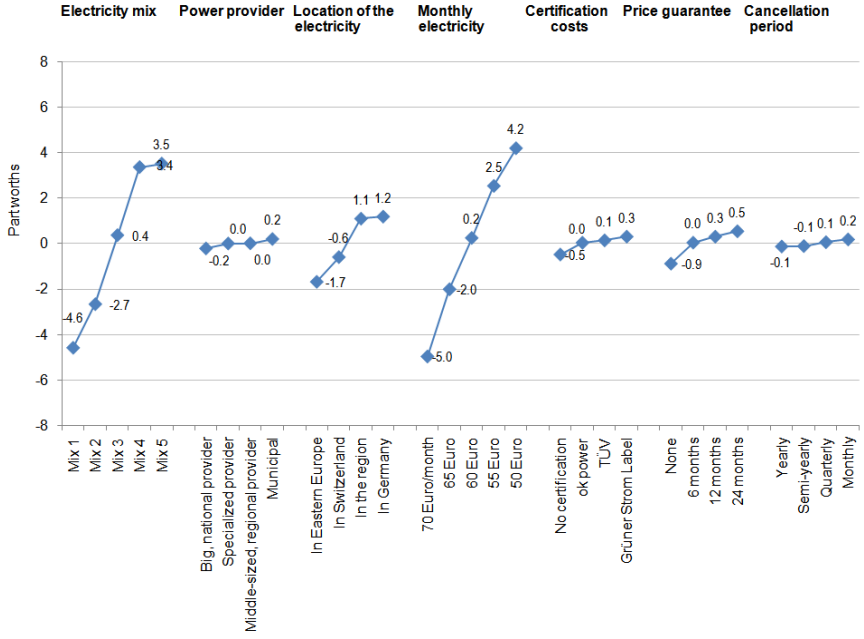


Figure 2 clearly shows that the attributes electricity mix and location of electricity generation (together with monthly electricity costs) have the most influence on the decision-making process. Electricity mixes with renewable energy are favored over those containing high shares of non-renewable energy sources. This is shown by the low popularity of mix 1 (60% coal, 25% nuclear power, 15% from unknown origin) and mix 2 (60% coal, 25% nuclear power, 5% water, 5% wind, 5% solar energy). These low levels of popularity for energy mixes with no or low share of renewable energy can then be compared to the substantially higher willingness to pay for green power in both mix 4 (50% wind, 30% water, 15% biomass, 5% solar) and mix 5 (100% wind power). When interpreting these results in favor of electricity generated from renewable energy it is important to note that the answers to questions involving environmental issues can be distorted because of social desirability biases (Diekman, 2006). Thus the ranking order of the attribute levels and the relative size of the intervals between the individual attribute levels tend to be more meaningful than the absolute amounts of the part-worths. One reason for the comparatively low popularity of Mix 1 could possibly be the presence of a portion of power of unknown origin. A direct comparison of a nuclear power scenario (mix 2) with a scenario that includes gas power (mix 3) could be

interesting in light of current political debates about the future of Germany's energy supply: The majority of respondents in this study chose the nuclear-free, but CO2-emitting scenario when these two mixes were compared. The results of an additional question, which asked respondents whether they would call the storage of CO2 or the storage of nuclear waste the lesser evil, paints a similar picture: While the number of respondents who are definitely opposed to nuclear power waste (9.5%) or definitely opposed to CO2 storage (6.8%) does not differ much, there were clearly more respondents moderately opposed to the storage of nuclear power (65.8%) than moderately opposed to the storage of CO2 (17.1%). Furthermore, the present study shows that an electricity mix that is more broadly based in new renewable energy (mix 4) provides almost the same level of utility to the surveyed customers than an electricity mix that is solely based on wind (mix 5).

In regards to the location of electricity generation, there is clearly a higher willingness to pay for electricity produced in Germany as opposed to electricity which is imported. It can be assumed that customers associate domestic power with a higher level of energy supply security. The part-worths for electricity from municipals and middle-sized regional providers are higher than that for electricity from big, national providers or specialized providers. However, the differences are rather minimal.

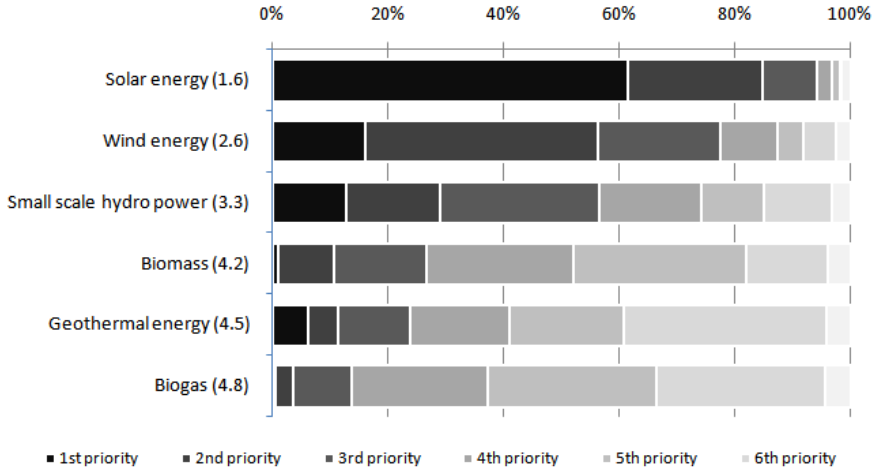
Among the different certification possibilities, the green power label "Grüner Strom Label" was able to attract a slightly higher implicit willingness to pay than the TÜV and the ok power label. However, the differences between attribute levels are not very pronounced.

Shorter contract lengths also tend to be preferred to longer ones. However, it should be noted that both the attributes contract length and price guarantee had little influence on product choices in this study.

5.2. The preferred energy source

Besides choice experiments, the survey also included a section with descriptive questions. Several interesting findings relevant to the design of electricity products can be found in the results from this section. For example, many green power labels stipulate that a portion of the price premium must be invested in a fund to support the development of new renewable energy capacity. In the present study, the respondents were able to give their opinion on which types of renewable energy sources they think should be supported by such green power funds. To do this, the respondents were asked to rank the different types of renewable energy sources according to their preferences in order from 1 (favorite) to 6 (least favorite). The results are shown in Figure 3.

Figure 3: Ranking of preferences for the support of renewable energy sources (the values in parentheses represent the average ranking in the respondents' priority lists).



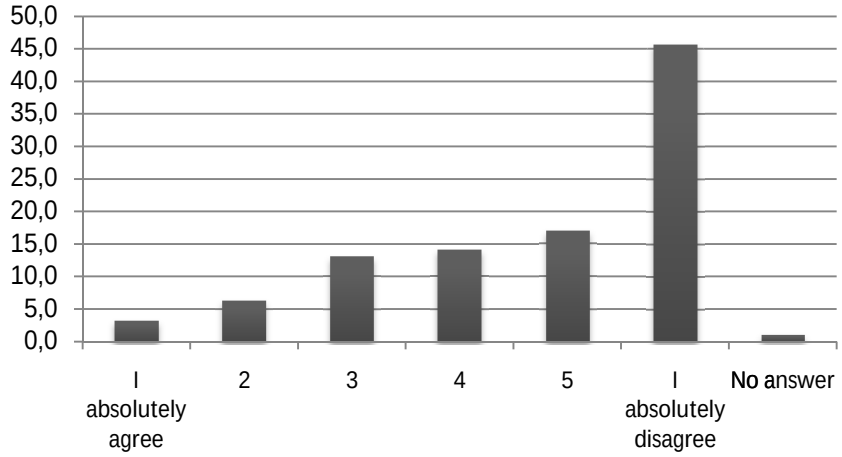
Solar power receives by far the most goodwill of all the renewable energy sources, confirming the results of various other studies (Borchers et al., 2007; Farhar, 1999). Ranking second and third, after quite a gap, are wind power and small hydropower plants, respectively. Geothermal energy ranked fifth in the survey. In the case of geothermal it is notable that a relatively high portion of the respondents ranked geothermal as their sixth, and thus, least favorite option. As in other surveys, biomass and biogas are somewhat less favored than the rest of the renewable energy sources. A possible explanation for this is that the positive environmental benefits that result from generating energy from biomass are not so clear to the average consumer.

Based on these results, designers of electricity products can learn that certified electricity products with a higher percentage of solar power are better suited for the higher priced products, while wind power and hydropower from small plants, because viewed less favorably than solar power in the eyes of the customers, will not add as much value to premium products. Since a comparatively high number of customers are sceptical of geothermal power, the safety concerns of the customers need be proactively addressed and answered through available communication channels when planning to use this type of energy source. The situation is similar for both biomass and biogas, which both tend to trigger a lower willingness to pay, but with appropriate marketing support these could become valuable additions to a locally produced green power product.

5.3. Opinion regarding nuclear power

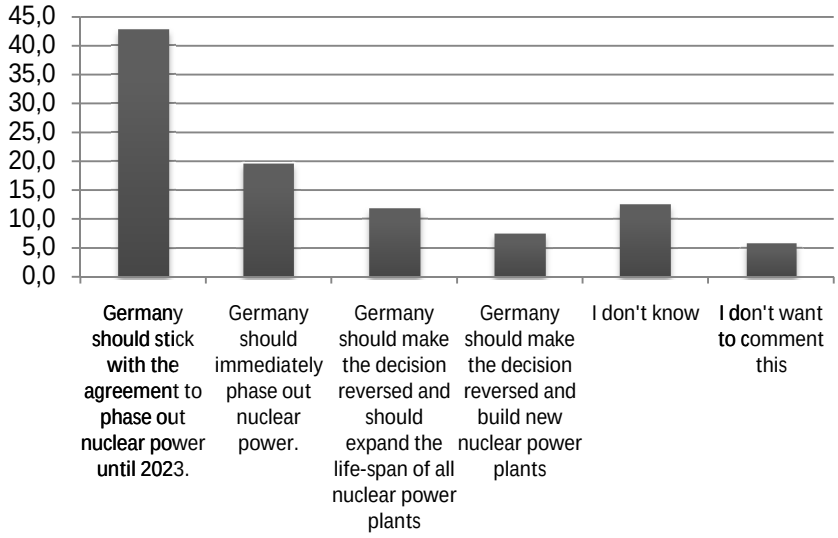
The survey also included a set of questions regarding the public opinion towards the topic of nuclear power. The question whether nuclear power should be expanded or not led to overwhelmingly negative reactions. Only about 3.1% of all respondents were clearly in favour of the expansion of nuclear power. In comparison, about 45.7% of all respondents absolutely disagreed with the statement that nuclear power should be expanded in Germany. This result shows that a relatively high proportion of the population positions itself on the very extreme ends of the scale, indicating that nuclear energy indeed is a controversial issue in Germany.

Figure 4: Agreement with statement: "Nuclear power should be expanded"



The survey also examined the opinion regarding the topic of phasing out nuclear power. The study found that over 42.8% of the German population agreed with the Governments' plan to phase out nuclear power and a 19.6% even was of the opinion that Germany should immediately phase out nuclear power. Only 11.8% of the German population was in favour that Germany should expand the life-span of all nuclear power plant whereas only 7.5% of the population favoured that new nuclear power plants should be build. 12.6% were indecisive and 5.8% did not want to comment at all on this question.

Figure 5: Opinion regarding the phase-out of nuclear power



6. Discussion and conclusions

A central finding of this study is that there is a remarkable gap between customer preferences and the products being offered on the German electricity market. In regards to the electricity production mix, the current (default) products offered rank second in terms of customer preferences. And while, according to recent studies, many electric utilities see the expansion of nuclear power capacity as the solution to future energy problems, private household customers express a clear preference for renewable energy products. Hereby the hypothesis stating, that current default electricity mixes do not correspond to average customer preferences, can be confirmed. As shown in this research, the composition of the electricity mix is the most important characteristic of electricity products influencing customer choices. For all other attributes investigated in this study the differences between current default electricity products and customer preferences are smaller. In terms of the different types of renewable energy sources, this study confirms the high level of favorability that solar energy enjoys. In addition, results clearly showed that the popularity of nuclear power is very low among German consumers.

One striking result of the study is the relatively low price sensitivity of demand. In addition, German consumers have a clear preference for domestically-generated power. Some attributes of product design proved to be rather insignificant at the time of the study, such as price guarantee and the contract length. The current study also shows that certification with eco-labels had low importance in the electricity market. Yet, it should also be mentioned that an eco-label, like other quality seals, can play an important supporting role to secure the credibility of the product (Truffer et al., 2001). The value of eco-labels for electricity products will probably only be recognized by customers if the media were to critically address their function and their importance.

Compared to asking direct questions about customer preferences regarding individual product attributes, choice experiments have a clear advantage because they mimic real-life decision-making situations. In addition, the problem of social desirability biases that surface when asking about environmental issues can be moderated using this type of survey methodology. Despite these advantages, there are limits to this study which could serve as starting points for further research and should be noted by researchers and marketing experts when interpreting the results.

One important limit of this study is its tendency to overestimate the importances and the part-worths of attribute levels. This is due to the fact that not all possible attributes and attribute levels of electricity products can be considered in the study design and because the customers in the choice experiment do not actually have to pay the mentioned prices. This limitation is inherent in all survey

methods, and willingness to pay is usually overestimated even in choice experiments (Byrnes et al., 1999). The WTP can be calibrated with market data. Another possibility is to test new products within a test market with a limited numbers of customers.

It should also be noted, that the results in some parts of this study are based on averaged preferences from the entire sample. Further research could analyze the differences between different target groups in more depth. For example, it would be interesting to examine whether or not leading societal groups like post-materialists or status-oriented groups are promising targets for marketing renewable electricity products to, as the they are for thermal solar collectors (Kaenzig and Wüstenhagen, 2008).

Finally there are interesting starting points for strategy research. For instance, German electric utilities, which typically offer a full range of products, may ask themselves if they should stop trying to meet the needs of all customer segments and instead focus on either inexpensive electricity products or on green power products. The results of this survey show that one should expect a relatively high market potential for renewable energy products. The large discrepancy between the revealed customer preferences and the current offerings show that there are positioning opportunities in the market. As in other formerly monopoly-dominated industries, there will likely be new competitors increasingly entering the market to meet the un-met demand. Thus established companies must ask themselves how successful they will be if they launch such products under existing brands. Further research in this area could explore if products from communal power providers enjoy higher levels of customer acceptance than those from the large electric utilities, which are also heavily involved with the non-renewable energy sources.

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8. Appendix

Table 4: Demographic characteristics of the sample (N=414) compared with the structure of the German population

Characteristics	Survey	German average	Characteristics	Survey	German average[a]
Gender			**State**		
Female	47.6%	51.0%	Baden- Württemberg	10.1%	13.1%
Male	52.4%	49.0%	Bayern	15.9%	15.2%
Age			Berlin	4.6%	4.2%
15 to 24 yrs	2.7%	13.4%	Bremen	0.7%	0.8%
25 to 39 yrs	19.8%	22.1%	Brandenburg	3.9%	3.1%
40 to 59 yrs	53.5%	35.1%	Hamburg	3.4%	2.2%
60 to 64 yrs	7.5%	6.0%	Hessen	5.3%	7.4%
65 yrs and older	16.6%	23.3%	Mecklenburg-Vorpommern	2.4%	2.0%
Highest level of education			Niedersachsen	6.0%	9.7%
None	1.0%	2.8%	Nordrhein-Westfalen	18.8%	21.9%
Elem./sec. school	35.7%	35.1%	Rheinland-Pfalz	6.8%	4.9%
General certificate	32.9%	18.1%	Sachsen	5.8%	5.1%
Polytechnic institute	6.8%	5.7%	Sachsen-Anhalt	3.1%	2.9%
Technical college	4.3%	4.7%	Saarland	1.0%	1.3%
Abitur	8.9%	15.8%	Schleswig-Holstein	9.2%	3.5%
University	10.1%	6.7%	Thüringen	2.9%	2.8%
Not specified	0.2%	0.7%	**City size**		
Still in school	n.a.	17.3%	n= 1- 19’999	39.1%	41.8%
Monthly net income of household			n= 20’000 – 99’999	30.0%	27.4%
Under € 1'500	33.8%	38.7%	n= 100’000 - 499’999	16.2%	15.0%
€1500 - €1999	19.5%	16.9%	n > 500’000	14.7%	15.9%
€2000 - €2599	17.3%	15.6%			
Over €2600	29.3%	28.8%	**People in the household**		
Civil status			1	38.4%	39.4%
Married	46.9%	47.2%	2	34.3%	34.0%
Unmarried	53.1%	52.8%	3	12.8%	13.1%
Property ownership situation			4	10.4%	9.9%
Property owner	46.4%	46.0%	5+	4.1%	3.6%
Renter	53.6%	54.0%			

[a] German federal statistics office (2009a, 2009b)

9. List of tables

10. List of figures