Department für Agrarökonomie und Rurale Entwicklung
Georg-August Universität Göttingen

2017

Diskussionspapiere

Discussion Papers

To switch or not to switch? – Understanding German consumers' willingness to pay for green electricity tariff attributes

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ISSN 1865-2697

Diskussionsbeitrag 1707

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Abstract

In order to achieve an environmentally friendly and sustainable energy supply, it is necessary that this goal is supported by society. In different countries worldwide it has been shown that one way consumers want to support the energy transition is by purchasing green electricity. However, few people make the leap from their intention to a buying decision. This study explores parameters that influence whether German consumers decide to switch to a green electricity tariff. We conducted a quota-representative online survey including a discrete choice experiment with 371 private households in Germany in 2016. For the econometric analysis, a generalized multinomial logit model in willingness to pay (WTP) space was employed, enabling the estimation of WTP values to be as realistic as possible. The results show that consumers' decision regarding whether or not to make the switch to green energy is influenced by many underlying drivers, such as the source of green energy, whether a person can outsource the switching process, and a person's attitude towards the renewable energy sources levy that currently exists in Germany. Implications for policy makers and recommendations for the marketing of green energy tariffs are provided.

Keywords

Energy transition, green energy, tariff switch, discrete choice experiment, generalised multinomial logit model, WTP space

1. Introduction

It is commonly agreed that the climate is changing due to anthropogenic greenhouse gas emissions. Thus, in the last three decades, the goal of bringing a halt to climate change emerged. Increasing the share of renewables in energy consumption is a key component of many countries' strategies to achieve climate protection (Haas et al., 2011; IEA, 2015; IEA, 2016). For the future expansion of renewable energies, it is of great importance that these technologies meet the requirements of sustainability, but also that they receive support from the population. The European Union (EU), for example, aspires to take a leading role and has set ambitious targets in international climate protection (Eurostat, 2016; Oberthür and Kelly, 2008; Parker and Karlsson, 2010;), such as that by 2030, at least 27% of its energy should come from renewables (Eurostat, 2017). Germany, as the greatest greenhouse gas emitter in Europe and a country with even more ambitious climate protection goals than those of the EU, serves as an example in this study (BMUB, 2014; UBA, 2016). As a member of the EU, the German government laid the foundation for its energy transition process with the Renewable Energy Sources Act in 2000 (EEG, 2000). By 2015, renewable energy sources (RES) already accounted for more than 30% of the gross electricity consumption in Germany (BMWi, 2015). However, the amendment of the law in 2014 aims to continuously and cost-efficiently increase the share of electricity generated from RES to at least 40% by 2025 (EEG, 2014). In addition to political interests that are involved in the promotion of renewable energies, there is also an increasing demand among consumers. Numerous studies show that consumers have an additional willingness to pay (WTP) for electricity from RES, the so-called *green electricity* (Aravena et al., 2012; Gerpott and Mahmudova, 2010; Hansla, 2011; Kaenzig et al., 2013; Litvine and Wüstenhagen, 2011; Longo et al., 2008; Oliver et al., 2011; Ma et al., 2015; Sundt and Rehdanz, 2015). A meta-analysis by Sundt and Rehdanz (2015) found that German consumers have one of the highest WTPs for green electricity compared to consumers of other countries.

However, although consumers claim to have a willingness to support the development of renewable energies by purchasing green electricity, the number of actual adoptions of green energy tariffs differs greatly from the intended willingness to change (Batley et al., 2001; Salmela and Varho, 2006). Thus, it can be assumed that there are obstacles that hinder consumers in the transition to a green electricity tariff, such as high transaction costs, insufficient financial incentives (e.g. no switching bonus payments), and a lack of information on the potential provider or tariff (Gamble et al. 2009; Kaenzig et al., 2013; Sunderer, 2006; Yang, 2014).

Against this background, the research challenge of this paper is to give new insights in consumers' willingness to switch to green electricity tariffs in order to better understand the gap between a supportive consumer intention to buy green energy and a low actual tariff adoption rate. It is therefore important to analyze consumers' preferences for green electricity products in order to draw conclusions about their future development potential. A relevant study in this context was conducted by Kaenzig et al. (2013), who used a quota-representative dataset from 2009 to investigate whether

German consumers have a WTP for an upgrade from the default electricity mix to a more environmentally friendly electricity mix. To address their research question, they employed a stated preferences survey including a discrete choice experiment (DCE). However, consumer preferences for green electricity may have changed since 2009, as there were several events that may have had an influence, such as Fukushima's nuclear accident in 2011 (BMUB, 2016). Furthermore, it can be observed that the strong expansion of some RES, such as increasing biogas production and installation of wind power plants, has resulted in some negative response, especially from consumers (Herrmann, 2013; Kintisch, 2010; Wüstenhagen et al., 2007; Zschache et al., 2010). It is therefore of interest for the present study to measure consumer preferences for several single RES, as we assume that these are currently more likely to be valued by consumers than a mix of different (renewable) energy sources, as was investigated by Burkhalter et al. (2009), Groesche and Schroeder (2011) and Kaenzig et al. (2013). Furthermore, this study is the first to use an experimental design which is based on existing comparison portals. This is advantageous since consumers use online comparison portals as their main information resource to gain information regarding different electricity tariffs (PWC, 2015; Verbraucherzentrale, 2016).

In this research, a DCE was applied, which allows conclusions to be drawn about future behavior from the results of hypothetical scenarios (List et al., 2006). In designing our analysis, we referred to Fiebig et al. (2010), who developed an advanced framework, the so-called generalized multinomial logit (GMNL) model, which considers preference and scale heterogeneity. The latter is particularly relevant, as each consumer interprets and responds to decision situations differently in such choice experiments. Thus, another novelty of this paper is that we transferred the GMNL model to the field of preference measurement in the green energy sector. In order to derive WTP values for the attributes of the DCE that are as realistic as possible, the model was specified in WTP space (Greene and Hensher, 2010; Train and Weeks, 2005). Additionally, a further important characteristic of our study is that we allowed for correlations between the random WTP coefficients of the tariff attributes. These have often not been regarded in previous WTP space studies (with the known exceptions of Balogh et al., 2016; Balcombe et al., 2010, 2009). By taking these correlations into account, estimations of consumer preferences for switching to a green electricity tariff are potentially more realistic.

The gap between the WTP for green electricity tariffs and actual adoption poses a problem for both political actors and electricity marketers. However, to enable the best possible energy transition, active participation of consumers in purchasing green electricity is indispensable in the long term. Therefore, this study provides insights for policy makers and electricity marketers that help to understand what motivates (discourages) consumers to switch to green electricity tariffs.

2. Theoretical background and development of hypotheses

To increase the willingness to switch to green electricity and thus to make a long-term contribution to the energy transition, it is necessary to be aware of the drivers and obstacles that are decisive for consumers in choosing such a tariff. In the following, influential factors in the decision-making process of private electricity consumers are considered.

2.1 *Different preferences regarding various RES*

The source of renewable electricity can influence the consumer's preference when choosing a green electricity tariff. In this context, different studies indicate that most consumers are generally willing to pay extra for green electricity, but the amount of this additional cost varies for different RES (Borchers et al., 2007; Cicia et al., 2012; Ek, 2005; Gracia et al., 2012; Kaenzig et al., 2013; Kosenius and Ollikainen, 2013; Ma et al. 2015). Ek (2005) found that Swedish households generally favor the production of wind energy. A study by Borchers et al. (2007) revealed that, from the US consumer perspective, the benefits of solar power exceed the benefits of wind energy, followed biomass and biogas energy, which were valued similarly and in third place after solar and wind energy. Cicia et al. (2012) found a group of Italian respondents who prefer wind and solar energy, but reject energy from biomass. Similarly, Gracia et al. (2012) revealed a WTP for solar and regionally produced energy by Spanish consumers, whereas the proposition of wind energy and energy from biomass leads to a request for discount. Burkhalter et al. (2009) showed for the German electricity market that an RES electricity mix is more preferred by the consumer than electricity from only one RES. In a more recent study, Kaenzig et al. (2013), however, found that the German consumer has a preference order, in which pure wind energy is valued above a green energy mix, which in turn is valued above a mix of renewable energies, coal and nuclear energy. Kosenius and Ollikainen (2013) showed for the Finnish case, that energy from plants, which can also be used as food, is the least frequently chosen energy option compared to energy production from wood, wind or water. In a meta-study of the recent literature, Ma et al. (2015) described that consumers have a higher WTP for solar and wind energy than for energy from biomass.

The literature reveals that energy from biomass is a component of the green electricity portfolio which is often negatively viewed by consumers (Cicia et al., 2012; Gracia et al., 2012; Kosenius and Ollikainen, 2013). In the German context, energy from biogas in particular is often criticized (Kaenzig et al., 2013; Zschache et al., 2010), but there is no study that investigates whether consumer rejection of biogas can lead to the decision not to switch to green electricity. Thus, the following hypothesis was derived:

H1 – The consumer prefers electricity from solar and wind energy over electricity from biogas.

2.2 *Influence of where the participant lives*

As far as the effect of consumer socio-demographics on the WTP for green electricity has been considered, the influence of the region and the town size in which the consumer lives has so far been neglected in German studies. However, it can be assumed that both characteristics have an influence on the WTP, since large price differences for green electricity tariffs within the country can be observed (Heidjann, 2017 a; Strom-Report, 2017 a). Another influential factor could be the degree to which consumers have been exposed to renewable energy, as it is conceivable that consumers in rural areas are more effected e.g. by the strong expansion of biogas production or the increasing installation of wind power plants (Kintisch, 2010; Wüstenhagen et al., 2007; Zschache, 2010). Hence, Hypothesis 2 was formulated as follows:

H2 – The participant's WTP for a green electricity tariff is dependent on the region and the town size in which he or she lives.

2.3 Influence of a person's attitude towards the EEG levy

The German Renewable Energy Sources Act guarantees green electricity producers a priority feed-in of their electricity by transmission system operators for a period of 20 years (EEG, 2014). In accordance with Klaassen et al. (2005), it is useful to shift the costs of generating and providing electricity from RES to all consumers in order to ensure the development of climate-protecting innovations and the profitability of the electricity-producing industry in the future. In the case of Germany, transmission system operators carry the costs of marketing green electricity to the customers with the so-called *EEG levy* (Kramer, 2015). In terms of figures, this means that a typical German household with an average annual electricity consumption of 3,500 kilowatt hours (kWh) paid about 84 € per month for electricity in 2016, of which the EEG levy accounts for 22%, or 18 € (BDEW, 2017). If consumers have a corresponding WTP, the apportionment model appears appropriate. However, a representative survey conducted by the Renewable Energies Agency (AEE) revealed that 31% of the participating consumers perceive the EEG levy to be too high (AEE, 2015). It is conceivable that at least some consumers have this opinion because they generally think that the EEG levy is an unjust instrument to push the expansion of renewable energies. This may lead to consumer backlash and low switching rates (Dickenberger et al., 1993). Therefore, the following hypothesis was derived:

H3 – The willingness to switch to a green electricity tariff depends on the acceptance of the EEG levy.

2.4 Environmental awareness and personal lifestyle

Numerous studies have confirmed that a relationship exists between environmental awareness of consumers and their preference for or the purchase of green electricity (see e.g. Ek, 2005; Gerpott and Mahmudova, 2009; Kosenius and Ollikainen, 2013). Clark et al. (2003) as well as Wiser (2007) pointed out that individuals with a greater awareness of their own responsibility in society, knowledge about environmental issues, and a willingness to do something for the environment are more likely to have an interest in electricity from RES. If people acknowledge that climate change exists and that they can contribute to its mitigation through a more environmentally conscious way of life, they often show an increased preference for green electricity (Tabi et al., 2014). MacPherson and Lange (2013) revealed that people with high income, Green Party supporters, and people with very environmentally conscious behavior in their everyday life have more often switched to green electricity tariffs in the past. Kotchen and Moore (2007) also noted that specific personal characteristics, such as environmental awareness, have an influence on the adoption of a green electricity tariff. Based on these relationships found by previous studies, the following hypothesis was formulated:

H4 – An environmentally conscious way of life leads to a higher WTP for green electricity.

2.5 Influence of the participant's desire to avoid transaction costs

Electricity is a low-involvement product, on which the consumer does not want to spend too much time (Friege and Herbes, 2015). This is one way to explain why about one third of the German population still obtains their electricity via basic tariffs, which are the most expensive alternative to receive electricity (Federal Network Agency, 2016). 40% of Germans are dissatisfied with the prices of their electricity tariffs (PWC, 2015), but only 6.4% of private households actively switched their electricity suppliers in 2015 (Federal Network Agency, 2016). In this context, comparison portals on the internet serve as the main information source for more than half of the households (PWC, 2015). The advantage of these portals is that they provide the opportunity to gain comprehensive information in a short time. However, by proceeding in this way, the consumer bears the risk of not being able to find the best provider or tariff for his/her purposes. We therefore derived the following hypothesis:

H5 – The number of tariff switches would increase if consumers could outsource the switching process to someone else.

3. Methods

3.1 The stated preferences approach

Preference analysis differentiates between *revealed* and *stated* preferences. The former aims to observe real market behavior of individuals. Through the verifiable purchase of a product, "real" preferences become visible (Louviere et al., 2000). With this approach, however, it is not possible to display preferences for hypothetical scenarios and services (Louviere et al., 2000; Train, 2009). Furthermore, in order to examine the preferences of German households for switching to green electricity tariffs and their WTP for certain tariff attributes, utilization of an experimental design within the stated preferences approach is advisable. By doing so in the present study, we avoided the problem of not being able to get a sufficiently detailed dataset of attributes that influence whether a person switches to green electricity (Kaenzig et al., 2013). Therefore, the stated preference approach is the method of choice as it allows for drawing conclusions regarding previously un-articulated preferences (Louviere et al., 2000). According to Louviere et al. (2000), this approach recognizes preferences as internalized settings of an individual which can be revealed by means of a survey.

Since sufficient empirical data for an econometric analysis was not available, a discrete choice experiment (DCE) was used, in which an attribute-based measure of respondents' preferences was possible through a scenario of hypothetical decision-making situations (List et al., 2006). This approach has several advantages over a WTP analysis which directly asks participants for WTP values. Firstly, the decision situation for or against a new tariff is closer to reality, since a DCE enables researchers to confront the participants with so-called "choice sets" containing different alternatives that they can choose from (Kaenzig et al., 2013). This organizational setting can be understood as a replication of real-life conditions, in which electricity customers are confronted with a broad variety of different tariffs. Each given alternative in this type of experiment consists of pre-defined attributes and their associated levels. These attributes and their levels are then systematically varied to determine the respective influence on the selection decision (List et al., 2006; Louviere et al., 2000). Secondly, the closed design in the choice sets is cognitively less demanding than open questions, thereby eliminating the risk of "wild guesses". Finally, compared to an open measurement, employing a DCE bears a lower risk of strategic responses, therefore the expressed WTP is more accurate (Hanley et al., 2003).

3.2 The discrete choice experiment – attributes and levels

In the DCE, the participants were confronted in several decision situations with the following hypothetical scenario: "Please imagine that you can switch your electricity tariff today. Your new electricity provider offers you two different tariffs, which both have a contract term of 12 months. The electricity consumption is based on the German average household and amounts in the following tariffs to 3,500 kilowatt hours per year. However, this is not the quantity that needs to be taken. If you opt for one of the two tariffs, your new provider will arrange the termination of the contract with your current supplier, and the switch will be completed". The offered green electricity tariffs varied in the following five attributes: "energy source", "share of green energy", "switching bonus", "price guarantee", and "tariff price". The attributes were selected based on tariff offers of the most popular online switching portals *verivox.de* and *check24.de* (Heidjann, 2017 b; Verbraucherzentrale, 2016) to enable a realistic experimental design. Furthermore, the results of a literature review, the analysis of current tariff data, and the findings of a pretest all contributed to the design of the contract alternatives as they are shown in Table 1. The attribute-levels were related to an expected annual electricity consumption of 3,500 kWh, the German average household consumption (Federal Network Agency, 2016) and a contract term of 12 months.

Table 1 – Attributes and levels of the DCE for an expected average electricity consumption of 3,500 kWh year^{-1}

Attributes	Levels	Units
Energy source	solar, biogas, wind, renewable energy-mix [45% wind, 25% biomass (15% biogas), 20% solar, 10% hydro power]	-
Share of green energy	40; 60; 80; 100 1,400; 2,100; 2,800; 3,500	% of the new tariff kWh year^{-1}
Switching bonus[a)]	30; 60; 90; 120	Euro (€)
Price guarantee	0; 6; 12	Months
Tariff price (incl. switching bonus and fees)[b)]	70; 75; 80; 85 770; 825; 880; 935 22.0; 23.5; 25.1; 26.7	Euro month^{-1} Euro year^{-1} Ct kWh^{-1}

Source: Author's elaboration

[a)] The switching bonus refers to a contract term of 12 months. It is a one-time payment that is paid as a discount on the annual tariff price.

[b)] The tariff price refers to a contract term of 12 months. Bonus payments are already included in the annual tariff price.

Each decision situation (choice set) provided two different and mutually exclusive tariff alternatives. The tariffs were neutrally referred to as "Tariff A" and "Tariff B", so as not to indicate any differences. Furthermore, the choice sets contained a status-quo alternative ("no switch"), since consumers have the opportunity to keep their current tariffs under real-life conditions as well.

3.3 The experimental design

The experimental design of the DCE was comprised of two generic alternatives, four attributes with four levels each and one attribute with three levels (cf. Section 3.2), thus resulting in a full-factorial design with [$(4{\cdot}4{\cdot}4{\cdot}4{\cdot}3)_{\text{Tariff A}} \cdot (4{\cdot}4{\cdot}4{\cdot}4{\cdot}3)_{\text{Tariff B}}$=] 589,824 possible decision situations or choice sets. In this design, all possible main and interaction effects were included (Rose and Bliemer, 2009). However, for the sake of practicability, this design was determined to be too extensive and therefore, the number of choice sets was reduced. To minimize the simultaneous and unavoidable loss of information when reducing the full factorial design, a so-called "efficient design" was applied. Efficient designs (Bliemer et al., 2008; Ferrini and Scarpa, 2007; Rose and Bliemer, 2009) require ex-ante information regarding the population's utility parameters since these designs aim to minimize the standard errors of the utility parameters for the estimation process. This information for the final experiment was obtained by conducting a pretest with 30 participants. As a result, a D-efficient Bayesian design (Bliemer et al., 2008; Sandor and Wedel, 2005; Scarpa and Rose, 2008) was found to be appropriate for our purpose (D-error: 0.051). Thus, the number of choice sets presented to the participants in the final survey was reduced to twelve. As an example, one of the twelve choice sets is depicted in Table 2. A complete list of the choice sets and the experimental setting can be found in Appendix A.

Table 2 – Example of one of the choice sets in the DCE

	Tariff A	Tariff B	No Switch
Energy source	Solar	Wind	
Share of green energy[a)]	80% = 2,800 kWh	60% = 2,100 kWh	
Switching bonus	30 €	90 €	
Price guarantee	6 months	6 months	
Tariff price for 3.500 kWh (incl. switching bonus and fees)	75 €/month 825 €/year 23.5 Cent/kWh	85 €/month 935 €/year 26.7 Cent/kWh	
Which alternative do you choose?	O	O	O

Source: Author's elaboration

[a)] The absolute share of green energy in the tariff is related to an expected average electricity consumption of 3,500 kWh year^{-1}.

3.4 Data collection

For the empirical analysis, primary data was collected from residential electricity customers in Germany. An online survey was designed to investigate consumers' preferences for green electricity tariffs and their switching behavior. The final sample was drawn by quota sampling, taking into consideration the distribution of the participants by monthly net income of the household, persons living in one household, and region (north, east, south, and west Germany) since we expected these characteristics to be appropriate for testing the derived hypotheses. The participants were selected by a professional online-sampling company (respondi) in July and August of 2016. In order to be suitable for the survey and the DCE, the participants had to confirm that they are responsible for their household's energy-related decisions. Then, participants who met all necessary criteria to achieve the desired representativeness were recruited. In the survey, participants were firstly asked to provide their electricity consumption data. Next, the DCE was conducted by presenting the choice sets in a randomized order. Then questions were raised to identify differences in the participants' perceptions of green energy sources and their sensitivity towards environmental and climate change issues. The final part of the survey was dedicated to collecting socio-demographic data. A total of 371 participants submitted surveys that could be used for further analysis. Answering the survey took 22 minutes on average.

Excluding the DCE, other data obtained from the survey served as explanatory variables for testing the derived hypotheses. Table 3 gives an overview of which statements from the survey were chosen as additional explanatory variables.

Table 3 – Explanatory variables used in the model estimation for testing the hypotheses

Hypotheses	Explanatory statements	Coding for analysis
H1 – In comparison to other RES, there is no additional WTP for energy from biogas.	**"food or fuel"**: Green electricity is only trustworthy if no plants which could alternatively be consumed as food or feed are used for its generation.	Effect coded: 1 = agreement; -1 = disagreement
H2 – The participant's WTP for a green electricity tariff is dependent on the region and the town size in which he or she lives.	**"region: east, south, west, north"**: In which of the following regions do you live? **"town size"**: How many people live in the place (village, town, city) of your primary residence?	Effect coded: 1 = east, south, west; -1 = north 1 = <5,000 residents 2 = 5,000-19,999 residents 3 = 20,000-99,999 residents 4 = 100,000-499,999 residents 5 = ≥ 500,000 residents
H3 – The willingness to switch to a green electricity tariff depends on the acceptance of the EEG levy.[a)]	**"EEG levy: likely instrument"**: The EEG levy of costs to all citizens is a good instrument to promote the expansion of renewable energies.	Effect coded: 1 = agreement; -1 = disagreement
H4 – An environmentally conscious way of life leads to a higher WTP for green electricity.	**"Green Party identification"**: I feel best represented by the political platform of the Green Party. **"environment is important when buying groceries"**: I consider environmental concerns when I buy my groceries for the week.	Effect coded: 1 = agreement; -1 = disagreement Effect coded: 1 = agreement; -1 = disagreement
H5 – The number of tariff switches would possibly increase if consumers could outsource the switching process to someone else.	**"never switched before"**: Have you ever actively (not moving) switched your electricity tariff? **"wish to outsource switching process"**: I would be more motivated to switch if there was somebody who could do this for me for a fixed fee of 50 Euros.	Effect coded: 1 = yes; -1 = no Effect coded: 1 = agreement; -1 = disagreement

Source: Author's elaboration; translated from German.

3.5 Model selection

In order to derive WTP values for the attributes of the DCE with the ultimate goal of giving recommendations for policy-makers and the energy sector, an approach that could produce realistic WTP values was needed. In this context, models in *preference space* are the current standard method for estimating the WTP of individuals.

A main assumption of these models is that the price coefficient is fixed across individuals. This is necessary because otherwise the WTP is derived by calculating the ratio of two randomly distributed terms, namely the ratio of the distribution of the non-monetary attribute and the distribution of the price coefficient. Unfortunately, this procedure often results in unrealistic and invalid distributions for the WTP (Hensher and Greene, 2011; Scarpa et al., 2008). However, handling the price coefficient as a fixed value is an unnecessarily restrictive assumption as it does not to account for heterogeneity in the price coefficient and furthermore, assumes that the scale parameter and therefore, the variance in the error term are identical for all individuals. Consequently, this unidentified scale heterogeneity can be erroneously attributed to a variation in the WTP (Train and Weeks, 2005).

However, models in *WTP space* are able to overcome this problem since coefficients of the WTP are directly estimated by re-formulating the model. In this case, assumptions regarding the distributions of the WTP are made directly rather than on the attribute coefficients. Therefore, in these models, it is possible to differentiate preference from scale heterogeneity, and hence to account for differences in the degree of heterogeneity in the DCE. A stated preference approach was used in our study, so this aspect of the method is particularly relevant, since each consumer interpreted and responded to each decision situation differently. By applying a generalized multinomial logit (GMNL) model in WTP space (Fiebig et al., 2010), our results were estimated while taking preference and scale heterogeneity into account.

Studies analyzing DCEs with GMNL models in WTP space can be found in a growing number of fields such as food production (Balogh et al., 2016), environmental sciences (Li et al., 2014) and agricultural economics (Coffie et al., 2016; Sauthoff et al., 2016). However, despite the great advantages of this model specification, it had not been used previously for measuring consumer preferences in the field of energy from RES. The general equations underlying the estimation process can be found in Appendix B.

4. Results and discussion

4.1 Description of the sample

The sample was drawn by quota sampling, considering participating households' monthly net income, the number of persons living in one household, and region. The participating consumers were between 18 and 78 years old, with a representative average age of 44 (BiB, 2017). Individuals younger than 18 years old were not included in the survey, since few people younger than 18 live in their own households and make decisions regarding their electricity tariffs. In our sample, females were slightly overrepresented compared to the general German population in 2015 (57% vs. 52%) (Destatis, 2016). However, since the focus of this investigation was rather on individuals who are responsible for household energy-related decisions, the gender distribution of surveyed decision-makers may differ from the general German population. A total of 24% of sampled individuals had obtained the general higher education entrance qualification and another 24% held a university degree as the highest qualification level.

Considering the electricity consumption data, participants used 2,750 kWh per year on average and paid about 750 € for their annual electricity bill. The latter value is considerably lower than the German average annual electricity bill, which amounted to 1,008 € in 2016 (BDEW, 2017). This difference may be due to the assumption that an average household has an electricity consumption of 3,500 kWh per year, while in our sample, 69% of the respondents stated that they consume less. Furthermore, only 6.4% of all German households switched their energy provider in 2015, meaning that few people have benefited from a cost reduction in their electricity bill (Federal Network Agency, 2016), whereas in our sample, a quarter of the individuals switched their provider or tariff within the past year.

Statements relevant to the hypotheses showed the following response frequencies: half of the sampled individuals stated that green electricity is only trustworthy if no plants which could alternatively be consumed as food or feed are used for its generation. A quarter of the participants agreed that the EEG levy is a good instrument to promote the expansion of renewable energies. However, 63% agreed that the demand for green energy could be increased through the elimination of the EEG levy for those who decide to receive pure green energy. 12% of the participants felt well-represented by the political platform of the Green Party. 52% of individuals considered environmental concerns when they buy their groceries. Although two thirds of participants had a positive attitude towards green energy, 31% of the participants had never taken the initiative to switch. About 16% of the participants would be more motivated to switch if there was somebody who could do this for them for a fixed fee of 50 Euros. Full descriptive statistics are provided in Appendix C.

4.2 General findings of the GMNL model in WTP space

Table 4 presents a basic model (Model 1) which represents the WTP of the average consumer as well as a model that includes several participant-specific variables as interaction terms with different tariff attributes (Model 2). Both were estimated in WTP space as a specified form of the GMNL model (Fiebig et al., 2010; Greene and Hensher, 2010) by implementing the Stata module of Gu et al. (2013) using 1,000 Halton draws. These interaction terms account for possible causes of the observed heterogeneity in the valuation of the random parameters “alternative-specific constant (ASC)”, “share of green energy”, “switching bonus”, and “price guarantee” which are characterized by the standard deviations of the random parameter distributions of Model 1. As suggested by Hensher et al. (2005: 664), interactions that were not significant were excluded from the estimation process as they could have had an effect on the other coefficients within the model. Therefore, other tested variables, such as the participants’ educational level or the size of the household, were not considered in the final model estimation since they lacked significance. In order to prove the explanatory power of the models, the pseudo-R^2 was used as a goodness-of-fit measure. The values show that Model 2, with a pseudo-R^2 of 0.32, is an improvement of Model 1. According to Hensher et al. (2005: 338), a pseudo-R^2 of at least 0.3 represents an appropriate model fit.

Table 4 – Generalized multinomial logit model in willingness-to-pay space [a)]

Variables	GMNL-WTP-space I Basic Model	GMNL-WTP-space II Interaction Model
	Coefficient (mean)	Coefficient (mean)
Random parameters		
Alternative-specific constant (ASC) [b)]	21.914 ***	27.429 ***
Share of green energy	0.024 ***	0.030 ***
Switching bonus	0.005 **	-0.001
Price guarantee	0.157 ***	0.059 **
Tariff price	-1[fixed]	-1[fixed]
Non-random Parameters [c)]		
Energy source: solar	0.192 **	0.195 **
Energy source: wind	0.216 **	0.199 **
Energy source: RE mix	0.059	0.056
Interaction variables		
ASC x region: east [d)]		0.213
ASC x region: south [d)]		-0.525 *
ASC x region: west [d)]		0.379
ASC x town size [e)]		-0.547 ***
ASC x EEG levy: likely instrument [f)]		0.705 ***
ASC x Green Party identification [f)]		-0.920 **
Share of green energy x Green Party identification [f)]		0.011 **
ASC x food or fuel [f)]		-0.463 **
ASC x environment is important when buying groceries [f)]		0.834 **
ASC x never switched before [g)]		-0.769 ***
ASC x wish to outsource switching process [f)]		0.782 ***
ASC x age of respondent		-0.108 ***
Price guarantee x age of respondent		0.002 **
ASC x children [h)]		-0.376 **
Switching bonus x income [i)]		0.002 **
Standard deviations (SD) of parameter distributions		
SD ASC	6.016 ***	5.322 ***
SD Share of green energy	0.021 ***	0.020 ***
SD Switching bonus	0.009 ***	0.007 ***
SD Price guarantee	0.091 ***	0.092 ***
Scale heterogeneity		
Tau	0.790 ***	0.788 ***
Goodness of fit measures		
Participants/observations	371/4,452	371/4,452
McFadden pseudo-R^2	0.309	0.322
Log-Likelihood at convergence	-2,725.627	-2,674.040
Akaike information criterion	5,487.254	5,416.080

Source: Author's calculations by means of the STATA-command "gmnl" in STATA 14 using 1,000 Halton draws.

Notes: [a)] * $p < 0.1$; ** $p < 0.05$; *** $p < 0.001$; randomized WTP coefficients with significant SD are assumed to be normally distributed and correlated; the price coefficient was normalized to be log-normal and constrained to -1.

[b)] Binary coded variable; reference: status-quo alternative "no switch."

[c)] Effect coded; reference: "Energy source: biogas".

[d)] Effect coded; reference: "Region: north".

[e)] The variable "town size" was divided into five groups, and ranged from "less than 5,000 residents" to "more than 500,000 residents". For a detailed structuring of the groups see Appendix C.

[f)] Effect coded; reference: "Participant does not support the queried statement".

[g)] Effect coded; reference: "Participant switched the electricity tariff at least once before".

[h)] Effect coded; reference: "Participant has no children".

[i)] The variable "income" was divided into 6 groups, and ranged from "less than 1,300 €" to "more than 4,500 €". For a detailed structuring of the groups see Appendix C.

The price coefficient was normalized to -1, and the other coefficients represent the WTP for each variable. The models include a dummy-coded ASC, which was valued at one for choosing one of the tariff alternatives and zero for the status-quo alternative “no switch”. The significant ASC of Model 1 implies that the average participant is willing to pay 21.9 Eurocent kWh^{-1} for an offered green electricity tariff instead of choosing no offered tariff (status-quo alternative). This value reflects a general WTP for green electricity as all offered tariffs within the DCE contained green electricity. On average, German consumers paid about 28.8 Eurocent kWh^{-1} for their electricity in 2016 (BDEW, 2017), indicating that a tariff switch can be strongly motivated by a price reduction. However, this relatively high value arises from the fact that about one third of the consumers received electricity via basic tariffs, which are the most expensive way to obtain electricity (Federal Network Agency, 2016). Considering all available existing pure green energy tariffs in Germany, the average cost for one kilowatt hour was only 22 Eurocent kWh^{-1} in 2016 (Heidjann, 2017 a). Therefore, it can be assumed that the estimated WTP of 21.9 Eurocent kWh^{-1} for switching to a green electricity tariff reflects a realistic amount.

The attribute “share of green energy” was measured in percent and described the proportion of green energy sources in the tariff for an annual electricity consumption of 3,500 kWh. Model 1 shows that on average, the WTP increased by 0.024 Eurocent kWh^{-1} if the share of green energy increased by 1%. For instance, the lowest offered green energy share in the tariffs was 40%, resulting in an additional WTP of 0.96 Eurocent kWh^{-1} (0.024*40), meaning that participants would agree to pay 2.4 Eurocent kWh^{-1} more for a pure green energy tariff if they decided to switch their tariff. In terms of the annual electricity bill, this means a sum of 84 € (0.024*100*3,500). The influence of the “switching bonus” was also significant if the participants were willing to opt for a new tariff. Model 1 reveals that for a one Euro increase in the bonus payment, participants would pay 0.005 Eurocent kWh^{-1}. Thus, in order to receive the maximum offered switching bonus of 120 €, the average participant was willing to spend 21 € (0.005*120*3,500) more on the annual electricity bill. The “price guarantee” was given in months and led to a relatively high WTP, as shown in Model 1. If the average participant decided to switch his/her tariff, he/she was willing to pay 0.16 Eurocent kWh^{-1} for every additional month the guarantee is extended. In other words, regarding an annual electricity consumption of 3,500 kWh, a 12-month guarantee was valued by the average participant at 67.2 €. The variable “energy source” was effect coded, meaning that “biogas” acted as a reference for the other energy sources. The coefficient for biogas was then calculated as suggested by Hensher et al. (2010: 215) using the following equation: $WTP_{biogas} = -(WTP_{solar} + WTP_{wind})$. Thus, the coefficient was -0.408 (-0.408= – (0.192 + 0.216)), as it can be understood from Model 1. This suggests that participants had a WTP for a tariff including solar or wind energy but not for a tariff with biogas energy. Furthermore, no significant WTP for a renewable electricity mix was found.

4.3 Hypotheses testing

Hypothesis 1 – Different preferences regarding RES

The results of Model 1 reflecting the average consumer's preferences were used for testing *Hypothesis 1* since no preference heterogeneity was determined for the coefficients of the energy sources "solar", "wind", and "RE mix." The results revealed that consumers have a marginally higher WTP for wind energy than solar energy (coefficients: 0.216 vs. 0.192). Furthermore, a renewable electricity mix does not motivate participants to pay more for a new tariff, as the coefficient was not significant. This indicates that if consumers have the choice between the energy sources presented in this study, neither biogas nor a RE mix are energy sources that facilitate an increased rate of tariff switching. This is contrary to Burkhalter et al. (2009), who reported that a green electricity mix is more appreciated by consumers than green electricity from a single source. However, if consumers have a negative perception of biogas production and more specifically, of RES that can alternatively serve as feed or food (Cicia et al., 2012; Kosenius and Ollikainen, 2013), it seems plausible that a green electricity mix containing energy of this origin is more likely to be rejected. This assumption was confirmed by the negative coefficient of the interaction term "ASC x food or fuel" (Model 2: -0.463). Without accounting for specific tariff arrangements, it was shown that if a participant does not want to support an energy source that can either serve as food or fuel, his/her WTP decreases by 0.463 Eurocent kWh^{1}. Consequently, our results corroborate other scientific studies that also found that if consumers consider switching to green energy tariffs, they have a general WTP for green electricity products, but that this varies over different energy sources (Borchers et al., 2007; Cicia et al., 2012; Ek, 2005; Gracia et al., 2012; Kaenzig et al., 2013; Kosenius and Ollikainen, 2013; Ma et al. 2015). In light of these results, *H1: the consumer prefers electricity from solar and wind over electricity from biogas* can be confirmed.

Hypothesis 2 – Influence of where the participant lives

Socio-demographic characteristics, especially the region and the town size, were expected to affect the decision for or against an offered tariff. Therefore, we divided the federal states of Germany into four regions[1] based on the cardinal directions.

The northern states of Germany served as the reference for the estimations in Model 2, since consumers pay an average value for green electricity compared to the other regions (Heidjann, 2017 a). Our results showed that compared to the north, the south has a significantly lower WTP for switching to green electricity (-0.53 Eurocent kWh^{-1}). Interestingly, households in the east or west do not differ significantly from households in the north.

The coefficient "ASC x town size" was significantly negative (-0.547). The variable "town size" was divided into five groups, and ranged from "less than 5,000 residents" to "more than 500,000 residents"

[1] The distribution of the federal states to the regions was as follows: *north* (Bremen, Hamburg, Lower Saxony, Schleswig-Holstein), *east* (Brandenburg, Mecklenburg-Western Pomerania, Saxony, Saxony-Anhalt, Thuringia, Berlin), *west* (North-Rhine Westphalia, Saarland), *south* (Bavaria, Baden-Wuerttemberg, Hesse, Rhineland-Palatinate).

following the classifications of the German Federal Statistical Office (see Appendix C). The coefficient can be interpreted as follows: the bigger the town a person lives in, the lower the WTP for a green electricity tariff switch. In other words, participants who live in very large cities with more than 500,000 residents have a five times lower WTP (-2.74 Eurocent kWh^{-1}). In terms of the annual electricity bill, this means that these participants want to pay about 96 € less (5*(-0.547)*3,500). This is an interesting finding, as on the one hand, it is conceivable that people who live in rural areas (represented by the smallest town unit) are more impacted by negative effects of renewable energy production, and therefore it could be expected that these participants would have the lowest WTP. On the other hand, and this is what our results suggest, it can be assumed that these participants are probably closer to nature and more involved in renewable energy production, and therefore have the highest WTP. However, since this is probably the first study that considered the influence of where a person lives on whether a person wants to switch to green energy or not, further studies could analyze why consumers in towns want to pay less. Nevertheless, it becomes evident that *H2: the participant's WTP for a green electricity tariff is dependent on the region and the town size* can only partially be confirmed. While town size has an influence on the participants' WTP for switching to a green electricity tariff, regional price differences have only a marginal impact.

Hypothesis 3 – Influence of a person's attitude towards the EEG levy

The survey included the question of whether the participants perceived the EEG levy of costs to all citizens as a good instrument to promote the expansion of renewable energies. About 26% of the sample agreed with this. For those who supported this statement, the WTP increased significantly (by 0.71 Eurocent kWh^{-1}) if they decide to switch their tariff ("ASC x EEG levy: likely instrument"). However, the WTP decreased by the same amount for individuals who disagreed with this statement. In terms of the annual electricity bill, this amounts to 18 € that participants were (not) willing to pay more. Since the EEG levy, in reality, costs consumers 216 € per year at a consumption level of 3,500 kWh (BDEW, 2017), our findings indicate that the WTP of participants who agreed (disagreed) with the EEG levy was 234 € (198 €). Thus, *H3: the willingness to switch to a green electricity tariff depends on the acceptance of the EEG levy* can be confirmed, even if the influence of a person's attitude is rather modest in terms of concrete figures. However, to explain why the majority of the participants want to reach a tariff price discount by reducing the amount of the EEG, it may be helpful to know that currently only 42% of the EEG levy is used to promote the expansion of renewable energies (Strom-Report, 2017). If participants have knowledge of this, it is conceivable that they consider the EEG levy to be an inappropriate mechanism. This assumption was additionally supported by 63% of participants, who stated in the survey that the demand for green energy could be increased through the elimination of the EEG levy for those who decide to receive pure green energy. For policy makers, this could be an interesting approach to motivate consumers to buy pure green energy. Consumers who decide to opt for a pure green energy tariff could be rewarded with a discount in the amount of the EEG levy, whereas all other groups of electricity customers who do not support the energy transition by purchasing green energy might be charged a penalty.

Hypothesis 4 – Environmental awareness and personal lifestyle

It seems obvious that people with a high awareness regarding environmental and sustainability issues are more likely to be interested in buying green electricity (Tabi et al., 2014; Wiser, 2007; Clark et al., 2003). One way to gain information about consumer awareness is to ask whether participants are Green Party supporters (MacPherson and Lange, 2013). In this study, the question was raised whether participants feel represented by the political platform of the Green Party. Those who identified with the Green Party showed a significantly reduced WTP for a switch to the offered green energy tariffs ("ASC x Green Party identification" = -0.902). This might be due to the fact that from the viewpoint of Green Party supporters, the offered tariffs could have included unfavorable energy sources, such as biogas. Interestingly, it was evident that the same participants had a rising WTP for each percentage increase in the share of green energy in the offered tariff ("share of green energy x Green Party identification" = 0.011). Therefore, it is conceivable that participants who felt represented by the Green Party considered switching to a green energy tariff only if this tariff consisted of pure green energy sources. If this is true, other tariffs that comprise lower shares of green energy, including the electricity-mix currently offered in Germany, might not be a successful way to encourage this consumer group to switch to "greener" energy tariffs.

The influence of awareness of environmental issues on the participants' decision to switch tariffs was also shown by the significant coefficient of the interaction term "ASC x environment is important when buying groceries = 0.834". This result indicates that consumers who consider environmental issues in their daily life, e.g. when doing the weekly grocery shopping, have a higher WTP for switching to a green energy tariff. It is also conceivable that consumers who aspire to lead an environmentally-friendly lifestyle are more likely to switch their energy tariff to a green energy tariff since this kind of energy contributes to their desired way of life. Consequently, *H4: an environmentally consciousness way of life leads to a higher WTP for green electricity* is confirmed.

Hypothesis 5 – Influence of the participant's desire to avoid transaction costs

There are several reasons, why consumers do not switch their electricity tariffs, even if switching would lead to financial benefit (Yang, 2014; Gamble et al., 2009; Sunderer, 2006). It was revealed that if a participant had never switched his/her tariff, then he/she had a significantly lower WTP regarding a switch to a green energy tariff ("ASC x never switched before" = -0.769). This result can be understood as a confirmation that certain obstacles to consumers switching their tariff exist. Thus, participants were asked in the survey whether they were more motivated to switch if they could outsource the switching process to someone else. The significant coefficient of the interaction term "ASC x wish to outsource the switching process = 0.782" shows that participants who want to outsource the switching process demonstrate their appreciation of this assistance with an increased WTP. In light of these results, *H5: the number of tariff switches would increase if consumers could* *outsource the switching process to someone else* is confirmed. Therefore, offering a “full-service switch” could be one way to increase green energy adoption rates.

Further results

Additionally, interactions with further socio-demographic variables were estimated and provide the following results: the older the participants, the lower their WTP for switching to green electricity (“ASC x age of respondent” = -0.108). More specifically, our results demonstrate that a 30-year-old participant has a WTP of 24.2 Eurocent kWh^{-1} (27.4 - (-0.108*30)), whereas a 50-year-old participant c.p. wants to pay only about 22 Eurocent kWh^{-1} (27.4 - (-0.108*50)). It can be assumed that with increasing age, participants have been involved in their households’ energy-related decisions for a longer time, leading to the awareness that prices have risen sharply in the past two decades (BDEW, 2015). Therefore, these participants are likely to be more sensitive to increasing prices and thus, they have a lower WTP for a tariff switch. Furthermore, the coefficient “price guarantee x age of respondent” (0.002) indicates that participants have a growing need for security with increasing age. While a 30-year old participant appreciates a 12-month price guarantee by paying a price mark-up of 1.43 Eurocent kWh^{-1} ((0.059*12) + (0.002*30*12)), a 50-year old participant is even willing to pay 1.9 Eurocent kWh^{-1} c.p.

Having children results in a significant lower WTP for switching to a green electricity tariff (“ASC x children” = -0.376). This is possibly due to financial restrictions households facing with children (BMFSFJ, 2013). Thus, such households might not want or be able to spend much money on their electricity tariff. However, since households with children often consume large amounts of electricity, one idea would be for the government to introduce subsidized “family tariffs” containing pure green energy.

With respect to the financial situation of the participants, the results show that the monthly household’s net income has an influence on the switching bonus (“switching bonus x income” = 0.002). The variable “income” divided the participants into six groups following the classifications and statistics of the German Federal Statistical Office (see Appendix C). Participants of the lowest income group (less than 1,300 € $month^{-1}$) were willing to pay 0.002 Eurocent kWh^{-1} for a one Euro increase in the bonus payments, while participants of the highest income group (more than 4,500 € $month^{-1}$) would pay a mark-up of 0.012 Eurocent kWh^{-1} c. p. These values may initially seem very low, however if scaled-up to a bonus payment of 100 € for a tariff that includes 3,500 kWh, the results show that participants of the highest income group were willing to pay 42 € to receive a bonus payment of 100 € (0.002*6*3,500*100). This suggests that the importance of bonus payments increases with increasing income. This is an unexpected finding, as it is to some extent counterintuitive. However, it shows that low-income participants are more price sensitive, as they accept a bonus only if it is a real bonus which does not have any hidden costs that are later added to the tariff. This indicates that the tariff price is the major driver in the decision-making of low-income participants.

5. Conclusions

This paper presents the results of a quota-representative discrete choice experiment with 371 German electricity consumers conducted to elicit factors that are important for consumers when deciding whether to switch to green electricity. In order to provide policy makers and marketers with a valuable understanding of consumer behavior with regard to demand for green energy electricity, an estimation approach was chosen that produces WTP values that are as realistic as possible. Therefore, this study allows policy makers and electricity marketers to gain insights into how specific parameters influence consumers' WTP, which might be worth considering in order to increase adoption rates of green energy electricity in private households. This is particularly important since Germany aims to rely solely on renewable energy sources in the future (UBA, 2010).

Considering the gap between consumers' intentions and consumers' actions, the following implications can be drawn from the results of this tariff switching experiment:

In order to make switching to green energy tariffs more attractive for consumers, electricity marketers and policy makers should focus on support of pure green energy tariffs that solely consist of solar or wind energy. As our findings indicate, German consumers are reluctant to switch to a green energy tariff if the source of green energy is biogas or a mix of different renewable energies that also contains biogas as a source. This is supported by the result that if plants which can also serve as food or livestock feed are used to produce green electricity, the WTP decreases for a green energy tariff. Therefore, the support of solar and wind energy should be a priority for politicians as these energy sources are specifically demanded by the consumer. In addition, marketers could demand higher prices if they can offer such differentiated tariffs.

A further implication is that marketers should replace the "general" switching bonus with a specifically "framed" bonus in the amount of the current EEG levy. As suggested by our results, the EEG levy is a reason why consumers have lower WTP for a switch to a green tariff. Therefore, a "framed bonus" could be a promising way to increase adoption rates of green energy tariffs, especially for those who are critical of the EEG levy. Furthermore, policy makers could take this point as a suggestion to consider whether a reward and punishment policy could be more promising than the current EEG levy to promote renewable energy expansion.

We also suggest that attention should be given to psychological and behavioral aspects, as they are of great influence on consumers in their decision whether to switch to green energy. This is in line with Tabi et al. (2014: 212), who also suggested that these aspects should be considered "when it comes to understanding why consumers who evince strong preferences towards electricity produced from renewable energy sources do not act according to their preferences by opting to purchase green power". We found, for example, that if marketers offered a "full-service switch" or a "subscription for frequent switches", this could be a great opportunity to increase green tariff adoption rates for consumers who try to avoid transaction costs. However, there may also be other factors that play a role when consumers consider outsourcing the switch. Therefore, further research could investigate which authorities consumers consider to be trustworthy enough to carry out the switch for them.

These conclusions are based on the results of a DCE. Although we designed the experiment as realistically as possible and used an analytical approach that enables estimation of actionable WTP values, this piece of research suffers from the same limitations as any other study, and may therefore serve as starting point for further research. For instance, findings regarding the region and town size suggest more investigation is necessary in order to determine the influence of these characteristics on the consumers' WTP for green energy. Therefore, the population of rural areas and their exposure to RES production should be investigated more in detail. Additionally, as our results relate to a fixed annual electricity consumption of 3,500 kWh, reflecting the average German household (BDEW, 2017), it could be interesting to design a DCE that relies on the real consumption data of the participating individuals. Such an adjustment could be helpful to reduce the potential hypothetical bias that may lead to overestimation of the WTP in choice experiments (Ma et al., 2015; Byrnes et al., 1999). Furthermore, this study is limited to Germany, so it would be enlightening if further research could apply our experimental design to investigate whether consumers of other countries have similar preferences.

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Appendix A: The discrete choice experiment (DCE) (may appear exclusively online)
[The following section shows the DCE as it was presented to the participants. The instructions and choice sets have been translated from German.]

Introduction:

Please imagine that you can switch your electricity tariff today. Your new electricity provider offers you two different tariffs, which both have a contract term of 12 months. The electricity consumption is based on the average German household: 3,500 kilowatt hours per year. However, this is not the quantity that needs to be taken. If you opt for one of the two tariffs, your new provider will arrange the termination of the existing contract with your current supplier to complete the switch.

In order to enable a better understanding, there was a brief explanation of how the tariff components may vary:

1. **Energy source**

   For the offered tariffs, the share of green electricity may consist of different renewable energy sources. Available renewable energy sources may include solar energy, wind power, biogas or a mix of several renewable energy sources.

2. **Share of green energy**

   The share of green energy is expressed as both a percentage value and as a concrete figure, i.e. how many kilowatt hours are replaced by renewable energy. The share of green energy can vary, and therefore, it may be above or below your current tariff's share of green energy. The remaining share of the tariff that is not derived from renewable energy sources is covered by conventional, non-regenerative power sources (coal, nuclear power, natural gas and other fossil fuels).

3. **Switching bonus**

   The switching bonus represents a payment to you as new customer. It will be included in your tariff rate. The bonus payment can vary.

4. **Price guarantee**

   The price guarantee refers to a period in months over which the electricity provider can assure the price will not change after you switch. The price guarantee applies to all price components, with the exception of taxes, government charges and levies. After the expiration of the price guarantee, changes may occur which could result in a financial burden or a reduction in the costs. The duration of the price guarantee can vary.

5. **Tariff price**

   To increase transparency, the tariff price is displayed as a monthly rate. In addition, you will be given the amount of the annual electricity bill, and the price per kilowatt hour. The switching bonus is already included in the tariff price as well as the basic charge. The tariff price refers to the German average household's electricity consumption and amounts to 3,500 kilowatt hours per year.

-------------*[page break]*--------------

Subsequently, questions were posed to check whether the participants read and understood the introduction:

Before we start presenting different decision situations to you, we would like to make sure that you know which core data the decision situations relate to. Please answer the following two questions:

What annual electricity consumption do we use to calculate the tariffs in the decision situations?

- ☐ 1,050 kWh
- ☐ 2,000 kWh
- ☐ 3,500 kWh
- ☐ Your individual electricity consumption

How long is the contract term of the tariffs?

_____________ Months.

[If the answers to the questions were correct, the instructions follow. Otherwise, the introduction and the questions were presented again. If the questions were incorrectly answered twice, the experiment was blocked for the participant.]

-------------*[page break]*--------------

[The following twelve choice sets were presented to the participants in a random order to avoid an order effect.]

Each choice set was introduced with the following paragraph. In order to keep the appendix concise, this paragraph is only shown for the first choice set.

Instructions for the DCE:

In the following, you will be asked twelve times whether you would like to switch your current electricity tariff. In each of the twelve decision situations, two different tariff alternatives are offered which refer to an **annual electricity consumption of 3,500 kilowatt hours**. Please consider each decision situation independently of the others. We are interested in your personal opinion. Therefore, there are no "wrong" answers. In order to make the choice easier, please imagine that the assumed consumption of 3,500 kilowatt hours will later be adjusted to the annual electricity consumption you stated in the beginning.

Please note that the declared tariff costs are the amount that your household has to pay if the chosen alternative is to be implemented. Previous studies on the willingness to pay for switching the electricity tariff have shown that participants seem to be over-estimating how much they really are willing to pay. Therefore, if you decide to switch the tariff, consider carefully how the costs will affect your budget, to make sure that you would select the chosen tariff in reality as well. That is why, it is particularly important that you deal with the tariff alternatives in each of the 12 decision situations. **Just imagine that according to your answers, an electricity tariff would be tailor-made for you**. Within the experiment, you will always be given the possibility to choose a new tariff alternative, as well as have the option to keep your existing tariff with the alternative 'no switch'.

[Choice set 1]

	Tariff A	Tariff B	No Switch
Energy source	Wind	Biogas	
Share of green energy	40 % = 1,400 kWh	80 % = 2,800 kWh	
Switching bonus	120 €	30 €	
Price guarantee	6 months	6 months	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	70 €/month 770 €/year 22.0 Cent/kWh	80 €/month 880 €/year 25.1 Cent/kWh	
Which alternative do you choose?	O	O	O

[Choice set 2]

	Tariff A	Tariff B	No Switch
Energy source	Biogas	Solar	
Share of green energy	100 % = 3,500 kWh	40 % = 1,400 kWh	
Switching bonus	120 €	120 €	
Price guarantee	12 months	none	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	85 €/month 935 €/year 26.7 Cent/kWh	75 €/month 825 €/year 23.5 Cent/kWh	
Which alternative do you choose?	O	O	O

[Choice set 3]

	Tariff A	Tariff B	No Switch
Energy source	Wind	Wind	
Share of green energy	100 % = 3,500 kWh	40 % = 1,400 kWh	
Switching bonus	60 €	60 €	
Price guarantee	none	12 months	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	75 €/month 825 €/year 23.5 Cent/kWh	85 €/month 935 €/year 26.7 Cent/kWh	
Which alternative do you choose?	O	O	O

[Choice set 4]

	Tariff A	Tariff B	No Switch
Energy source	Wind	RE-Mix (45% Wind, 25% Biomass (15% Biogas) 20% Solar, 10% Waterpower)	
Share of green energy	60 % = 2,100 kWh	80 % = 2,800 kWh	
Switching bonus	90 €	120 €	
Price guarantee	none	6 months	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	80 €/month 880 €/year 25.1 Cent/kWh	70 €/month 770 €/year 22.0 Cent/kWh	
Which alternative do you choose?	O	O	O

[Choice set 5]

	Tariff A	Tariff B	No Switch
Energy source	RE-Mix (45% Wind, 25% Biomass (15% Biogas) 20% Solar, 10% Waterpower)	Solar	
Share of green energy	40 % = 1,400 kWh	100 % = 3,500 kWh	
Switching bonus	60 €	60 €	
Price guarantee	none	12 months	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	80 €/month 880 €/year 25.1 Cent/kWh	75 €/month 825 €/year 23.5 Cent/kWh	
Which alternative do you choose?	O	O	O

[Choice set 6]

	Tariff A	Tariff B	No Switch
Energy source	Biogas	RE-Mix (45% Wind, 25% Biomass (15% Biogas) 20% Solar, 10% Waterpower)	
Share of green energy	40 % = 1,400 kWh	100 % = 3,500 kWh	
Switching bonus	60 €	90 €	
Price guarantee	12 months	none	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	75 €/month 825 €/year 23.5 Cent/kWh	80 €/month 880 €/year 25.1 Cent/kWh	
Which alternative do you choose?	O	O	O

[Choice set 7]

	Tariff A	Tariff B	No Switch
Energy source	Biogas	RE-Mix (45% Wind, 25% Biomass (15% Biogas) 20% Solar, 10% Waterpower)	
Share of green energy	80 % = 2,800 kWh	40 % = 1,400 kWh	
Switching bonus	30 €	30 €	
Price guarantee	none	12 months	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	85 €/month 935 €/year 26.7 Cent/kWh	80 €/month 880 €/year 25.1 Cent/kWh	
Which alternative do you choose?	O	O	O

[Choice set 8]

	Tariff A	Tariff B	No Switch
Energy source	Solar	Wind	
Share of green energy	80 % = 2,800 kWh	60 % = 2,100 kWh	
Switching bonus	30 €	90 €	
Price guarantee	6 months	6 months	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	75 €/month 825 €/year 23.5 Cent/kWh	85 €/month 935 €/year 26.7 Cent/kWh	
Which alternative do you choose?	O	O	O

[Choice set 9]

	Tariff A	Tariff B	No Switch
Energy source	RE-Mix (45% Wind, 25% Biomass (15% Biogas) 20% Solar, 10% Waterpower)	Biogas	
Share of green energy	80 % = 2,800 kWh	60 % = 2,100 kWh	
Switching bonus	30 €	120 €	
Price guarantee	6 months	6 months	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	70 €/month 770 €/year 22.0 Cent/kWh	85 €/month 935 €/year 26.7 Cent/kWh	
Which alternative do you choose?	O	O	O

[Choice set 10]

	Tariff A	Tariff B	No Switch
Energy source	RE-Mix (45% Wind, 25% Biomass (15% Biogas) 20% Solar, 10% Waterpower)	Wind	
Share of green energy	60 % = 2,100 kWh	80 % = 2,800 kWh	
Switching bonus	120 €	30 €	
Price guarantee	12 months	none	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	70 €/month 770 €/year 22.0 Cent/kWh	75 €/month 825 €/year 23.5 Cent/kWh	
Which alternative do you choose?	○	○	○

[Choice set 11]

	Tariff A	Tariff B	No Switch
Energy source	Solar	Wind	
Share of green energy	60 % = 2,100 kWh	100 % = 3,500 kWh	
Switching bonus	90 €	60 €	
Price guarantee	6 months	12 months	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	80 €/month 880 €/year 25.1 Cent/kWh	70 €/month 770 €/year 22.0 Cent/kWh	
Which alternative do you choose?	○	○	○

[Choice set 12]

	Tariff A	Tariff B	No Switch
Energy source	Solar	Biogas	
Share of green energy	100 % = 3,500 kWh	60 % = 2,100 kWh	
Switching bonus	90 €	90 €	
Price guarantee	12 months	none	
Tariff price for 3,500 kWh (incl. switching bonus and fees)	85 €/month 935 €/year 26.7 Cent/kWh	70 €/month 770 €/year 22.0 Cent/kWh	
Which alternative do you choose?	○	○	○

Appendix B: Development of the willingness to pay (WTP) in WTP space

The starting point of the econometric analysis was the *random utility theory* (McFadden, 1974), which says that for each individual n and each good or action alternative i which is available in a decision situation, an indirect utility function U_{in} can be established:

$$U_{in} = \beta_{kn}' x_{ik} + \varepsilon_{in}$$

This indirect utility function U_{in} can be described by k utilizing attributes. Unobservable individual preferences are considered by the unexplained component $\boldsymbol{\varepsilon}_{in}$. As a utility maximizer, individual n chooses alternative i instead of j from a given set of alternatives C_n if:

$$U_i > U_j \;\; \forall\, j \in C_n, \qquad i \neq j$$

Train (2009) argued that various models can be used to analyze DCE. They differ in the fact that different assumptions for the distribution of the undefined component $\boldsymbol{\varepsilon}_{in}$ can be drawn. In this investigation, a generalized multinomial logit model was chosen.

In discrete choice models, the utility of alternative j perceived by respondent n in choice situation t is denoted by U_{ntj}. Moreover, U_{ntj} is divided into two components, with a deterministic component V_{ntj} and an unobserved component ε_{ntj}, so that

$$U_{ntj} = V_{ntj} + \varepsilon_{ntj} \tag{1}$$

Focusing on the estimation of the willingness to pay (WTP), the deterministic component can be divided by a price component, p_{ntj}, and non-price attributes, x_{ntj}:

$$U_{ntj} = -\alpha_n p_{ntj} + \beta_n' x_{ntj} + \varepsilon_{ntj} \tag{2}$$

where α_n and β_n vary randomly for all electricity customers and ε_{ntj} is an independent and identically distributed (IID) random component. In order to account for the variance of ε_{ntj} being different for different electricity customers, k_n is introduced as a scale parameter for electricity customer n. Therefore, the utility in equation (2) is divided by $\mathrm{k_n}$ without affecting behavior (Train, 2004):

$$U_{ntj} = -(\alpha_n/k_n) p_{ntj} + (\beta_n/k_n)' x_{ntj} + \varepsilon_{ntj} \tag{3}$$

Defining the utility coefficient as $\lambda_n = (\alpha_n/k_n)$ and $c_n = (\beta_n/k_n)$, utility can be written as:

$$U_{ntj} = -\lambda_n p_{ntj} + c_n' x_{ntj} + \varepsilon_{ntj} \tag{4}$$

which is referred to as the model in preference space. The WTP for an attribute is the ratio of the attribute's coefficient to the price coefficient calculated ex post estimation: $w_n = c_n/\lambda_n$. Based on this definition, utility can be rewritten as

$$U_{ntj} = -\lambda_n p_{ntj} + (c_n' w_{ntj})' + \varepsilon_{ntj} \tag{5}$$

which is referred to as utility in WTP space, where w_n is calculated directly in the estimation process.

Appendix C

Table C.1 – Descriptive statistics of the sample

Characteristics	Sample n=371	Germany	Source
Female	57.4	51.5	Destatis, 2016: 26
Male	42.6	48.5	Destatis, 2016: 26
Ø Age (years)	43.9	44.3	BiB-Demographie, 2017*)
Married	30.5	42.3	Destatis, 2016: 51
Household without child/ren (%)	77.6	72.0	Destatis, 2016: 52*)
Ø living space (square meters)	98.8	92.1	Destatis, 2016, PM:316/16
Ø annual electricity consumption (kWh)	2,750	3,247	Destatis, 2017: Energieverbrauch
Ø annual electricity costs (Euro)	750	1,008**)	BDEW, 2015
Household with pure green energy tariff (%)	35.3	19.1	Federal Network Agency, 2016
No switch within the past 5 years (%)	38.8	-	
Persons living in the same household	**%**	**%**	Destatis, 2016: 50
1	37.7	41.3	
2	36.9	34.2	
3 or more	25.4	24.4	
Age (years)	**%**	**%**	Destatis, 2017, Code: 12411-0005*)
18-24	12	7.7	
25-29	9	6.6	
30-39	18	12.3	
40-49	22	14.0	
50-64	33	22.1	
> 64	6	21.1	
Region	**%**	**%**	Destatis, 2016: 27
North	16.4	16	
East	20.2	20	
South	42.9	41	
West	20.5	23	
Monthly household's net income (Euro)	**%**	**%**	Destatis, 2017, Code:12211-0105*)
< 1,300	25.3	23.0	
1,300-1,999	24.5	22.6	
2,000-2,599	16.2	14.9	
2,600-3,199	8.1	10.9	
3,200-4,499	14.3	14.4	
> 4,500	11.6	11.4	

Table C.1 (*continued*)

Characteristics	Sample n=371	Germany	Source
Town size (number of residents)	**%**	**%**	Destatis, 2017, Code: 12211-0103*)
< 5.000	16.2	13.1	
5.000-19.999	19.9	24.8	
20.000-99.999	22.1	27.3	
100.000-499.999	20.8	16.1	
> = 500.000	21.0	18.7	
Consumer attitudes	**% agreement**		
Food or fuel: RES only from plants not used for food or feed production	50.4		
EEG levy: likely instrument	26.4		
Increase the demand for green electricity tariffs by cancelling the EEG levy for those who decide to switch to pure green energy tariffs.	62.5		
Green Party identification	12.4		
Environment is important when buying groceries	52.0		
Never switched before	31.3		
Wish to outsource switching process	16.4		

Source: Author`s elaboration and calculations; translated from German into English
*) Own calculations based on the German census for 2015
**) Annual electricity costs arising for a consumption of 3,500 kWh

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2000 bis 31. Mai 2006
Institut für Agrarökonomie
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	2001	
0101	Leserer, M.	Zur Stochastik sequentieller Entscheidungen, 2001
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0103	Birner, R. et al.	‚Ich kaufe, also will ich?': eine interdisziplinäre Analyse der Entscheidung für oder gegen den Kauf besonders tier- u. umweltfreundlich erzeugter Lebensmittel, 2001
0104	Wilkens, I.	Wertschöpfung von Großschutzgebieten: Befragung von Besuchern des Nationalparks Unteres Odertal als Baustein einer Kosten-Nutzen-Analyse, 2001
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0504	Jahn, G., M. Schramm u. A. Spiller	Institutional Change in Quality Assurance: the Case of Organic Farming in Germany, 2005
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Die Wurzeln der **Fakultät für Agrarwissenschaften** reichen in das 19. Jahrhundert zurück. Mit Ausgang des Wintersemesters 1951/52 wurde sie als siebente Fakultät an der Georgia-Augusta-Universität durch Ausgliederung bereits existierender landwirtschaftlicher Disziplinen aus der Mathematisch-Naturwis-senschaftlichen Fakultät etabliert.

1969/70 wurde durch Zusammenschluss mehrerer bis dahin selbständiger Institute das **Institut für Agrarökonomie** gegründet. Im Jahr 2006 wurden das Institut für Agrarökonomie und das Institut für Rurale Entwicklung zum heutigen **Department für Agrarökonomie und Rurale Entwicklung** zusammengeführt.

Das Department für Agrarökonomie und Rurale Entwicklung besteht aus insgesamt neun Lehrstühlen zu den folgenden Themenschwerpunkten:

- Agrarpolitik
- Betriebswirtschaftslehre des Agribusiness
- Internationale Agrarökonomie
- Landwirtschaftliche Betriebslehre
- Landwirtschaftliche Marktlehre
- Marketing für Lebensmittel und Agrarprodukte
- Soziologie Ländlicher Räume
- Umwelt- und Ressourcenökonomik
- Welternährung und rurale Entwicklung

In der Lehre ist das Department für Agrarökonomie und Rurale Entwicklung führend für die Studienrichtung Wirtschafts- und Sozialwissenschaften des Landbaus sowie maßgeblich eingebunden in die Studienrichtungen Agribusiness und Ressourcenmanagement. Das Forschungsspektrum des Departments ist breit gefächert. Schwerpunkte liegen sowohl in der Grundlagenforschung als auch in angewandten Forschungsbereichen. Das Department bildet heute eine schlagkräftige Einheit mit international beachteten Forschungsleistungen.

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