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# Are consumers willing to pay more for electricity from cooperatives? Results from an online Choice Experiment in Germany

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## ABSTRACT

With liberalization in 1998, numerous firms have entered the German retail electricity market, including newly formed consumer cooperatives. Based on Transaction Cost Economics, we develop a theoretical framework seeking to explain preferences for electricity supplied by cooperatives from a consumer perspective. Drawing on a convenience sample of 287 German electricity consumers and Choice Experiment data from an online survey, we estimate Willingness-to-Pay values for organizational attributes of electricity suppliers, while accounting for observed and unobserved heterogeneity. Consumers in the sample exhibit a large Willingness-to-Pay for renewable energy. Our results also indicate a substantial Willingness-to-Pay for transparent pricing, participation in decision making, and local suppliers. Democratic decision making – a distinct feature of cooperatives – exhibits positive Willingness-to-Pay values for approximately one fifth of the sample. Taken together, our findings suggest a slightly higher Willingness-to-Pay for electricity produced by cooperatives. Limitations of applied sampling and other important aspects of energy transition are also discussed.

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## 1. Introduction

Over the past 15 years, German electricity supply has undergone significant changes, and a large number of new firms have entered the retail market [1–3], including consumer cooperatives, customer-owned businesses, that are generally distinguished from publicly-owned or investor-owned firms (IOFs). Consequently, today numerous German electricity suppliers not only differ in terms of prices, offered services, or energy mix, but also regarding how they are organized (i.e. their governance structures).

Empirical research on energy cooperatives in Germany has largely focused on practitioner problems and the production side [4–10], but rarely on the role of consumers. Theory-wise, a consumer perspective on the organization of enterprise can be built on Williamson's [11] argument that opportunistic and boundedly rational agents may require safeguards for organizing transactions. Controlling for other important characteristics of electricity (e.g. renewable energy share), we developed a Choice Experiment (CE)

to estimate consumer preferences and subsequent Willingness-to-Pay (WTP) values for governance attributes of electric utilities. In a CE, respondents take part in a survey and repeatedly choose between two or more alternatives describing the good to be valued, separated into its characteristics, generating data that can be used to estimate welfare measures for changes in attributes.

We included several governance attributes in our CE, such as decision-making structures and commitment to price transparency, which may help consumers to reduce transaction costs resulting from challenges present on electricity markets, such as non-competitive market structures in generation and transmission or information asymmetries. Our study focuses on Cooperative Governance as a means to economize on transaction costs [8,12], seeking to understand the recent success of electricity-supply cooperatives [10] from the consumer side of the transaction, especially in markets for renewable energy.

In Germany, energy cooperatives are predominately involved in producing electricity from renewable sources. It is, thus, particularly important to disentangle consumer preferences for renewable energy from preferences that are related to the cooperative enterprise, because the two have very different policy implications. In other words, we ask here whether policy makers should direct more attention to *what* is produced, i.e. electricity from renewable vs. non-renewable sources, or to *how*

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it is produced, i.e. electricity produced by consumer-controlled enterprises vs. private or publicly owned firms. Our study is explorative in nature, as the topic has not been researched so far. Hence, we relied on a small non-probability sample from students and employees at different universities to assure environmental awareness and high education standards.

Germany is Europe's largest economy and the fourth largest economy of the world. The German government has decided for a massive shift of the energy system which, under the term "Energiewende" (energy transition), has attracted a lot of interest from other countries. Beside technological progress in the field of renewable energy, societal change on various fields is required for a successful regime shift [13,14]. As shown by a recent survey, engineers have dominated the field of energy research and a focus on social science research is desperately needed. More specifically, fifteen promising fields have been identified that could advance our knowledge of energy systems [15]. In this context, our paper, by looking at consumer preferences for locally and collectively produced energy, contributes to an improved understanding especially in the fields of "geography and scale" and "institutions and energy governance." Further, as Sovacool points out, "consumer preferences are more complex than normal market approaches would suggest [...] and] the social dimensions of energy technology and use are worth greater attention" [15]. We also contribute to the literature on trust [16], control and decentralization [17] as well as the interactions of households and energy systems [18], where large gaps exist in energy research.

The German case presented in this paper has implications also for other countries. The European Union wants to achieve a low-carbon economy and various policy adjustments need to take place for achieving the required technological shift [19]. From a comparative perspective, our paper helps to understand differences between, on the one hand, countries like Germany or the Netherlands, which have some experience with renewable energy cooperatives, and, on the other hand, countries like Japan or the US, where there is a long history of energy cooperatives, but relatively little interest in renewable energy cooperatives (US), or little experience but a strong interest (Japan). The particular perspective of customers may also be of interest for some Scandinavian countries, especially for Denmark, where considerable parts of the energy system are controlled by citizens.

This paper is organized as follows. First, we develop a theoretical framework for analyzing Cooperative Governance in retail electricity markets and then describe our empirical approach, followed by presentation and discussion of results. The last section offers a summary and concludes.

## 2. Background and theoretical framework

### 2.1. Energy transition and cooperatives

The liberalization of electricity markets in 1998, in combination with the *Erneuerbare Energien Gesetz* (Renewable Energy Act) and the start of nuclear phase-out in 2002, set the framework for a process which is referred to as an "Energiewende" (energy transition) in the German public.<sup>1</sup> Some of its most visible outcomes have

been technical change (e.g. decentralized renewable-energy power plants), a retail market for renewable energy, and electric utilities competing for ways to promote further development of this energy transition vis-à-vis their customers [20].<sup>2</sup> It is, thus, not surprising that recent research on consumer electricity preferences has focused on WTP for renewable energy from different perspectives. Bergmann et al. [22,23], Roe et al. [24], Garcia et al. [25], Ku and Yoo [26], Yoo and Ready [27] and Longo et al. [28], among others, have investigated WTP for renewable energy in general. Borchers et al. [29] have accounted for differences in WTP from different sources. Externalities from wind energy have been studied by Meyerhoff et al. [30], Dimitropoulos and Kontoleon [31], Ladenburg and Dubgaard [32], and Álvarez-Farizo and Hanley [33]. Other sources like micro-generation and biomass have been studied by Scarpa and Willis [34], Soliño [35] and Soliño et al. [36]. Michelsen and Madlener [37] and Achtnicht [38] have looked at preferences for cleaner energy from a house owners' perspective.

Electricity from renewable energy sources has characteristics strongly resembling from credence goods. Due to information asymmetries, consumers cannot easily assess the utility from consuming such goods. While the utility from electric energy use is relatively easy to assess, it is difficult to assess the utility component of *renewables*, because this requires knowledge of the production process. Electric utilities may, thus, use tariffs for renewable energy to hide margins, resulting from information asymmetries and opportunistic behavior [39,40].

In the year 2000, Germany ratified a Renewable Energy Act (EEG). A key component is the feed-in-tariff (above average market prices) for producers of electricity from renewable sources. Costs for these subsidies are shared by consumers. Since its ratification, the law was amended several times. Another reform is planned for the current legislature [41]. The reform plans foresee a decrease in feed-in-tariffs especially for on-shore wind power, solar PV, and biomass. Tariffs for (large-scale) off-shore wind power installations remain relatively high. The law now also sets targets for additional capacities. For instance, the annual increase in generation for solar PV should be about 2500 MW and tariffs should be used to adjust these capacity targets. Taken together, the reform proposal favors private investors with a diverse product portfolio and may be a step back for many small-scale community-driven projects as it involves several price and policy risks. It remains to be seen, however, how exactly these plans will be put into practice.

Energy cooperatives experienced a recent boom in Germany. Between 2008 and 2012, the number of officially registered cooperatives in this field increased from less than 100 to more than 700 companies [10]. These are engaged in producing electricity from renewable sources, typically using solar PV or biomass [10]. They are embedded in a particular community, small in membership (usually less than 100 people), and, based on the German feed-in tariff, make most of their revenue from selling electricity. Members' decisions are made in the general assembly, and volunteering or professional managers are appointed in democratic elections.

<sup>1</sup> Please note that the nuclear-phase out was first introduced by a coalition of social-democrats and the green party in 2002. The law was then modified by a more conservative government in 2010. More specifically, the run-time for several nuclear power plants was extended. Following the events of Fukushima, in 2011, the same government reversed the decisions, again reducing the run-time of nuclear power plants with the aim of shutting down all remaining nuclear facilities by the year 2022. A detailed analysis of the legal aspects, such as the Renewable Energy Act, technical change, and its relationship to the recent rise of electricity

cooperatives, is beyond the scope of this paper. For more information see Müller and Rommel [8]. The new coalition of social-democrats, Christian democrats, and the Christian socialist union, has planned a comprehensive reform of the Renewable Energy Act, including the substantial reduction of feed-in tariffs, especially for biomass. It remains to be seen how this reform will affect producers of electricity from renewables.

<sup>2</sup> In many Western countries, consumer preferences have changed over the last decades. For a relatively small but growing part of the population, social and environmental impacts of consumption choices play an increasingly important role. A recent overview focusing on the social aspects of "sustainable consumption" can be found in Seyfang [21].

**Table 1**  
Challenges and cooperative governance solutions on electricity markets.

Challenge on electricity market	Cooperative governance solution	Key reference
Monopolistic market structures	Participation and democratic control, reducing regulation costs	[12]
Energy transition and sustainable consumption	Activity space for commitment/initiatives, reducing information costs	[8]
Electricity (from renewables) as a credence good	Transparency; local suppliers embedded in social networks, reducing enforcement and information costs	[29]

Some cooperatives also run heat grids or they are engaged in trade with electricity from renewable resources [42]. These *trading cooperatives* include the two largest players in the field – the *Elektrizitätswerke Schönau* and *Greenpeace Energy eG*. These large trading cooperatives are particular, because most of their business is with non-members. Greenpeace Energy, for instance, has about 23,000 members, but serves 110,000 customers, out of which more than 100,000 are private households [43]. It is exactly these (non-member) customers that our research focuses on, because in these cases the question arises whether customers are willing to pay price premiums for renewable energy or for energy that is produced by a cooperative enterprise.

Cooperatives also differ in their participation possibilities. While small cooperatives often use more direct forms of democracy and managers are mostly recruited from the pool of members, large cooperatives tend to employ professional managers. With increasing size, decision-making moves from direct to representative democracy [44]. Also in energy cooperatives, governance mechanisms and subsequent participation possibilities for members differ, contingent on the type of transaction [42].

Historically, successful cooperatives have been explained by their ability to help members overcome economic misery [45,46], the social network created among members, most prominently displayed in a cooperative's *Genossenschaftsgeist* (cooperative spirit; [47]), or their contribution to competitive pricing under imperfect competition [48]. One could argue today that increased consumer demand for electricity from cooperatives reflects their self-help character: people support cooperatives because there seems no other way to make nuclear power plants obsolete and achieve a sustainable energy system. Social networks may also explain consumer support, because cooperatives provide space for communication and activities to people with similar attitudes. In contrast to IOFs, whose owners share the goal of maximizing profits, cooperatives, by definition [49], seek to advance their members' economic, social, and cultural goals through a jointly owned and democratically controlled organization.

The user-owner identity in cooperatives leads to an alignment of interests, resulting in higher levels of transparency and lower regulation costs, i.e. all costs associated with negotiating and adjusting tariffs in a way that they represent marginal cost. Cooperatives can more easily ensure price transparency, reducing uncertainties related to the credence-good character of renewable energy [8]. In contrast to the approaches mentioned already, these facets are quite explicitly taken into account by the Transaction Cost Economics literature on cooperatives [12,50,51].

## 2.2. Transaction Cost Economics and Cooperative Governance

Based on the seminal work of Coase [52], Transaction Cost Economics has argued that economic transactions are associated with costs exceeding production costs. Along with Property Rights Theory, Principal-Agent Theory, and Contract Theory, Transaction Cost Economics, is part of New Institutional Economics [53]. The key idea of Transaction Cost Economics is that net utility derived from economic transactions cannot be understood solely

by looking at prices, but must also be evaluated against knowledge of how transactions are organized [11,52,54]. Transaction costs are added to those for production and consumption, occurring for example when actors negotiate and design contracts or safeguard transactions. Agents can economize by finding optimal governance systems for organizing transactions [11]. Governance can be broadly defined as institutions at contractual or organizational levels which can be shaped by actors involved in transactions [55].

Cooperative governance is distinct from that of publicly owned utilities and IOFs. In spite of the diverse governance models existing within the cooperative sector [56,57], common features can be found across it which are most prominently reflected in cooperative principles (see also [49,58]) that form the core of cooperative governance. These principles include (1) voluntary and open membership; (2) democratic control; (3) economic participation; (4) autonomy and independence; (5) education, training, and information; (6) concern for community; and (7) cooperation of cooperatives.<sup>3</sup> In practice, not all of these principles are followed at all times, as shown by a recent survey of European cooperatives in agriculture [59]. For instance in milk processing, some dairy cooperatives may restrict membership according to processing capacities.

Historically, electricity markets have been dominated by non-competitive market structures, originating from the natural monopoly characteristics of the grid and its associated regulation costs [60]. In a cooperative, profits and losses are typically distributed proportionately to patronage (economic participation). Thus, relatively high/low prices would result in profits/losses being attributed to user-owners proportionate to the amount of services received, aligning interests of users and owners and lowering regulation costs [12]. Although today integrated monopolists are unbundled and the natural monopoly is confined to the grid, customers are confronted with the market power of former monopolists in electricity generation [1]. By becoming cooperative members, customers can participate in its democratic decision making.

Credence good characteristics of electricity generation result from high information costs. Cooperatives are typically embedded in local economic structures which can reduce information and enforcement costs through peer pressure or higher levels of trust [50,61]. A non-exhaustive overview of the challenges observed on electricity markets and their cooperative governance solutions is listed in Table 1. Cooperatives also address other challenges on markets. By playing a competitive yardstick role, they level the playing field for market participants. Under imperfect competition, cooperatives drive prices toward marginal cost as demonstrated empirically for instance for European dairy markets [48].

Empirically, few studies have tried to quantify WTP for organizational attributes in the environmental valuation literature. Remoundou et al. [62] analyzed whether WTP for environmental

<sup>3</sup> An in-depth discussion of these principles goes beyond the scope of this paper. For an introduction to the topic the reader is referred to Laurinkari [58].

protection depends on the providing authority. Bougherara and Ducos [63] directly included governance attributes into a CE on contracts between the European Union and farmers. Reise et al. [64] studied farmers' contracts. In analyzing supply relationships with biogas plants, the authors included contract duration and contracting partner as attributes in a CE. Abebe et al. [65] study preferences for different contract farming settings of smallholders in Ethiopia. Applying a CE, they use the organizational form of the contractor and details of the contract as attributes. Two studies used Stated Preferences methods related to electricity and cooperatives [66,67]. Hanisch et al. [66] found that about a third of the respondents would support cooperative arrangements in energy supply. Applying a CE, Rommel et al. [67] investigated preferences regarding electricity sector reforms, with only a small sample subgroup preferring electricity from a cooperative.

These theoretical considerations and empirical results have guided the selection of attributes for our CE, which we now turn to.

### 3. Choice Experiments and experimental design

#### 3.1. Background

According to the household production framework developed by Lancaster [68] and Rosen [69], consumers derive utility from characteristics of a good, rather than from the good itself. For example, utility from wine consumption may stem from taste, color, or alcohol content. CEs employ this approach, incorporating such attributes as “utility-sensitive” elements.

Thurstone [70] laid the ground for random utility models by formally deriving the effect of different stimuli – good characteristics or attributes – on perceived ratings, meaning preferences or choice probabilities. He also stressed that humans are much better in comparing alternatives than in judging them individually. The model was formalized by Manski [71]; McFadden [72] then combined these approaches and developed a statistical model, based on which Louviere and Woodworth [73] conducted the first CE.

As any other method, CEs have strengths and weaknesses. As a Stated Preferences Method, they are subject to hypothetical bias and strategic behavior (see e.g. [74,75]). Further, CEs assume full rationality of respondents, based on assumptions of neoclassical economic demand theory. In practice, however, rationality requirements are limited to the choice task: the required information is listed in the attributes and rationality is reduced to choosing the best option. Compared to choices in the real world, CEs are fairly simple. It should be noted that the complexity of real-life decision making cannot be compared to the online survey used here. The particular strength of the CE method lies in its ability to single out the valuation of particular attributes, which has proven useful for the problem studied in this paper.

#### 3.2. The formal model

We assume that individuals can derive utility from consumption of alternative electricity-supply contracts, depending on their attributes, choosing the one with the highest level of utility. We assume a linear indirect utility function  $V_i$  and a linearly added identical and independent distributed (iid) extreme value type 1 error term,  $\varepsilon_i$ , with the cumulative distribution function  $F(\varepsilon_i) = \exp(-\exp(\varepsilon_i))$  for each alternative  $i$ , so that the probability of choosing alternative  $j$  is given by

$$\Pr\{\text{Choose } j\} = \Pr\{V_j(\mathbf{A}_j, y - p_j\mathbf{A}_j) + \varepsilon_j > V_i(\mathbf{A}_i, y - p_i\mathbf{A}_i) + \varepsilon_i\}, \quad \forall i \neq j \quad (1)$$

where  $\mathbf{A}_j$  and  $\mathbf{A}_i$  are the attribute vectors of alternative  $i$  and  $j$  and  $y - p_i\mathbf{A}_i$  is the budget constraint or the price of the alternative.

Some manipulation will lead to McFadden's [72] conditional logit (CL) probability, which is

$$\Pr\{\text{Choose } j\} = \frac{\exp(V_j)}{\sum_{i=1}^n \exp(V_i)} \quad (2)$$

The linear indirect utility function for alternative  $j$  is

$$V_j = \beta\mathbf{A}_j \quad (3)$$

where  $\beta$  is a parameter vector to be estimated so that

$$\Pr\{\text{Choose } j\} = \frac{\exp(\beta\mathbf{A}_j)}{\sum_{i=1}^n \exp(\beta\mathbf{A}_i)} \quad (4)$$

With the following specification, the maximum likelihood method can be used to estimate  $\beta$ .

The CL model has some restrictions. First, the iid assumption implies that adding new irrelevant alternatives will not change the current substitution pattern, which is known as the Irrelevance of Independent Alternatives assumption. Second, the CL model assumes homogeneity of respondents. That is, apart from the unobserved iid random deviation, all respondents have identical preferences.

A large number of CL model extensions exist [76] that relax the iid assumption and allow incorporation of scale and preference heterogeneity into estimation. Prominent examples include the nested, the scaled (SMNL), random parameter (RPL) and latent class logit (LCL) models.

The LCL is an extension of the CL model, as it endogenously estimates preference classes, that is, finite discrete distributions of preferences. Each class has individual parameter vectors  $\beta_s$ , where  $s$  indicates the class. Parameters for each class are estimated with separate CL models:

$$\Pr\{\text{Choose } j|s\} = \frac{\exp(\beta_s\mathbf{A}_j)}{\sum_{i=1}^n \exp(\beta_s\mathbf{A}_i)} \quad (5)$$

Class probabilities are estimated with a multinomial logit model:

$$\Pr\{\text{member of } t\} = \frac{\exp(\gamma_t\mathbf{Z})}{\sum_{s=1}^S \exp(\gamma_s\mathbf{Z})} \quad (6)$$

where  $\mathbf{Z}$  are individual specific variables and  $\gamma_t$  the corresponding parameters.

The unconditional choice probability is then

$$\Pr\{\text{Choose } j\} = \sum_{s=1}^S \frac{\exp(\gamma_s\mathbf{Z})}{\sum_{k=1}^S \exp(\gamma_k\mathbf{Z})} \times \frac{\exp(\beta_s\mathbf{A}_j)}{\sum_{i=1}^n \exp(\beta_s\mathbf{A}_i)} \quad (7)$$

The number of classes is decided by the researcher, based on statistical measures of fit such as Bayesian Information Criterion (BIC) or Consistent Akaike Information Criterion (CAIC).

Recent research has focused on models that include scale and preference heterogeneity simultaneously. The Scale Adjusted Latent Class Model [77] and the Generalized Multinomial Logit Model (GMNL) [78] are generalizations of the LCL and RPL models. Hess and Rose [79] however contest the additional benefits of such approaches, arguing that the incorporation of scale heterogeneity in RPL models is a re-parameterization and may lead to misinterpretation.

Greene and Hensher [80] have developed a Latent Class Random Parameter (LCRP) model. Here, a RPL instead of a CL is estimated within each class of a LCL. The advantage is that within each class unobserved preference heterogeneity is allowed.



**Table 2**  
Description of attributes and levels.

Attribute	Description	Levels	Coding
Transparency	How a firm communicates pricing policy	Full price transparency Statutory price transparency	0 1
Participation	Consumer participation in a firm's decision-making process	Possible Impossible	0 1
Decision making	How a firm makes internal decisions	One member one vote Proportionate to equity	0 1
Location	Distance of company's headquarters to customers	Non-local (outside 30 km radius) Local (radius of 30 km);	0 1
Owners	Number of people sharing company ownership	1–9; 10–99; 100–999; >1000	Dummy Coded
Renewables	Share of renewable energy	0%; 33.3%; 66.6%; 100%	Dummy Coded
Price	Price per kWh in Eurocents	15; 20; 25; 30	0; 1; 2; 3

### 3.3. Statistical design

Here, statistical design refers to the alignment of attribute levels for each alternative and Choice Set. The best possible design is a full factorial one, including all possible combinations of levels and alternatives. Various methods [81–83] can be applied to reduce the number of possible combinations. Important concepts here are *orthogonality*, meaning that attributes are uncorrelated, and *balance*, meaning that each level of an attribute appears with the same frequency. Designs which are orthogonal and balanced are called orthogonal arrays, which do not confound the main effects. As interaction effects may be confounded with main effects and other interaction effects, extending the design with a fold-over avoids confounding of two-way interaction effects. The fold-over mirrors the design with opposite values for the levels.

## 4. Questionnaire and choice experiment

### 4.1. Attribute choice and choice sets

Starting with an initial list of nine attributes, we reduced their number through pre-studies and pre-tests, following the procedure suggested by Coast et al. [84]. Through an expert interview with a representative of a consumer service website and additional interviews with representatives of energy cooperatives and consumers, we then identified the most relevant attributes with respect to utility governance.

As discussed in Section 2, three attributes are particularly important with respect to cooperative governance and retail electricity markets – *price transparency*, *participation rights*, and *location* – and *decision making* is a distinct cooperative governance attribute that helps to further specify the participation attribute.<sup>4</sup> In cooperatives, each member has one vote, in contrast to voting rights based on equity in IOFs. The power of a cooperative member is, thus, also related to the *number of owners* of the organization. The more owners the organization has, the lower is the impact of one particular member in a democratically controlled enterprise. The size of an organization typically also leads to an increase in free-riding behavior [85] which is also commonly observed in open membership cooperatives [86]. To our knowledge, there is no specific

empirical evidence on the degree of the free-rider problem in energy cooperatives.

*Share of renewable energy* and *price* complete the attribute list. Price is presented in Eurocents per kWh – the form German consumers are most familiar with. We identified two extreme levels of 15 and 30 Eurocents per kWh as the minimum and maximum tariffs,<sup>5</sup> which we then divided into five Eurocent steps. Price levels were selected in a way to have an impact on choice, but they also should not have completely dominated it. A summary of the seven attributes and the levels used in the CE is provided in Table 2.

Respondents were likely to have different tariffs; a common status quo alternative was, thus, not realistic. An opt-out option (i.e. neither alternative is chosen) would also not have been useful, because all respondents consume electricity. Hence, we decided on choice sets with two alternatives and no opt-out or status quo option,<sup>6</sup> explaining to participants that these alternatives would result from a hypothetical search for a new electricity supplier, a procedure commonly applied in CEs in network industries [90].

The final experimental design consisted of an orthogonal array with its fold-over, generated with the software package NGENE [91] and finally comprised of 48 Choice Sets arranged into four blocks. Each respondent was asked to fill in one randomly assigned block of twelve Choice Sets with two alternatives each.

### 4.2. Sample and descriptive statistics

We implemented the questionnaire and CE using *Unipark*, an online environment for survey research. Respondents were recruited through mailing lists of the universities of the authors, covering students and employees. A link was sent to potential participants requesting that they take part in an approximately 15 minute-long online survey.

We are aware of the bias introduced by this sampling process. Data obtained from such non-probability sampling cannot be statistically generalized, thus the procedure demands additional justification. When only certain members of a population are of interest, non-probability sampling targeted at specific sub-populations may be the best available alternative to achieve a

<sup>5</sup> We used a consumer website to identify minimum and maximum price levels based on average tariffs, including fixed monthly costs, special offers, and prepaid packages.

<sup>6</sup> Recently, research has also focused on the effects of various status quo and opt out formats. Domínguez-Torreiro and Soliño [87] and Marsh et al. [88] have asked respondents to state their status quo. In a split sample these results were then compared to a status quo provided to respondents as part of the survey. Banzhaf et al. [89] have compared an opt out option to a status quo option. In all three studies the way the status quo is presented has a significant effect on welfare estimates.

<sup>4</sup> Participation, as an attribute, here refers to the fundamental *possibility* of participation, whereas democratic decision making refers to the *way* decisions are made. Please also note that the focus here has been especially on attributes that are of value to *all customers* of the cooperative. We have, thus, not included attributes that would mainly benefit *members* such as “education and training” as opposed to “price transparency” for instance.

**Table 3**  
Summary statistics for survey variables.

Name	Description	Obs.	Mean	SD	Min	Max
Sex	=1 if female	287	0.51	0.50	0	1
Age	Age in years	287	29.04	9.59	18	99
Education	Education on ordinal scale, with 1 = no formal education and 11 = post-graduate degree	285	7.69	2.01	1	11
Income	Monthly household income in Euros	238	2251.74	7404.68	0.00	100,000.00
Household size	Number of people living in household	287	2.22	1.23	1	11
Special knowledge	=1 if respondent has background in electrical engineering etc.	265	0.17	0.38	0	1
Consumption	Electricity consumption per year in kWh	134	2557.28	3203.10	1.27	35,000.00
Expenditures	Electricity expenditure in Euros per month	181	58.95	91.75	1.00	1200.00
Tariff	Currently paid price in Eurocent per kWh	111	22.39	3.57	5.00	30.00
Changed	=1 if respondent has changed supplier	278	0.69	0.47	0	1
Green Party	=1 if respondent would vote for Green Party in next election	287	0.42	0.49	0	1
Transparent	5-point Likert scale ranking if the electricity market is perceived as transparent (1 = highest perceived transparency to 5 = lowest perceived transparency)	230	4.08	0.95	1	5

sufficiently large number of observations [92]. As shown in experimental economics, sampling from a student population, within the same culture, does not necessarily introduce bias as compared to the general population [93,94]. This holds especially true if important characteristics of subjects are controlled for [95,96].

In cases where a problem is relatively under-researched, a small and easily available sample may be a good starting point for initially exploring it [97]. In addition, the costs for sampling conveniently available respondents are substantially lower.<sup>7</sup> Our reasoning for recruiting subjects via non-probability sampling was motivated by a mix of these factors. Our sample is strongly biased toward highly educated, environmentally aware people. This bears the advantage that we have a larger chance that the respondents would understand the CE and that the attributes are more relevant than it would be with the overall population. In an explorative study like this, this point can be of critical importance. We had good reason to believe that the attributes of the CE would not be similarly relevant for all groups. For instance, interviews in the pre-study indicated that “governance” plays a role especially for the young and those following an environmentally-friendly lifestyle. Similar evidence is available for pro-environmental consumption choices in other contexts in Germany [38]. It was, consequently, important to address the sampling bias by controlling for observed heterogeneity and by critically reflecting on potential confounding factors and selection bias [97].

The questionnaire began with a brief introductory text. Next, respondents were asked to provide some basic information, including income, age, and gender. Then the CE was introduced, with all attributes being described in detail. During the whole CE, attribute descriptions were available for respondents by drawing their mouse over attributes and levels. On each screen of the online survey, respondents could provide feedback and comments. From such qualitative comments, we can conclude that the level of understanding of the CE was generally good, even though in rare

cases some attributes were not fully understood. In the next part of the questionnaire, respondents were presented with questions on their energy use and knowledge, including whether they have switched their supplier in the past or purchase renewable energies. The last part of the survey asked for environmental and political attitudes as well as knowledge and awareness of cooperatives.

The survey was conducted from 18 January 2012 to 27 February 2012. Out of the 886 respondents who opened the online survey, 287 completed or partly completed the CE and 275 (=31.04%) completed the full questionnaire, including all questions that followed the CE. Summary statistics of key variables are presented in Table 3.

It can be seen that the gender ratio was balanced and respondents were relatively young and well-educated. Since education was measured on an ordinal scale, the mean of 7.69 represents an undergraduate university or college degree. Households were relatively small and incomes mostly below the German average.<sup>8</sup> One question asked about special knowledge on energy issues, such as having an engineering degree or participating in professional activities in the field. About 17 percent of the respondents had prior knowledge of energy issues. More than half of the respondents provided some data on household energy consumption and costs, indicating good knowledge of prices and tariffs. On average, surveyed households consumed about 2500 units per year, paid roughly 60 Euros a month, and purchased their electricity at 22 Eurocents per kWh. More than two thirds of the respondents have changed their electricity distribution company at least once. About 40 percent would vote for the Green Party in future elections, which is extremely high compared to the average votes of less than ten percent the Green Party receives in elections. It is a clear indication that our sample is biased toward a more environmentally sensitive population.

<sup>8</sup> Two respondents indicated a monthly income of 50,000 and 100,000 Euros. Although these numbers seem exceptionally high, we have no reason to believe that respondents indicated false information. The same applies to the high electricity expenditures. We have, nonetheless, kept the data in the analysis. A drawback is the high number of zero incomes, often resulting from students living on scholarships or transfers.

<sup>7</sup> For further information on the merits and demerits of non-probability sampling and an overview on different sampling designs, see Henry [97].

**Table 4**  
Estimation results conditional logit models.

	(1) Basic	(2) Interactions	(3) Interactions and ln(Income)
Transparency	−0.770*** (−8.84)	−0.713** (−7.21)	−0.759** (−7.21)
Participation	−0.537*** (−5.88)	0.975* (1.93)	1.026* (1.87)
Decision making	−0.0309 (−0.36)	−0.091 (−0.90)	−0.039 (−0.37)
Location	0.787*** (7.96)	0.796*** (6.96)	0.752*** (6.41)
Owners_10–99	0.156 (1.32)	0.228* (1.65)	0.306** (2.09)
Owners_100–999	0.143 (1.43)	0.158 (1.33)	0.169 (1.29)
Owners_>1000	0.0699 (0.55)	0.170 (1.15)	0.311** (2.06)
Renewables_33%	1.944*** (14.04)	1.785*** (6.67)	1.857*** (5.89)
Renewables_66%	3.039*** (21.50)	2.856*** (6.22)	3.395*** (5.93)
Renewables_100%	4.699*** (23.54)	4.336*** (6.34)	5.045*** (5.95)
Price	−1.055*** (−20.89)	−1.055*** (−18.21)	
Participation × Age		−0.025*** (−2.73)	−0.024** (−2.32)
Participation × Transparent		−0.214** (−2.19)	−0.205* (−1.84)
Renewables × Changed		0.410*** (4.72)	0.340*** (3.47)
Renewables × Green Party		0.504*** (5.38)	0.562*** (5.32)
Renewables × Transparent		−0.061 (−1.23)	−0.151** (−2.39)
Price/ln(Income)			−1.226*** (−16.13)
Respondents	287	225	187
Observations	3404	2702	2249
Pseudo R <sup>2</sup>	0.484	0.513	0.499
χ <sup>2</sup>	2284.8***	1920.8***	1554.3***
Log likelihood (Null)	−2359.5	−1872.9	−1558.9
Log likelihood	−1217.1	−912.5	−781.7

t statistics in parentheses.

\* p < 0.10.

\*\* p < 0.05.

\*\*\* p < 0.01.

We also asked respondents whether they felt that the price setting of utilities is transparent. With an average of more than four, respondents seem to perceive pricing as highly non-transparent.

## 5. Results

### 5.1. Conditional logit and latent class logit results

Table 4 reports results of three specifications of the CL model.

The first model is basic, including only the attributes. In the second model, we added interaction variables of socio-demographic and attitude data with attributes. The third model also includes an adjusted price attribute. Dividing the price attribute by the logarithm of income allows variation in the marginal utility of income across respondents.

As indicated by the  $\chi^2$ -statistics, all models are statistically significant at the one percent level. The attribute coefficients display the expected signs. Transparency, Participation and Decision Making have negative coefficients, meaning that respondents prefer more price transparency over less, possibilities of participation over non-participation, and democratic decision making. Location has a positive sign, implying that local distribution companies are preferred. The Owners dummies are all positive. Companies with a higher number of owners are preferred. The same applies to the Renewables dummies, revealing a preference for higher share of renewable energy.<sup>9</sup>

<sup>9</sup> We tested for a linear trend in utility in the basic CL model. The Wald test results indicate that the coefficients are statistically significantly different.  $H_0$ : Slope zero

**Table 5**  
Information criteria of LCL models.

Classes	LLF	Nparam	CAIC	BIC	AIC
2	-670.092	28	<b>1526.552</b>	1498.552	1396.184
3	-620.987	45	1541.493	<b>1496.493</b>	1331.973
4	-592.968	62	1598.608	1536.608	1309.937
5	-572.076	79	1669.976	1590.976	<b>1302.152</b>
6	-576.231	96	1791.438	1695.438	1344.463

Bold figures indicate the minimum value.

The negative coefficient for Price indicates that, as expected, lower tariffs are preferred over higher. In model 1, all coefficients are statistically significant except Decision Making and the Owners dummies, which are also not jointly statistically significant. In model 2, we included four interaction terms to derive inferences about the influence of case-specific variables on attributes. Our sample is (intentionally) biased toward the young, Green Party voters, and consumers with experience in switching suppliers. Thus, we have specifically controlled for these socio-demographic and attitudinal sample-selection biases by interacting Age with Participation, Perception of price-setting transparency with Participation and Renewables, and Green Party and Company Changed with Renewables. The negative sign of the Participation × Age coefficient indicates that, with increasing age, participation becomes more important. The negative sign of Participation × Transparent implies that people perceiving price setting as non-transparent become more interested in participation.<sup>10</sup>

Respondents who had changed suppliers, would vote for the Green Party, and rated price setting in the electricity market as transparent exhibit a stronger preference for renewable energies. Model 3 shows that higher-income respondents care less about price. The marginal effect of Price, which can be interpreted as a change in income and, hence, is its marginal utility, is calculated as  $\beta_{price}$  divided by  $\ln(\text{Income})$ .<sup>11</sup>

In order to account for unobserved scale and preference heterogeneity, we have applied different models with various specifications. The models used include the LCL, RPL, GMNL, SMNL and the LCRP. We found that the LCL model fits our data best, based on measures of fit (BIC, AIC), the improvement of the likelihood function, and the significance of individual parameters.<sup>12</sup> In the following, we present the results of the LCL. We decided for a three class model based on the plausibility of the results and BIC. Table 5 shows the log likelihood values, BIC, as well as AIC and CAIC for LCL models from two to six classes. The CAIC punishes an increase in parameters, which lead to the lowest value in the two class model. The BIC tends toward a three class model and the AIC to a five class model. However, we will report the results of the three class model as it turned out useful in the interpretation of the data.

Table 6 presents estimation results of a three-class LCL model.

to 33% = Slope 33–66%:  $p = 0.0002$ ;  $H_0$ : Slope 33–66% = Slope 66–100%:  $p = 0.39$ ;  $H_0$ : Slope zero to 33% = Slope 66–100%:  $p = 0.0001$ ;  $H_0$ : All slopes equal:  $p = 0.0005$ .

<sup>10</sup> It should be noted that the sign for Participation changes because the marginal effect of the attribute on utility is not  $\beta$  but  $\beta - \alpha z$ , where  $z$  is the case-specific variable and  $\alpha$  is the corresponding parameter. Taking the means of the two interaction variables will lead to a marginal effect for Participation of  $-0.611$ , which is close to the marginal effect in the basic model of  $-0.537$ . It is worth mentioning that respondents of the average sample age, 29, who regard the electricity market as transparent would have a small positive marginal effect. Hence, they would prefer that participation not be possible.

<sup>11</sup> Note that the lower number of observations results from the large number of zero income observations which drop out of the estimation in model 3. Given that the coefficients of model 2 and model 3 are fairly close, this change in sample does not seem to introduce a selection bias.

<sup>12</sup> Estimation tables of the estimated models are available from the authors on request.

**Table 6**  
Estimation results latent class logit model.

	Class 1	Class 2	Class 3
Transparency	-4.396*** (-4.73)	0.137 (0.34)	-0.734*** (-4.27)
Participation	-8.944*** (-4.60)	-0.836** (-2.42)	-0.155 (-0.91)
Decision making	3.181*** (2.84)	-1.163** (-2.55)	-0.339* (-1.90)
Location	9.868*** (4.24)	1.224*** (3.31)	0.788*** (4.02)
Owners_10-99	2.372*** (2.98)	-0.158 (-0.33)	0.537** (2.02)
Owners_100-999	-1.412*** (-2.74)	0.450 (1.05)	0.005 (0.02)
Owners_>1000	0.711 (0.82)	-0.079 (-0.14)	0.666*** (2.95)
Renewables_33%	8.905*** (6.71)	1.954*** (3.12)	1.243*** (5.15)
Renewables_66%	19.25*** (5.92)	2.027*** (3.75)	2.758*** (9.82)
Renewables_100%	27.66*** (6.27)	3.219*** (3.56)	4.005*** (12.57)
Price	-5.904*** (-5.88)	-2.714*** (-7.19)	-0.247*** (-3.41)
Class share	0.499	0.210	0.291
Respondents	287	287	287
Observations	3404	3404	3404
Pseudo R <sup>2</sup>	0.806	0.715	0.453
$\chi^2$	1253.1***	467.5***	412.4***
Log likelihood (Null)	-777.4	-326.8	-454.7
Log likelihood	-150.8	-93.04	-248.5

t statistics in parentheses.

\*  $p < 0.10$ .

\*\*  $p < 0.05$ .

\*\*\*  $p < 0.01$ .

The overall model is statistically significant at the one percent level. Class 1 is the largest, with a share of 50 percent. Classes 2 and 3 have shares of 21 and 29 percent, respectively.

The coefficient of Transparency is large, negative, and statistically significant in Class 1; smaller, yet also statistically significant, in Class 3; and close to zero in Class 2. Participation has the expected negative sign in all classes, but is particularly large and statistically significant at the one percent level in Class 1. Members of Class 1 also prefer Decision Making proportionate to equity. In all three classes, local utilities are preferred over distant ones, with a particularly large coefficient in Class 1. Coefficients of the Owners dummies are jointly significant at the one percent level in Class 1 and Class 3. In both cases, companies with either a few or many members are preferred. The Renewables dummies and Price are highly significant in all classes and display the expected signs. In the LCL estimation, we included case-specific variables in the membership function to account for observed heterogeneity (Table 7).

Class 3 is the base category, for which values are zero. Younger people are more likely to be members of Class 1 and less likely members of Class 2. Those who have already changed distribution companies are more likely to be members of Class 3. Green Party voters are more likely to be members of Class 1 and less likely to belong to Class 2. Those who perceive the price setting as non-transparent and richer people are also more likely to be members of Class 1 and 2.



**Table 7**  
LCL membership function.

Variable	Class 1	Class 2
Age	−0.036	0.039
Changed	−1.036	−1.343
Green Party	0.987	−1.364
Transparent	0.215	0.064
Ln(Income)	0.758	0.726
Constant	−4.451	−5.67

## 5.2. Willingness to pay analysis

Table 8 provides estimates and confidence intervals for WTP for all estimated models.

WTP values are calculated by dividing attribute coefficient by Price coefficient. Resulting values indicate the monetary amounts respondents are willing to pay for marginal improvement in an attribute. Upper and lower limits form the confidence intervals of WTP values, calculated with the delta method [98] at a 95% confidence level. The larger the gaps are between these limits, the noisier the data.

A WTP value of 3.72 for Location in the first column, for example, means that, on average, respondents are willing to pay an additional 3.72 Eurocent per kWh for regional suppliers. For a change from statutory price transparency to full price transparency, respondents are willing to pay 3.65 Eurocent per kWh. For the two four-level attributes, the reference category is the first level. For an increase from zero to a 33% share of renewable energy, respondents are willing to pay 9.21 Eurocent; for an increase from zero to 66%, the WTP is 14.4 Eurocent. The WTP for increasing from 33% to 66% is, thus, 5.19 Eurocent.

It turns out that, on average, Renewables and Price dominate the choices and contribute to the largest share of utility, followed by Location, Transparency and Participation. In the LCL model, members of Class 1 put special emphasis on renewable energy, locally produced power, and right to participate in the decision making process. Therefore we name this class “green participators”. Respondents from Class 2 are characterized by rather low WTP values, but show a preference for locally produced power and renewable energy. Respondents in Class 2 also have a positive WTP for democratic decision making that lies within the 95% confidence interval. This class can be described as the “price conscious democrats”. Class 3 is marked by cost insensitivity and displays very high WTP values, especially for Renewables. The other important attributes for this group are Transparency and Location. We name this class “change makers”.

**Table 8**  
Confidence intervals (95%) for WTP values by models.

	CL basic model			LCL three-class model								
	WTP	Lower	Upper	Class 1 Green participators			Class 2 Price conscious democrats			Class 3 Change makers		
				WTP	Lower	Upper	WTP	Lower	Upper	WTP	Lower	Upper
Transparency	−3.65	−4.50	−2.79	−3.72	−4.31	−3.13	0.25	−1.15	1.66	−14.86	−26.54	−3.17
Participation	−2.54	−3.33	−1.75	−7.57	−8.68	−6.46	−1.54	−2.72	−0.35	−3.13	−9.60	3.32
Decision making	−0.14	−0.94	0.64	2.69	1.33	4.05	−2.14	−3.42	−0.86	−6.85	−15.27	1.55
Location	3.72	2.79	4.65	8.35	6.48	10.23	2.25	0.88	3.62	15.94	5.58	26.30
Owners_10-99	0.74	−0.35	1.83	2.00	0.92	3.09	−0.29	−2.03	1.45	10.86	−0.912	22.63
Owners_100-999	0.68	−0.25	1.61	−1.19	−2.01	−0.38	0.82	−0.69	2.35	0.09	−10.14	10.33
Owners_>1000	0.33	−0.85	1.52	0.60	−0.78	1.99	−0.14	−2.13	1.84	13.47	2.13	24.82
Renewables_33%	9.21	8.14	10.26	7.54	6.50	8.58	3.59	1.83	5.36	25.15	9.82	40.48
Renewables_66%	14.40	13.15	15.64	16.29	14.70	17.89	3.73	2.06	5.40	55.81	23.97	87.66
Renewables_100%	22.26	20.91	23.61	23.42	22.34	24.50	5.92	3.44	8.41	81.04	36.08	126.01

## 6. Discussion

Overall, our findings indicate that the most important attributes for respondents are Price and Renewables but lower WTP also exists for the governance attributes Transparency, Participation, and Location. The Owners attribute is not decisive; with respect to Decision Making, only members of Class 2 have a statistically significant higher WTP of about two Eurocents.

Coefficient signs and WTP values of the governance attributes are in line with the Transaction Cost Economics framework we have developed. Locally produced electricity may reduce information and enforcement costs. Consumers can more easily observe how their energy is produced, which creates trust. An alternative explanation may be distrust toward large IOFs. Participation possibilities are important as well. The implied user-owner identity can be a valuable mechanism to protect against market-power abuse by former monopolists. Likewise, price transparency is valued highly. Given the credence good characteristics of electricity, this mechanism can reduce information costs and quality uncertainty. It should be clear by now that cooperatives are inherently advantageous in this respect. Nonetheless, transparent pricing could be mimicked by non-cooperative electric utilities.

Democratic decision making is the only distinct cooperative governance mechanism included in our CE. In the basic model, it is not statistically significantly different from zero. In the LCL model, our results indicate a positive and statistically significant WTP only for Class 2, representing one fifth of the sample. For Class 1, representing half of the respondents, democratically controlled utilities seem actually *less* attractive. These respondents may perceive the *one member, one vote* principle as a disadvantage for several reasons. For instance, people in this group could be more sensitive to conflicts which may arise from democratic decision-making processes. They may also perceive such processes as inefficient, leading to (false) compromises built on (too broad) consensus. Ultimately, exploring the diverse motivations in greater detail is an important task for future research.

Of course, the negative effect of Decision Making in Class 1 does not imply that consumers pay less for electricity from cooperatives. WTP for the other typical cooperative attributes appear to outrank the rather small effects of Decision Making in Class 1. In Germany, electricity supply cooperatives are mainly engaged in the field of renewable energy. One important finding of our research is, thus, that price premiums paid for electricity from cooperatives can to a large extent be attributed to consumer WTP for renewable energies.

The extremely high WTP of up to 80 Eurocent per kWh may, however, also point toward some problems with the biased sample and the hypothetical setting respondents were placed in. WTP for Participation increases with age. But, as our sample is biased toward

the young, the average effect is likely over-estimated and can be corrected by using the respective coefficients provided in Table 4. The same applies to Green Party voters and people with experience in changing suppliers. Both variables interact with the coefficients of the renewable energy estimate, and respondents seem over-represented compared to the general population. Correcting for this observed heterogeneity would result in lower estimates for WTP for renewable energy.

Ultimately, it would be worth repeating the CE with a random sample of the general population or a consumer panel to control for unobserved heterogeneity and possibly derive more robust recommendations for utilities. Further, it may be useful to conduct the survey with members and customers of energy cooperatives as well as with those, who purchase renewable energy from investor-oriented firms. These results can then be compared to a control group. In our limited sample, consumer WTP for renewable energy is substantial, a result also found in other empirical studies, which we have supplemented by focusing on WTP for the *organization* of the retail electricity consumption process. In principle, utilities could adapt more transparent policies or engage in local production to attract additional customers or to set higher tariffs. But just how far companies are really willing to take consumer demands into account and what the particular costs of such reforms might be, require substantiation through further research.

## 7. Summary and conclusion

In this paper, we have investigated whether Cooperative Governance attributes contribute to greater WTP for electricity. From a theoretical perspective, we have argued that these attributes can solve contemporary electricity-market challenges. To address this question empirically, we conducted an online CE with a convenience sample of 287 respondents. Our results show that respondents have a particularly high WTP for renewable energies, but full price transparency, possibility to participate, and company proximity also increased their WTP. Although we find that supplier governance matters, we did not find strong evidence that respondents support democratic decision making as practiced in cooperatives. WTP varies substantially with age, income, past change of supplier and perception of market transparency. Using an LCL model, we have identified three classes of consumers, varying strongly in magnitude and direction of preferences.

Our results indicate that, for consumers, cooperatives are for the most part attractive for *what* they produce: electricity from renewable resources. To a smaller extent electricity is also valued for *how* it is produced: locally, democratically, and transparently. The recent boom of energy cooperatives in Germany cannot be explained by consumer *demand* alone. Cooperatives offer participation possibilities and scope for societal engagement on the *supply* side. Our research shows that renewable energy policies will have a relatively large impact on consumer welfare. In this regard, the planned reform of the Renewable Energy Act in Germany will play an important role. As part of the reform, it is envisaged to substantially lower feed-in-tariffs and to hinder small-scale local renewable energy supply concepts for instance [41]. Also, targets set for the share of renewable energies in the power mix are less ambitious. This will also affect cooperatives and, as profitability decreases, growth of the sector may slow down over the coming years. In contrast to the planned reform, support for locally produced electricity and transparency should be continued, as both aspects are valued by consumers.

Although consumers in Germany *do* play a role in the energy system, their role is mostly limited to creating additional demand

for renewable energies. Their importance in affecting the organization of the system seems to be relatively small. Whether governance characteristics can play a critical role on the production side requires further research. Looking at member cohesion, trust among members, social networks formed around cooperatives, and the question of scale and geographical proximity will be important parts of such an endeavor.

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