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Supplier choice and WTP for electricity attributes in an emerging market: the role of past experience, environmental concern and energy saving behavior

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SUPPLIER CHOICE AND WTP FOR ELECTRICITY ATTRIBUTES IN AN EMERGING MARKET: THE ROLE OF PAST EXPERIENCE, ENVIRONMENTAL CONCERN AND ENERGY SAVING BEHAVIOR

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ABSTRACT

In this study, we analyze customers' preferences and their willingness to pay for certain attributes of the electricity supply in a supplier-choice context and for an emerging market, recently deregulated, where limited competition exists. Specifically, a stated preference choice experiment (CE) is conducted in the Canary Islands' residential market. The results show that new companies could enter the market without having to improve significantly on the level of service provided by the current company. Furthermore, customers who are more satisfied with the service of their current supplier and older people are less likely to change company. Regarding the estimated willingness to pay (WTP), several results should be highlighted. First, customers who have experienced more serious outages in the past tend to show a higher WTP to reduce the outage frequency. Second, highly-educated respondents, those who state a great concern for the greenhouse gases (GHG) emissions and those who carry out energy saving actions in their homes exhibit a larger WTP for renewable energies. This empirical evidence is an important input in the design of a regulatory process to introduce competition, as well as providing useful planning information for authorities charged with designing energy policy.

KEY WORDS

Choice experiments, willingness to pay, mixed logit, emerging market, renewable energy

JEL CLASSIFICATION

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1. INTRODUCTION

With the enactment of Law 54/1997 on the Electrical Sector (LSE), Spain's electricity industry started a transition from a traditional regulatory regime to one that introduced competition in both generation and supply activities in the retail market. As happened in other countries, however, there has been no significant development of the retail market for residential customers.[1] In December 2010, only 18.1% of domestic supply outlets, representing 27.5% of electricity consumption, were supplied through the free market. A large majority of users, thus, remain in the regulated market. Moreover, the electricity suppliers, in an effort to attract new clients or keep existing ones, began to offer a series of complementary services or attributes in the supply of electricity, such as the joint sale of gas, various insurance offers, energy consulting, etc.

At the same time, several governments have started to include renewable energy on their public policy agenda. Recent initiatives, like the EU's 20-20-20 plan, have led many countries, including Spain, to establish as one of their main goals an increase in the share of renewable energy in electricity generation to reduce greenhouse gases (GHG) emissions.

In this context, the knowledge of customers' preferences and of their willingness to pay (WTP) for the attributes that characterize the electricity supply is crucial to evaluate the chances of attaining a greater degree of competition in the retail market, and to design energy policies to achieve different goals, such as energy efficiency improvements, green energy penetration, etc. Furthermore, the WTP allows for the analysis of the market sustainability of governments' goals in renewable energy generation.

[1] This measure, first tested in Norway, then in Britain, was applied in all countries of the European Union, in some US states, in Australia, and in New Zealand. However, the current situation of retail electricity markets reveals that the expected results did not always materialize. To date, the proportion of active consumers is rather limited in many countries [see Defeuilley (2009)].

Various studies have used choice experiments (CE) to analyze residential customers' preferences for their electricity supplier by household. Notable among these are the ones by Cai et al. (1998), Revelt and Train (1998), Goett et al. (2000), and more recently Abdullah and Mariel (2010) in the context of developing countries, and Muñuzuri et al. (2009) for the case of Spain. The advantage of CEs is that they allow for a consideration of service attributes that are either not currently available on the market or whose degree of variability on the market is insufficient to allow for estimation. The most frequently analyzed attributes include type of pricing, type of supplier, reliability, amount of renewables, length of contract, etc.

Empirical research shows that preferences for service attributes vary considerably among customers, which could allow the entry of new electricity suppliers into the retail market if existing ones do not offer the entire range of preferences desired (Goett et al., 2000). Abdullah and Mariel (2010) identify substantial heterogeneity among households with regard to socio-economic and demographic variables. Reliability is one of the attributes most valued by customers (Carlsson and Martinson (2007, 2008). Regarding the type of supplier, Goett et al. (2000) finds that a company specialized in energy but unfamiliar to customers is viewed as being worse than a company not specialized in energy but familiar to customers. Recent studies have also shown that the share of renewable energy is becoming increasingly important to consumers (Borchers et al., 2007; Yoo and Kwak, 2009), confirming that consumers are effectively willing to pay more for the presence of this kind of energy. However, it is shown that this willingness is not always sufficient to cover the required costs of reaching the targets set by energy authorities [Bollino, 2009 and Scarpa and Willis, 2010].

There are reasons to suggest that preferences, and therefore WTP, can be influenced by additional factors. Cameron and Englin (1997) found evidence that WTP for environmental resources is systematically related to respondents' own experience with the good in question, where experience is interpreted as the number of years in which an individual has been a user of that resource. In the current context, the experience as client of a company and level of attributes experienced in the past (e.g. the importance of power outages suffered at home) could be aspects that need to be considered when investigating preferences. Accordingly, Carlsson et al. (2011) found that experience of a power outage due to a big storm results in a significantly lower WTP to avoid power outages.

Other studies have shown that factors, such as lifestyle and awareness of environmental problems, can affect the criteria for energy consumption and result in greater WTP (see, for example, Brandon and Lewis, 1999). Analyzing this line of argument in greater depth raises the question of whether the value given to renewable energies is related to household characteristics that are easily observable, such as energy-saving habits (e.g. the use of low energy consumption bulbs and domestic appliances, etc.), or to the level of concern about the environment. Knowing the influence of these factors on WTP will enable the assessment of the potential impact that fine-tuning policies related to the use of renewable energies, such as environmental awareness campaigns, might have.

This study analyzes consumer preferences and their WTP for certain service attributes of electricity in a context of choosing the electricity supplier in the retail market. In particular, the work focuses on the preferences for company type, the reliability of the service, the use of renewable energies and the availability of a complementary energy audit service for residential customers.[2] In addition, unlike previous studies on this subject, we analyze preferences by company type considering, firstly, how customers evaluate their past experience with the current company and, secondly, how customers rate the service

[2] As will be seen in section 2, a focus group was used to select the attributes to include in the experiment.

provided by new companies. The paper also studies the degree to which the assessment of the reliability supply depends on the customers' past experience and, more precisely, on the importance they give to the last outage they experienced in their homes. Finally, it assesses the extent to which households that declare having taken measures to save electricity and have a greater concern for GHG emissions, are willing to pay for the introduction of renewable energies.

To achieve the objectives proposed in the previous paragraph, a stated preference electricity supplier company CE was conducted. In the experiment design, the customers were asked to choose between two hypothetical companies that differed in terms of their attributes, or the option to stay with their current supplier. The information on the level of satisfaction, outage past experience, saving energy behavior and environmental concern were measured by using a set of rating-scale questions that were included in the questionnaire.

The choice scenarios were generated using an efficient design (Huber and Zwerina, 1996). To our knowledge, this novel technique has not been applied in this area until the recent work by Scarpa and Willis (2010). Additionally, in an effort to increase the realism of the experiment, both labeled choice tasks and a reference alternative have been included in the design. To the authors' knowledge, this is the first time such an experimental design is employed to analyze energy demand.

The experiment was conducted in the Canary Islands (Spain). The Canary Islands show two specific characteristics arising from its status as a small and isolated electricity system, which makes its choice for this study, even more relevant. First, there is almost no competition in the wholesale and retail market due to the system size and the vertical integration of the industry.[3] Second, local laws are keenly aware of environmental issues since the territory is limited (over 50% of the territory of the Canary Islands consists of protected natural spaces) and the main economic industry is tourism (35% of GDP). This information is useful for similar emerging market situations and to compare with those territories where competition is at a more advanced stage.[4] In addition, it will be interesting to test whether the abovementioned circumstances imply a higher WTP for renewable energies.

The econometric model used is a mixed logit panel with error components with a focus on capturing systematic heterogeneity in the preferences. This model takes into account the panel correlation inherent in the data, the correlation between the experiment's hypothetical alternatives and the presence of random heterogeneity in the preferences. The effect of some specific factors analyzed in this work (e.g. environmental concern) is considered by introducing interactive covariates with rating-scale variables into the specification for the deterministic component of utility. The results obtained in this study highlight the importance of accounting for the customers' past experience, their electricity consumption patterns and their awareness of environmental issues when attempting to more accurately characterize the distribution of the population's WTP.

The rest of the paper is structured as follows. In the next section, we describe the experiment of stated preferences. In Section 3, we present the microeconomic bases and the econometric formulations, while in Section 4 we provide a brief, descriptive analysis of the data used. Section 5 shows the results of the different models estimated

[3] Most of the residential market (96%) is served by a company that belongs to the monopoly that was in place before deregulation. Until now, only a few companies have begun to compete effectively with the current supplier. For a more detailed analysis of the specific features of the market in the Canary Islands, see Pérez and Ramos-Real (2008).

[4] Emerging refers to a market in transition from a traditional integrated and monopolistic one to a competitive deregulated one.

and discusses the results. In Section 6, we present the willingness to pay for various attributes and compare this to findings for international markets. Finally, we offer the main conclusions drawn in this paper.

2. THE STATED PREFERENCES EXPERIMENT

A common practice for determining WTP is to use contingent valuation methods. However, there is some controversy regarding the use of this method and its ability to find a reliable WTP, especially when applied to situations where multiple options and attributes are considered (Diamond and Hausman, 1994). Choice experiments also rely on stated preferences and involve hypothetical choice contexts in which survey respondents implicitly reveal their valuations of different attributes. This method offers certain advantages over contingent valuation, particularly when it is necessary to obtain the values of the characteristics that describe a resource or service, rather than valuing the overall resource or service (Hanley et al., 1998). In this study, we opted to design an experiment in which residential customers must choose an electricity supplier.

A preliminary phase in the design involved a focus group to select the attributes to include in the experiment. Subsequently, a pilot survey was conducted among 73 individuals to test the questionnaire and its wording, sequence and format on a larger and more heterogeneous group of individuals than those comprising the initial focus group. With the sample obtained from the pilot survey, preliminary multinomial logit models were estimated. As a result of this process, the most relevant attributes and the parameters associated with each one of them were identified. The resulting estimated parameters allowed us to recover the prior parameter used in the design of the choice experiment. The most relevant attributes were cost, reliability of the electricity supply, use of green energy and availability of a complementary energy audit service.[5]

The attributes were quantified based on criteria similar to those in recent research in this area. Specifically, the cost is measured as the monthly electricity expenditure [see, for instance, Bollino (2009) and Nomura and Akai (2004)]. Following the approach adopted by Morrison and Nalder (2009), the reliability of the service was characterized by two indicators: the number of non-scheduled outages occurring in a year (*Outfreq*) and their average duration (*Outdur*). The company's involvement with sustainable development is measured through the share of renewable energies employed in the generation of electricity (*Renewables*). This is the same measure used by most authors [recently Borchers et al. (2007) and Yoo and Kwak (2009)]. Lastly, a dummy variable was defined (*Audit*) to indicate whether the company offers a shared savings energy audit service. This attribute has already been addressed in some studies, as in Goett, Hudson and Train (2000) and Grosch and Vance (2009). We opted for a definition similar to that used in the former, in which the energy audit and the installation of the recommended equipment is free and the savings are shared 50/50.

Likewise, in order to increase the realism and make the hypothetical choices more familiar, a *reference* or *pivot alternative* was included in the experimental design (Rose et al., 2008). This allows us to adapt the levels of the attributes to the survey respondent's current experience. Thus, the level of the attributes shown to the respondents in each choice situation is defined by pivoting around the levels in their reference alternative, considering absolute or relative variations.

[5] Though the focus group also identified the existence of a personalized customer service office as a relevant attribute when choosing the suppliers, the subsequent pilot survey showed that the availability of this complementary service does not have a significant effect on the choice.

In this paper, we chose the current supplier as the pivot alternative. The levels of the attributes for this alternative were calculated as follows. The cost corresponds to the average monthly electricity expenditure as reported by the respondent. The percentage of electricity produced with renewable energy sources was obtained from the Estadísticas Energéticas de Canarias (2007). The number of outages per year and their average duration were derived from information available provided by current supplier and from conversations with its staff.[6] Given the impossibility of accessing individual information for each household, the current levels of these variables were assumed to be four, non-scheduled outages a year lasting 15 minutes each for all households. Finally, given that the current supplier does not offer an energy audit service, *Audit* takes the value of 0. Attribute levels for alternative suppliers are shown in Table 1.

Table 1. Attributes and their levels for the choice experiment

Acronym	Attributes	Levels	Current supplier	Alternative suppliers		
				Level 0	Level 1	Level 2
Cost	Monthly household electricity bill in €	3	Reported average	-15%	0%	+15%
Outfreq	Number of outages per year	3	4	2	4	6
Outdur	Outages average length in minutes	3	15	5	15	30
Renewables%	Electricity generated from renewable energies (%)	3	3.5	3.5	15	30
Audit	Energy audit	2	No	Yes	No	-

Labels are used in this experiment to characterize each of the suppliers since our goal, among others, is to assess the degree of acceptance that the establishment of new companies would have.[7] Likewise, it is necessary to distinguish among companies inside and outside the electricity industry. As a result, the choice set consists of three

[6] This value was obtained from the quality index known as TIEPI (equivalent outage time of the installed power).

[7] As noted by some authors, the use of labels increases the realism of the experiment (Hensher et al., 2005) and ensures the responses will better reflect the emotional context in which preferences are ultimately revealed (Blamey et al., 2000).

alternatives: (i) the company that currently supplies electricity (the current supplier)[8]; (ii) a supplier belonging to another electric company; and (iii) a supplier that belongs to a non-electric company with good reputation among customers.

Lastly, an efficient design was used in order to generate the choice situations, i.e. a design that is constructed for the purpose of minimizing the standard error of the coefficients to be estimated (see Huber and Zwerina, 1996; Kanninen, 2002; Sándor and Wedel, 2002). Specifically, we built a design that minimizes the D_p*-error*, which is an efficiency measure that can be used when *a priori* information is available on the value of the parameters (Carlsson and Martinsson, 2002, and Huber and Zwerina, 1996). In this case, the *a priori* values for the parameters were obtained from the previously conducted pilot experiment.[9] Due to the difficulty of knowing in advance the final model specification, we opted to generate an efficient design for a logit multinomial model with a linear-in-parameters specification of the utility function. The design is homogeneous for all the individuals, each of them facing nine choice situations, and was generated using the *N-gene* program (ChoiceMetrics, 2010), setting one million iterations.

The choice experiment includes various rating scale items (0 to 10). In the first one, *Current-rate*, individuals assess the service provided by their current supplier. In the next two items, *Elec_rate* and *Nonelec_rate*, individuals rate the service that was provided by another electric supplier or by a non-electric company.[10] In the next item, respondents rate the importance of the last outage experienced (*Outimp*) with the aim of

[8] At the time of the survey (12/2010), practically all households in the Canary Islands had their electricity supplied by Endesa Energía XXI, S.L., a supplier that belongs to the former monopoly.

[9] This pilot experiment also relied on an efficient design in which the pre-existing parameter values were set such that the resulting WTP was consistent with those yielded by similar studies.

[10] These items account for the effect on preferences of aspects such as satisfaction with the current service and, in the case of other companies, of customers' expectations regarding the quality of the service that said companies would provide.

analyzing whether those who endured outages with significant consequences exhibit a greater WTP to avoid future occurrences. Several items were also included to determine whether respondents would engage in certain behavior to save electricity. Specifically, we asked about (i) the use of power strips for various electrical appliances (*Strips*), (ii) the use of low-consumption bulbs (*LC-Bulbs*), (iii) the use of Class A appliances (C*lass A*) and (iv) avoiding having unnecessary lights on (*Avlights*). Finally, respondents were asked to indicate how concerned they are about GHG emissions due to electricity generation (*Concern*).[11]

3. Microeconomic bases and econometric formulations

The analysis of the preferences for electric suppliers was based on random utility discrete choice models (McFadden, 1981). According to this approach, individuals are rational and choose the option that maximizes utility. As the analyst is not aware of all the attributes and individual tastes that govern behaviour and as there are also measurement errors involved, the utility of alternative i for household q (U_{iq}) is viewed as a stochastic variable made up of the sum of a deterministic component V_{iq} and a random term, ε_{iq}. In fact, U_{iq} is a *conditional indirect utility function* (CIUF) and V_{iq} is usually a linear function in both attributes and parameters as in the following expression (Hanemann, 2001; Jara-Díaz, 2007):

$$U_{iq} = V_{iq} + \varepsilon_{iq} = ASC_i + \lambda(I_q - c_{iq}) + \beta' x_{iq} + \varepsilon_{iq} \qquad i = 1,...,M_q \tag{1}$$

where ASC_i is an alternative specific constant which represents the intrinsic preference for alternative i, x_{iq} is a K-dimension column vector of observed attributes or level-of-service variables affecting the utility of individual q for alternative i, β is a corresponding column vector of coefficients, c_{iq} is the cost associated with the

[11] The purpose of including these final items was to determine whether those individuals who follow energy saving guidelines and exhibit a concern for GHG emissions show a greater WTP for renewable energies.

alternative i, I_q is income, λ is the *marginal utility of income* (*MUI*)[12] and M_q the number of mutually exclusive alternatives that belongs to individual q's choice set.

Because of the linearity of residual income in the CIUF, the *marginal utility of income* (MUI) is equal to minus the cost coefficient, i.e. $\lambda = -\beta_c$. As a consequence, the *marginal willingness to pay* (MWTP) for an attribute is simply given by the ratio between the estimated attribute's coefficient and *MUI*. That is,

$$MWTP_k = \frac{\hat{\beta}_k}{\hat{\lambda}} = -\frac{\hat{\beta}_k}{\hat{\beta}_c} \tag{2}$$

In discrete choice models the test for income effect is whether the probability that an individual will choose an alternative depends on her income level (Daly, 2004). In that case, MUI is expected to decrease (and thus MTWP to increase) with individual's income level.[13] To account for the income effect we need to consider a more general dependence of CIUF on income than that given in (1); for instance, a nonlinear function of residual income or a function of residual income that varies by alternative (McFadden, 1999). Jara-Díaz and Videla, (1989) postulated a simple test to detect the presence of this effect in mode choice, and consists of estimating a model with a cost-squared variable in the utility specification for each alternative.[14] Since a significant cost squared term indicates that the cost parameter depends on the income level, Jara-Díaz and Guerra (2003) argued that an alternative way to account for income effect can be to specify an income dependent coefficient for cost. In order to do this while avoiding sample segmentation, we specify interactions between the cost coefficient and

[12] Note that the choice of a specification such as this implies assuming that the marginal utility of income is constant and common for every alternative.

[13] The existence of an income effect has rarely been taken into account in the context of studies aimed at deriving MWTP measures in the field of energy economics. However, its consideration could be particularly relevant when individuals spend a substantial part of their income on electricity, as might be the case for many socio-economic groups, particularly in less developed areas.

[14] See Ortúzar and González (2002) for an application of this method.

income stratum dummies as is suggested, for instance, in Amador et al. (2008).[15]

In order to account for the heterogeneity of the preferences, the model can be extended so that the coefficient vectors ASC_{iq} and β_q in equation (1) are also being q indexed. Following the general approach suggested by Bhat (2001) and Bhat and Gossen (2004), we allow the alternative specific constant ASC_{iq} to vary across individuals due to observed and unobserved heterogeneity. To do this we specify ASC_{iq} as a function of both an observed L-dimension vector s_q of individual characteristics and a random term γ_{iq} normally distributed across individuals:

$$ASC_{iq} = \alpha_i + \kappa_i' s_q + \gamma_{iq} \tag{3}$$

where κ_i is a *(Lx1)*-column vector with the sum $(\alpha_i + \sum_l \kappa_{il} s_{ql})$ being the average effect of unobserved variables on the utility associated with alternative i for individual q who exhibits s_q observed characteristics. γ_{iq} is an element capturing individual q's differential preference for alternative i compared to the average preference of other individuals with the same observed characteristics. Thus, the individual-specific γ_{iq} terms allow for unobserved heterogeneity across individuals in the intrinsic preference for each alternative.

Analogously, we allow for heterogeneity (across individuals) in response to level-of-service changes by specifying the level-of-service coefficient β_{qk} associated with the kth level-of-service attribute also as a function of both an observed P-dimension vector

[15] We note that some authors have attempted to test what they call the internal validity of the responses, which refers to whether WTP grows with income (see Longo et al., 2008). To test this hypothesis, they suggest introducing direct interactions between the income level and the utility's attributes. This method for incorporating income into the model, However, is not microeconomically consistent with the decrease in the marginal utility of income.

r_{qk} of individual characteristics associated with the preference for alternative k and a random term η_{qk} normally distributed across individuals:

$$\beta_{qk} = \beta_k + \psi'_k r_{qk} + \eta_{qk} \tag{4}$$

where the sum $(\beta_k + \sum_p \psi_{pk} r_{pqk})$ is the average marginal utility of attribute k for individual q with r_{qk} observed characteristics. Similarly, η_{qk} provides for unobserved heterogeneity across individuals in the attributes' preferences by capturing individual q's differential preference for attribute k as compared to the average preference of other individuals with the same observed characteristics.

Modeling the choice probability of the different alternatives requires making an assumption regarding the probability distribution of the random terms ε_{iq}. As is well known, if the error components are assumed to be independently and identically distributed (iid) according to a type-1 extreme value distribution, this yields a *conditional logit* (CL) model (McFadden, 1974).

A known property of the CL model is the independence of irrelevant alternatives (IIA). Nevertheless, when individuals are faced with a choice experiment in which one of the alternatives available coincides with their current choice, there are arguments to be made for considering a correlation among the remaining alternatives.[16] Precisely to take into account the possible correlation between alternatives, and also to account for the pseudo-panel data inherent to the stated preference experiments, it is possible to use a *panel mixed logit specification with error components* (PML-EC), as suggested in

[16] One such argument suggests that individuals choose sequentially, first deciding whether to change suppliers or not, and only if they decide to change then choice among the remaining companies available (Samuelson and Zeckhauser, 1988). Another argument is that the aforementioned correlation could result from the fact that the alternative companies share that both are hypothetical and have not been experienced by the individual.

Brownstone and Train (1999). To do this, the error term ε_{qit} may be partitioned into two components, ζ_{iqt} and $\mu' z_{iqt}$.[17] The result of this specification is an analog to the nested logit model with covariance among alternatives in a group, but heteroscedasticity across the groups of alternatives.

Using Eq. (3) and (4) and the error-component specification for ε_{qit} discussed above, Eq. (1) may be rewritten as:

$$U_{iqt} = (\alpha_i + \kappa_i' s_q) y_i + (\theta + \psi' r_q + \eta_q)' x_{iqt} + \gamma_{iq} y_i + \mu' z_{iqt} + \zeta_{iqt} \qquad (5)$$

where y_i is a *(I x 1)*-column vector of 1's and 0's with a 1 in row *i* and 0 in other rows. In the PML-EC specification used in this paper we assume that the elements in each of the random vectors, $\gamma_q = (\gamma_{1q}, ..., \gamma_{Iq})$ and $\eta_q = (\eta_{q1}, ..., \eta_{qK})$, are independent of both the elements in that vector and the elements in other vector. The vector of true parameters characterizing the mean and variance-covariance matrix of the coefficients vectors ASC_{iq}, β_q and μ can be estimated using the method of maximum simulated likelihood (Train, 2003). In our estimation we used BIOGEME (Bierlaire, 2003) and the CFSQP algorithm (Lawrence et al., 1997) so as to avoid the problem of local optima. Each individual's choice probability was simulated using 500 quasi-random draws via Latin-hypercube sampling (Hess et al., 2006).

4. DATA

The study focused on households with a maximum electricity power up to 10 kW. The data were gathered by trained interviewers using the computer-aided personal interview

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[17] The first component is assumed to be independently and identically extreme value type I (EV1) distributed across alternatives and choice occasions. The second component in the error term induces heteroscedasticity and correlation across unobserved utility components of the alternatives at any choice occasion *t*. z_{iqt} is specified to be a column vector of dimension *M* with each row representing a group *m* *(m=1,2,…,M)* of alternatives sharing common unobserved components. The row(s) corresponding to the group(s) of which *i* is a member take(s) a value of one and other rows take a value of 0. The μ (of dimension *M*) may be specified to have independent elements normally distributed, each element having zero mean and a variance component σ^2_m.

technique and the Sawtooth SSIWeb 6.6.8 software, which allowed us to personalize the survey to each individual. A total of 376 valid surveys were obtained from a stratified random sample of households on the island of Tenerife (Canary Islands, Spain) between November and December 2010. The sample was chosen to reflect the age, gender, household type, activity type and income levels on the island. Each individual was presented with 9 choice scenarios, resulting in a total of 3384 observations.

Table 2 show a summary statistics for the variables introduced in the model specification, including several dummy variables. The data show that the distribution by gender is homogeneous, with 185 men (49.2%) and 191 women (50.8%). The average respondent was in the 41 to 50 age range (28.72%), had secondary or vocational training (34.57%), was employed by someone else (63.8%) and had a monthly family income of between 1,000 and 2,000 euros (39.89%). The average household monthly electricity expenditure was €49.18.

Table 2 also shows information on the 0 to 10 rating scale questions. The company that obtained the highest average score was the current supplier, followed by another electric company and finally a non-electric company. On average the respondents stated not having experienced significant damage from outages.

In relation to the variables involved in saving electricity, the most common practice was to avoid leaving lights on, followed by the use of low-consumption bulbs, the use of class A appliances and finally the use of power strips to avoid leaving devices on standby. Likewise, to synthetize the information on energy saving actions into a global index, the variable *EnerSav* was defined as measuring the average score of the preceding four actions. The average score obtained for greenhouse gas emissions highlights the respondents' high level of concern for this type of externality.

Table 2 Variables used in models: descriptive statistics

Acronym	Description	Sample mean	Median	Std dev	Min	Max
Cost	Monthly electricity bill (euros)	49.18	45	25.74	8	220
Age		41.65	41	12.89	20	84
Education	Highest education level (Categorical)[a]	3.28	3	1.35	1	6
Occupation	Categorical[b]	2.06	1	1.68	1	6
Hinc	Monthly household net income . (Categorical)[c]	2.68	2	1.27	1	7
D_MidHinc	1 if Hinc = 3; 0 otherwise	0.63	1	0.48	0	1
D_HighHinc	1 if Hinc > 3; 0 otherwise	0.23	0	0.42	0	1
D_College	1 if has a college degree; 0 otherwise	0.40	0	0.49	0	1
D_Male	1 if male; 0 otherwise	0.49	1	0.50	0	1
Outimp	Last outage importance (0=not important ; 10=very important)	5.76	6	3.21	0	10
Current_rate	Current company rate (0=very low; 10= very high)	5.46	5	2.06	0	10
Elec_rate	Electric company rate (0=very bad; 10= very good)	4.84	5	2.61	0	10
NonElec_rate	Non-electric company rate (0=very low; 10= very high)	3.81	5	2.71	0	10
Concern	Concerned about GHG emissions due to electricity generation (0=not concerned; 10=very concerned)	8.94	10	1.67	0	10
LC-lamps	Low consumption lamps usage (0=never , 10=always)	6.59	7	3.29	0	10
Strip	Use of strip (0=never , 10=always)	5.77	6	3.35	0	10
A-appliances	Energy-efficient appliances label A usage (0=never , 10=always)	6.34	7	3.60	0	10
Avlights	Avoid unnecessary lights on (0=never , 10=always)	8.82	10	1.87	0	10
EnerSav	Bulbs, strip, class A and lights, global average rating	6.88	7	1.91	1	10

[a] 1=primary; 2=secondary; 3 =vocational; 4 3-yr degree; 5-yr degree; 6 graduate No Studies or Primary School, Vocational school, Secondary school complete or partial or similar, Undergrad college tech school or similar, Graduate Studies or similar
[b] 1=Employee; 2=Self-employed ; 3=Housekeeper; 4=Student; 5=Unemployed; 6=Retired
[c] 1: 0 – 1,000; 2: 1,001 – 2,000; 3: 2,001 – 3,000; 4: 3,001 – 4,000, 5: 4,001 – 5,000; 6: 5,001 – 6,000; 7: more than 6,000 €

5. Empirical application.

The main hypotheses tested in this study are summarized in Table 3.

Table 3: Hypotheses tested with our model

Hypothesis	Description
I	The preferences regarding the type of supplier and the service attributes vary systematically with the users' socio-economic characteristics.
II	There is an income effect that explains higher income households exhibit a greater MWTP.
III	The importance of past outages influence the MWTP for reducing the number of outages.
IV	The preferences for renewable energies are related to energy saving behavior and to environmental concern stated by the respondents.
V	Each company's rating has a positive effect on its choice probability.
VI	The preferences for the type of supplier and for the service attributes vary among the customers due to non-observable factors.

Table 4 shows the results of the models estimated. First, a simple fixed parameter conditional logit (*CL*) model including only the level-of-service attribute variables is estimated in order to provide an initial insight into the analyzed data. All attributes are specified with generic parameters, and alternative specific constants (*ASCs*) for each type of company are also included, except for the current supplier which is taken as a reference.

The results obtained for the CL model indicate that all estimated coefficients are significant at the 1% level. The cost coefficient is negative, as expected. Respondents preferred fewer outages of shorter duration, as indicated by the negative sign for the outage frequency and duration coefficients. Moreover, the respondents value both the use of renewable energies and the availability of an energy audit service positively, as evidenced by the positive sign of the coefficients for these attributes. The ASCs for the two alternative suppliers are significant and have a negative sign, which is indicative of a systematic relative preference among respondents for the current supplier.

Secondly, as an intermediate step to detect the presence of systematic heterogeneity in the preferences (Hypothesis I), whether due to service attributes or to the type of supplier, different specifications of the CL models were estimated by introducing interactions between the ASCs, the service attributes and the different socio-economic, rating and dummy variables listed in Table 2. The CL-SE model includes only the significant interactive covariates. Its results are shown in table 4. Based on the adjusted rho-square, the overall fit of this model is much better in comparison to the model without interactions.

The specification finally proposed to contrast the different hypotheses is a panel mixed logit model with a normal *iid* error component, with zero mean and the variance to be estimated, which is introduced in the utility of the two hypothetical electricity suppliers (PML-EC).[18] This model allows for testing heterogeneity around the mean of the distribution random parameter distribution by estimating their standard deviations in addition to the interactive covariates.

We have postulated a normal distribution for the *ASC*s and the attribute parameters, except for the cost parameter.[19] Assuming a fixed coefficient of the cost variable is consistent with previous applications of this model (e.g. Revelt and Train, 1998; Morrison and Nalder, 2009; Hensher et al., 2005).

The results for the interactive covariates between socioeconomic variables and ASCs suggest the existence of systematic heterogeneity in the preferences in keeping with the respondents' socio-economic characteristics (Hypothesis I). Specifically, we find that

[18] When the error components were introduced, we also tested the two other possible combinations, which imply introducing the error component in the current supplier and in one of the alternative suppliers, but the gain in the goodness of the fit was significantly lower in both cases.

[19] Distributing the cost coefficient using a normal distribution is likely to be inappropriate as it may imply that some respondents have a positively signed cost coefficient. Moreover, some authors (Ruud, 1996) suggest that a model specification with all random coefficients can be empirically unidentified.

the age factor has a negative influence on the probability of switching suppliers, since the generic coefficient estimated for the interactions between age and the ASC of the alternative companies is negative and significant. Likewise, the strength of the preference for renewable energies increases with the level of education.

All of the standard deviations estimated are statistically significant, which confirms the existence of random heterogeneity in addition to the systematic heterogeneity accounted for by the interactive covariates. This result provides evidence in favor of Hypothesis IV. In addition, the parameter σ, which denotes the standard deviation of the normal error term component, is statistically significant at individual level. The considerable increase in the value of the adjusted rho square confirms that the introduction of random parameters and of an error component, along with the panel correlation assumption, yields a significant improvement in the goodness of the fit. As a result, the PML-EC model was chosen to characterize consumer preferences, to contrast the study's various hypotheses and also to calculate the MWTPs presented in the next section.

The sign and magnitude of the coefficients associated with the interactions between cost and income dummy variables imply customers perceive a marginal price increase to be more onerous when their income is low than when their income is high, that is, they confirm that the marginal utility of income is decreasing.[20] This result provides evidence in favor of Hypothesis II. Likewise, for Hypothesis III, there is evidence of the effect of past experiences on the preferences for outage frequency. The significant and negative coefficient of the interaction term between outage frequency and the *Outimp* variable indicates that an increase in outage frequency results in a greater disutility to

[20] The presence of the income effect was contrasted previously by following the method suggested in Jara-Díaz and Videla (1989). The results of the model that includes the cost squared in its specification are not shown due to space constraints, but are available upon request.

the individuals who bestow a greater importance on the outages endured in the previous year.

The results for the interactive covariates with *Renewable* yield several findings. First, respondents with a college degree, *ceteris paribus*, exhibit a greater preference for renewable energy. Second, the positive sign of the interaction term with *EnerSav* suggests that the most energy thrifty individuals associate greater utility with renewable energy. Third, individuals who attach greater importance on greenhouse gas emissions, ceteris paribus, prefer renewable energy. These last two results confirm Hypothesis IV. Finally, customers differ in their attitudes toward renewables based on unobserved factors (Hypothesis VI). According to the estimated standard deviation for the *Renewables* coefficient, the share of customers that have a positive valuation of the use of renewables in the generation of electricity accounts for 96% of consumers.[21]

Regarding energy audits, the positive sign of the coefficient estimated for the dummy *Audit* confirms that the offer of this complementary service increases the attractiveness of a given supplier. The significance of the standard deviation of this coefficient implies that the preference for this service varies among the population according to unobserved factors. Nevertheless, the distribution of the coefficient reveals that the share of customers placing a positive value on the audits is greater than 99%.

[21] The marginal utility of *Renewables* was simulated 10.000 times for each individual in the sample. This was done by considering the rating of each item involved with renewables as assigned by each individual. Random extractions are then taken of the *Renewables* coefficient based on its estimated distribution in the population. A similar method was used with the ASCs and the marginal utilities of the remaining attributes in order to calculate the share of customers who view a service attribute positively or negatively.

Table 4. Estimated models

	Variables	CL		CL-SE		PML-EC	
		Coef.	Robust t-stat	Coef.	Robust t-stat	Coef.	Robust t-stat
Supplier type intrinsec preference	*Alternative specific constants (ASC)*						
	Electric	-0.144	-2.41	1.580	7.59	2.64	4.53
	Non-electric	-0.63	-9.22	0.869	4.03	1.37	2.3
	Heterogeneity in ASC						
	Current*Current_rate	-	-	0.238	10.84	0.446	6.32
	Electric*Elec_rate	-	-	0.101	6.43	0.22	5.2
	Non-electric*NonElec_rate	-	-	0.159	9.33	0.31	6.36
	Age (Electric,Non-electric)	-	-	-0.016	-5.3	-0.0199	-2.12
	Standard deviation of normally distributed ASC						
	Current	-	-	-	-	0.865	3.57
	Electric	-	-	-	-	0.808	3.74
	Non-electric	-	-	-	-	1.09	6.36
Response to level-of-service-measures	*Level-of-service parameters*						
	Cost	-0.104	-15.8	-0.1620	-16.7	-0.303	-9.9
	Outages per year	-0.169	-9.24	-0.1170	-3.23	-0.201	-2.4
	Outages average duration	-0.0134	-5.1	-0.0170	-6.17	-0.035	-6.57
	Renewables%	0.0412	18.85	-0.0636	-4.64	-0.109	-3.23
	Audit	0.239	5.04	0.2490	5.05	0.291	3.6
	Heterogeneity in parameters						
	Cost * D_MedHinc	-	-	0.0517	3.93	0.109	2.85
	Cost * D_HighHinc	-	-	0.0909	7.83	0.15	4.38
	Outages per year * Outimp	-	-	-0.0124	-2.79	-0.0264	-2.5
	Renewables * EnerSav	-	-	0.0023	2.36	0.00562	1.92
	Renewables * D_Graduate	-	-	0.0190	5.11	0.0306	2.64
	Renewables * Concern	-	-	0.0082	6.57	0.0126	3.86
	Standard deviation of normally distributed parameters						
	Outages per year	-	-	-	-	0.49	9.74
	Outages average duration	-	-	-	-	0.0606	8.84
	Renewables	-	-	-	-	0.0804	9.11
	Audit	-	-	-	-	0.877	5.59
Error component	σ	-	-	-	-	1.76	5.42
	Number of observations	3384		3384		3384	
	Final log-likelihood:	-3287.829		-3029.883		-2540.954	
	Likelihood ratio test:	859.749		1375.643		2353.501	
	Rho-square:	0.116		0.185		0.317	
	Adjusted rho-square	0.114		0.18		0.31	

The coefficients estimated for the interaction between the ASCs and each company's rating are all significant and positive, with each company's rating having a positive influence on its selection (Hypothesis V). In addition, the significance of the standard deviations of the ASC confirms the existence of heterogeneity in the preferences for the type of supplier that cannot be correlated to the respondent's age or to each company's rating (Hypothesis VI).

Given the heterogeneity in the mean of the random ASCs, and in order to comment on the results on the relative preference for the type of supplier, we calculated the percentage of customers who prefer each company type by taking into account the standard deviation estimated for the ASCs, as well as the individual ratings of the different companies by the age of the consumers. The results reveal that, *ceteris paribus*, 50.7% prefer their current supplier, 40.1% another company in the industry and only 9.2% prefer a company from another industry. Therefore, we may conclude that other electric utilities could successfully enter the market even if these companies did not significantly improve the level of service provided by the current company and/or offer some complementary service.

Analyzing the influence of each company's rating on the preferences by supplier type, it is observed that among customers who rate their current company with a 7 or higher (30% of consumers), most (63%) show a relative preference for their current company. This indicates that households who are more satisfied with the service of their current supplier are more likely not to change company, as expected (Hypothesis V). Moreover, the effect of the rating of the hypothetical companies on the preference for each company type is also positive, as evidenced by the parameters estimated for the *Electric*Elec-rate* and *Non-electric*NonElec-rate* interactions. One possible interpretation of this result is that high expectations for a company's level of service result into a greater probability of choosing that company. We find, however, that among customers who rate another electric supplier highly (with 7 or more, as did 27% of consumers), 44% prefer their current company. This, therefore, supports the fact that having individuals rate a company different from their current supplier highly is not a sufficient condition for showing a relative preference for it, something that could reflect the existence of brand loyalty to the current company and/or significant costs[22] to switch suppliers (Chen and Hitt, 2002).

Regarding the negative influence of age on the likelihood of switching suppliers, we find that if each company's rating is set to the average, individuals over the age of 51 prefer their current company. This result would validate Hypothesis I and could be due to the fact that the effects of brand loyalty to one's current company and/or the perceived switching costs increase with the age of the consumer.

6. Willingness to pay

6.1. Estimated Marginal Willingness to Pay (MWTP)

The estimated MWTP is obtained from expression (2) and by taking into account the interactions with both socio-economic and rating-scale variables. Table 5 shows the average MWTP yielded by the PML-SE model for the four service attributes considered. For those attributes that interact with the rating variables, the MWTP is shown for the average, maximum and minimum values of these variables. A negative sign indicates that the individual is willing to pay to reduce the level of the attribute, as it negatively affects the level of utility. The values of the estimated MWTP grow with the household income of the respondent. Specifically, we see that the willingness to pay of individuals in income stratum II is approximately 55% greater than that of income stratum I, while those in stratum III are 95% more willing to pay.

[22] Definitions of switching cost can be found in Klemperer (1987).

Table 5. Estimated average marginal willingness to pay

			MWTP (€/month)		
			Monthly household income (€)		
			(0 - 2.000)	(2.001 - 3.000)	(3.000 -)
Audit			0.96	1.50	1.90
Outfreq		**Mean** (Outimp = 7)	-1.27	-1.99	-2.52
		Outimp sensitivity (Outimp = 0, Outimp = 10)	(-0.75 , -1.62)	(-1.17 , -2.53)	(-1.48 , -3.21)
Outlenght			-0.11	-0.18	-0.23
Renewables%	Non-graduate	**Mean** (EnerSav = 6 , Concern = 8)	0.20	0.32	0.40
		(**Min**: EnerSav = Concern = 0 , **Max**: EnerSav = Concern = 10)	(-0.29 , 0.30)	(-0.46 , 0.47)	(-0.59 , 0.59)
		EnerSav sensitivity (Concern = 8) (EnerSav = 0 , EnerSav = 10)	(0.07 , 0.26)	(0.11 , 0.40)	(0.14 , 0.51)
		Concern sensitivity (EnerSav = 6) (Concern = 0 , Concern = 10)	(-0.16 , 0.24)	(-0.26 , 0.38)	(-0.33 , 0.48)
	Graduate	**Mean** (EnerSav = 6 , Concern = 8)	0.31	0.48	0.60
		(**Min**: EnerSav = Concern = 0 , **Max**: EnerSav = Concern = 10)	(-0.19 , 0.40)	(-0.31 , 0.62)	(-0.39 , 0.79)
		EnerSav sensitivity (Concern = 8) (EnerSav = 0 , EnerSav = 10)	(0.17 , 0.36)	(0.27 , 0.56)	(0.34 , 0.71)
		Concern sensitivity (EnerSav = 6) (Concern = 0 , Concern = 10)	(-0.06 , 0.34)	(-0.10 , 0.54)	(-0.13 , 0.68)

Reliability of service: outages and duration

The results show that respondents are willing to pay to reduce the number of outages, regardless of the importance they assign to the last outages they experienced. This effect, however, is quantitatively relevant, as the MWTP of those who most value this attribute is more than double that of those who least value it. As a representative example we note that an individual with an average household income who assigns an average rating to the importance of outages is willing to pay €1.99 more per month (approximately 4.2% of the monthly bill) to reduce the number of unscheduled outages by one unit. Diminishing the outage duration is also viewed positively. In the same income stratum, respondents are willing to pay almost €1 to reduce the outage duration by five minutes (33% of the average outage duration).

In order to compare our results with those of other studies, we calculated the combined effect of the variations in these two attributes. Thus, we see that a respondent is willing to pay approximately 15% of his bill to reduce both the number of outages by half and their duration to one minute. These values seem modest in comparison to those in Goett, Hudson and Train (2000), which estimates for the USA a WTP 50% of the price of a kWh ($.0277) to reduce the number of outages from four to two and their duration from 30 minutes to 30 seconds. The MWTPs estimated, however, are higher than those found by Carlsson and Martinson (2007, 2008) for Sweden, where avoiding a 4-hour weekday outage during a winter month represents less than 2% of an electricity bill. In summary, our findings highlight how the results depend on the context of the study (country, outage duration, etc.) and that the values estimated in this study are within the range observed in the empirical literature.

It should be taken into account that the electricity supplier does not manage the distribution network/grid and, therefore, is not responsible for the continuity and quality of the service. However, bearing in mind the results obtained, the offer of financial compensation or insurance that covers the risk of suffering interruptions in the electricity supply could be a successful policy to capture new clients.

Energy audits with shared savings 50/50

As in Goett et al. (2000) and Grosch and Vance (2009), we found that a large number of customers value having this option available as part of the services offered by electricity supplier. In our case, we estimated how much they are willing to pay to have this option offered by suppliers, and found that an average-income respondent would pay €1.5, that is, 2% of the monthly average bill. We should note, however, that given the variety of options that can be offered within this category of services (financing options, types of appliances, etc.), an *ad hoc* experiment which made explicit the characteristics of the audit would be necessary to estimate MWTP for such a service. Nevertheless, the results obtained seem to confirm that offering these kinds of services could be an instrument to capture new clients in the residential market.

6.2. WTP for renewable energies and policy goals in the Canary Islands

Some empirical studies show that the MWTP for green energy is linked to certain socio-economic characteristics, such as income, age, social group and educational level (Roe et al., 2001; Batley et al., 2001). In our case, the MWTP for renewables increases with income, as noted previously, and with education. In particular, individuals with university studies were willing to pay 50% more than those without any university education, regardless of income level. In relative terms, this means that in the average income stratum, those who attended university are willing to pay 10% of their bill to increase the share of renewables by 10%, a figure that drops to 6.6% for those without a university background.

Our results are similar to those obtained in other countries. These comparisons must be made cautiously, however, due to the differences in the contexts of the studies and the methods employed. For example, Nomura and Akai (2004) calculated for Japan a MWTP $17 a month for wind and solar energy. For the USA, Borchers et al. (2007) found an average WTP $14.77 (around 12.5% of the monthly bill) to take part in a program to increase the share of these renewables by 10%. For Korea, Yoo and Kwak (2009) calculated a MWTP $2 a month (about 30% of the monthly bill) to increase the share of renewables. Previous studies consider some specific behaviors that affect the MWTP for this type of energy. Ek (2005) includes a variable to consider the effect on MWTP of those people who express favorable attitudes toward the environment. He found that these people are more likely to value the introduction of renewable energies. Roe et al. (2001) found that the MWTP is greater in individuals with higher education and in those who declare belonging to environmental organizations.

In this paper we evaluated the influence of two specific aspects: the energy saving behavior (*EnerSav*) reported by respondents and the extent of their concern over the environmental effects of generating electricity (*Concern*). To examine the effects of the energy-saving behavior, we compared the MWTP that was obtained for the maximum and minimum values of *EnerSav* when the *Concern* parameter was set at its average value. For example, for individuals without university studies and lower incomes, the MTWP varies from €0.07 for the least energy saver individuals to €0.26 for the most. This underscores the considerable influence of this aspect, since it could explain why the MWTP of some individuals is up to four times greater than that of others. This proportion was almost the same in the three income strata. Likewise, we can see the effect of *Concern* by setting *EnerSav* at its average value. The most notable finding is that regardless of educational and income levels, less concerned individuals may even view the introduction of renewables as a negative. The combined effect of energy-saving behavior and a concern for the environment results in increased variability ranges for MWTP, as evidenced by the intervals that bracket it in Table 5.

With respect to these two factors, we wish to note that on average, most respondents reported an awareness of environmental issues (the average *Concern* was 8, with the maximum being 10). For these people the MWTP is always positive, even for those who did not report being thrifty. However, the MWTP for an average energy saving behavior respondent (i.e. *EnerSav*=6) could be negative if his level of environmental concern is low. This result suggests that people's concern for the environmental problems derived from the generation of electricity should be a critical aspect when crafting energy policy.

Another important use of these results is to make some estimates of the profits and costs of such programs to determine their viability and potential sources of financing. Bollino (2009) for Italy, Batley (2001) and Scarpa and Willis (2010) in UK and Ek (2005) in Sweden found that national objectives in the use of renewable electricity generation cannot be achieved using only market mechanisms. On average, in our results for the Canary Islands, to increase the share of green energy by 25 percent (the percentage increase required to meet the objectives of PECAN 2006.[23]), the average household would be willing to pay 20% more in their bill. This represents an annual amount of approximately 75 million euros in 2009.

This amount can be compared to the investment required to develop this type of energy under the PECAN 2006, which is 1420 million euros (1996) over eight years. The global willingness to pay (600 million) would cover almost 50% of the expenditure required to fund such programs. These percentages are almost identical to those of Bollino (2009 for Italy). Thus, the special circumstances arising from the economy and geographically insularity as well as the high level of environmentally protected areas do not seem to influence decisively the WTP for renewable energy.

7. CONCLUSIONS

Deregulation and the introduction of competition in the electricity industry in many countries have led companies to persistently pursue customer satisfaction in the retail market. The knowledge of customers' preferences and WTP is key information for suppliers to become more competitive in the retail market and for governments to design energy policies (i.e. share of renewable energy). In this study, we analyze these issues in an emerging market situation. Specifically, a stated preference electricity company CE was conducted in the Canary Islands' residential market.

The results obtained in our research on supplier choice allow us to draw two

[23] In Canary Islands, the basic energy regulation document is the *Canaries Energy Plan* 2006 (PECAN 2006). The set of measures in PECAN 2006 are aimed at reducing the Archipelago's energy system emission levels and its dependence on oil thanks to the introduction of natural gas and an increased reliance on renewable energy, especially solar and wind power, to generate electricity.

conclusions:

- 50.7% of respondents prefer their current supplier, 40.1% prefer another supplier and only 9.2% prefer a company in another industry.
- Individuals who are satisfied with their current supplier (rate it highly) do not, for the most part, change suppliers (63%), but also the fact that a significant portion of those (44%) who rate a competing company highly would also stay with their current supplier.
- The relative preference for one supplier also depends on age and on unobservable factors: the effects of brand loyalty on the current company and/or the perceived switching cost increase with the age of the consumer.

With respect to the WTP results obtained in this study, we highlight the following findings:

- WTPs for all of the attributes increase with household income and their values are similar to those obtained in the literature, which indicate that our specific study context does not affect these values.
- Consumers place a high value on having fewer outages and on these to be of short duration.
- The past experience of customers affects the WTP for power outages. We found evidence of a systematic variation in the preferences for outage frequency, in that the doubling of the WTP could be explained by respondents' experience in terms of the severity of outages they endured in the past.
- A large number of consumers view the availability of an energy audit with shared savings positively.
- Customers who report having an active behavior in energy saving are those who

attach a higher value to the introduction of renewable energy in the generation of electricity. In fact, these individuals exhibit a WTP that is up to four times higher than those who do not save energy. Respondents with a university education are also more willing to pay for renewable energy. A WTP for renewable energy was clearly evident in individuals who stated a concern for GHG.

- The results highlight that individuals who show energy-saving behavior and who report a concern for GHG exhibit the highest WTP for renewable energies.
- The global WTP for renewable energy (600 million euros) would cover almost 50% of the expenditure required to fund the PECAN (2006) goals for these energy sources.

The results obtained in this work lead us to conclude that other companies could enter the market. Specifically, it is possible to compete by offering services connected with the different attributes studied. However, they would have to deal with customer loyalty to the current supplier as well as customers' costs to switch suppliers.

Furthermore, the special circumstances arising from the Canarian economy and geographical location do not appear to have a decisive effect on the WTP for service attributes, including that of renewable energy. In fact, as found by Bollino (2009), Batley (2001) and Scarpa and Willis (2010) and Ek (2005), regional objectives in the use of renewable electricity generation cannot be achieved by using only market mechanisms.

It has been shown that the concern for GHG and energy-saving action behavior are key factors in influencing the WTP for renewable energy. Thus, all policies that affect these two factors would lead to greater financing to achieve greater penetration of renewable energy throughout the market. For example, information campaigns about rational energy use and promoting awareness of environmental problems in the generation of electricity.

The results of this study also appear to indicate that the market conditions offered in an emerging market do not determine customer's preferences. Nevertheless, it would be useful to provide more empirical evidence on this aspect.

Finally, other avenues for further research can be identified. These include a more accurate assessment of switching costs by studying a group of customers who have changed suppliers. Future research should also consider both groups of users, those who have switched and those who have not. This would also confirm whether an inertia effect exists involving previous suppliers, as has been shown in other sectors.

REFERENCES

Abdullah, S. and P. Mariel (2010). Choice experiment study on the willingness to pay to improve electricity services, Energy Policy, 38(8): 4570-4581.

Amador, F. J., R. M. González y J. de D. Ortúzar (2008). On Confounding Preference Heterogeneity and Income Effect in Discrete Choice Models, Networks and Spatial Economics, 8(2): 97-108.

Batley, S.L., D. Colbourne, P.D. Fleming, and P. Urwin (2001). Citizen versus consumer: challenges in the UK green power market. Energy Policy, 29 (6): 479-487.

Bhat, C. R. (2001). Quasi-Random Maximum Simulated Likelihood Estimation of the Mixed Multinomial Logit Model, Transportation Research 35B, 677-693.

Bhat, C. R., and R. Gossen (2004). A mixed multinomial Logit model analysis of weekend recreational episode type choice., Transportation Research Part B, 38: 767-787.

Blamey, R.K., J.W. Bennett, J.J. Louviere, M.D. Morrison and J. Rolfe (2000). A test of policy labels in environmental choice modeling studies, Ecological Economics, 32: 269-286.

Bierlaire, M.. (2003). BIOGEME: A free package for the estimation of discrete choice models, Proceedings of the 3rd Swiss Transportation Research Conference, Ascona, Switzerland.

Bollino, C. A. (2009). The willingness to pay for renewable energy sources: The case of Italy with socio-demographic determinants. The Energy Journal, 30 (2): 81-97.

Borchers, A.M., J.M. Duke, and G.R. Parsons. (2007). Does willingness to pay for green energy differ by source?, Energy Policy, 35: 3327-3334.

Brandon G and A. Lewis (1999). Reducing Household Energy Consumption: a qualitative and quantitative Field Study. Journal of Environmental Psychology, 70 (1). 3-21

Brownstone, D. and K. Train (1999). Forecasting new product penetration with flexible substitution patterns. Journal of Econometrics, 89: 109–129.

Cai, Y., I. Deilami and K. Train (1998). Customer Retention in Competitive Power Market: Analysis of a 'Double-Bounded Plus Follows-ups' Questionnaire. The Energy Journal, 19(2): 191-215.

Cameron, T. A and J. Englin (1997). Respondent Experience and Contingent Valuation of Environmental Goods, Journal of Environmental Economics and Management, 33(3): 296-313.

Carlsson, F. and P. Martinsson (2002). Design techniques for stated preference methods in health economics. Health Economics, 12: 281–294.

Carlsson, F. and P. Martinsson (2007). Willingness to pay among Swedish households to avoid power outages. A random parameter Tobit model approach. The Energy Journal, 28 (1): 75-89.

Carlsson, F. and P. Martinsson (2008). Does it matter when a power outage occurs?- A choice experiment study on the willingness to pay to avoid power outages. Energy Economics, 30: 1232-1245.

Carlsson, F., P. Martinsson, and A. Akay (2011). The effect of power outages and cheap talk on willingness to pay to reduce outages, Energy Economics, 33(5): 790-798

Chen, Pei-Yu and L. M. Hitt (2002). Measuring Switching Costs and Their Determinants in Internet Enabled Businesses: A Study of the Online Brokerage Industry. Information Systems Research, 13 (3):255–274.

ChoiceMetrics (2010). Ngene 1.0.2. User manual & reference guide. The Cutting Edge in Experimental Design. www.choice-metrics.com

Daly, A. J. (2004) Properties of Random Utility Models of Consumer Choice. TraLog Conference, Molde.

Diamond, P., and J. Hausman, Contingent valuation: is some number better than no number? Journal of Economic Perspectives, 8: 45–64.

Defeuilley, C. (2009). Retail competition in electricity markets, Energy Policy, 37, 377-386

Ek, K. (2005). Public and private attitudes towards green electricity: the case of Swedish wind power. Energy Policy, 33 (13): 1677-1689.

Estadísticas Energéticas de Canarias (2006), Consejería de empleo, industria y comercio. Gobierno de Canarias.

http://www.gobiernodecanarias.org/cicnt/doc/industriayenergia/publicaciones/Anuario2006.pdf

Goett, A., K. Hudson and K. Train (2000). Customer Choice Among Retail Energy Suppliers: The Willingness-to-Pay for Service Attributes, Energy Journal, 21, 1-28.

Grösche, P. and C. Vance (2009). Willingness to Pay for Energy Conservation and Free-Ridership on Subsidization: Evidence from Germany. The Energy Journal, 30 (2): 135-15.

Hanemann, W. M. (2001). Applied Welfare Analysis with Discrete Choice Models. In C. Kling and J. Herriges (eds.), Valuing the Environment Using Recreation Demand Models, Edward Elgar, Cheltenham.

Hanley, N., D. MacMillan, R. E. Wright, C. Bullock, I. Simpson, D. Parsisson, and B. Crabtree (1998). Contingent valuation versus choice experiments: estimating the benefits of environmentally sensitive areas in Scotland. Journal of Agricultural Economics, 49: 1-15.

Hensher, D., J. Rose, and W. Greene (2005) Applied Choice Analysis: A Primer, Cambridge University Press, Cambridge.

Hensher, D., N. Shore and K. Train (2005). Household's Willingness to pay for water service attributes. Environmental and Resource Economics 32, 509-531

Hess, S., K.E. Train, and J.W. Polak (2006). On the Use of a Modified Latin Hypercube Sampling (MLHS) Method in the Estimation of a Mixed Logit Model for Vehicle Choice. Transportation Research Part B, 40(2): 147-163.

Huber, J. and K. Zwerina (1996). The importance of utility balance and efficient choice designs. Journal of Marketing Research, 33: 307-317.

Jara-Díaz, S. (2007). Transport Economic Theory. Holland: Elsevier.

Jara-Díaz, S.. R. and J. Videla (1989). Detection of income effect in mode choice: theory and application., Transportation Research Part B, 23(6): 393-400.

Jara-Díaz, S.R. and R. Guerra, (2003). Modeling activity duration and travel choice from a common microeconomic framework. 10th International Conference on Travel Behaviour Research Conference, Lucerne, August 2003.

Kanninen, B. J. (2002). Optimal design for multinomial choice experiments. Journal of Marketing Research, 39 (2), 214-217.

Klemperer, P. D. (1987). Markets with Consumer Switching Costs. Quarterly Journal of Economics, 102: 375-394.

Lawrence, C., J. Zhou, and A. Tits (1997). User's guide for CFSQP version 2.5: A C code for solving (large scale) constrained nonlinear (minimax) optimization problems, generating iterates satisfying all inequality constraints. Technical Report TR-94-16r1, Institute for Systems Research, University of Maryland, College Park, MD 20742

Longo, A., A. Markandya and M. Petrucci (2008). The internalization of externalities in the production of electricity: Willingness to pay for the attributes of a policy for renewable energy. Ecological Economics, 67:140-152.

McFadden, D. (1974). Conditional logit analysis of qualitative choice behaviour. In P. Zarembka, ed, Frontiers in Econometrics. New York: Academic Press.

McFadden, D. (1981). Econometric Models of Probabilistic Choice, In C. Manski and D. McFadden (eds.) Structural Analysis of Discrete Data with Econometric Applications, MIT Press, Cambridge: 198-272.

McFadden, D. (1999) Computing Willingness-to-Pay for Transport Improvements. In J. Moore, R. Riezman and J. Melvin (eds.), Trade, Theory and Econometrics: Essays in Honour of John S. Chipman. Routledge, London.

Morrison, M.D. and C. Nalder (2009). Willingness to pay for Improved Quality of Electricity Supply Across Business Type and Location. The Energy Journal, 30(2): 117-133.

Muñuzuri, J., L. Onieva, E. Gutiérrez, and P. Cortés (2009). Un enfoque cuantitativo para valorar el servicio eléctrico por parte de los usuarios. Economía Industrial, 374: 83-93 (in spanish)

Nomura, N and M. Akai (2004). Willingness to pay for green electricity in Japan as estimated through contingent valuation method. Applied Energy 78: 453-463.

Ortúzar, J. de D. and R. M. González (2002). Inter-Island Travel Demand Response with Discrete Chhoice Models. Fuctional Form, Forecasts and Elasticities. Journal of Transport Economics and Policy, 36 (1), 115-138.

PECAN (2006). Canaries Energy Plan .

www.gobcan.es/cicnt/doc/industriayenergia/energia/pecan/pecan.pdf

Pérez, Y and F.J. Ramos-Real (2008). How to Make A European Integrated Market in Small and Isolated Electricity Systems? The Case of Canary Islands. Energy Policy, 36: 4159-4167

Revelt, D. and K. Train (1998). Mixed logit with repeated choices: households' choices of appliance efficiency level. The Review of Economics and Statistics, 4: 647-657.

Roe, B., M.F. Teisl, A. Levy and M. Russell (2001). US consumer's willingness to pay for green electricity. Energy Policy, 29 (11): 917-925.

Rose, J.M., M.C.J. Bliemer, D. A. Hensher, and A.C. Collins (2008). Designing efficient stated choice experiments involving respondent based reference alternatives. Transportation Research Part B, 42 (4): 395-406.

Ruud, P. (1996). Approximation and Simulation of the Multinomial Probit Model: An Analysis of Covariance Matrix Estimation, working paper, Department of Economics, University of California, Berkeley.

Samuelson, W. and R. Zeckhauser (1988). Status quo bias in decision making. Journal of Risk and Uncertainty, 1: 7-59.

Sándor, Z. and M. Wedel (2001). Designing Conjoint Choice Experiments Using Managers' Prior Beliefs. Journal of Marketing Research, 38: 430-444.

Scarpa, R. and K. Willis (2010). Willingness to pay for renewable energy: Primary and discretionary choice of British households for micro-generation technologies. Energy Economics, 32: 129-136.

Train, K. (2003). Discrete Choice Methods with Simulation. Cambridge: Cambridge University Press.

Yoo, S.H and S.Y. Kwak (2009). Willingness to pay for green electricity in Korea: A contingent valuation study. Energy Policy, 37: 5408-5416.