Consumer preferences for electric vehicles in Germany

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ABSTRACT: *Purpose*. Analyze the preference for battery electric vehicles (BEVs) as opposed to hybrid electric vehicles (HEVs) or normal combustible vehicles (NCVs) in Germany. *Design*. Survey of 400 respondents who stated their preference for one of the three vehicles and considered purchase price, driving range, fuel costs, emissions, refueling availability, refueling time, acceleration and policy incentives. Binary and multinomial choice logit models are applied. *Main findings*. We find strong evidence that previous experience of driving a BEV and car sharing are significant factors to state a preference for electric cars. Other factors such as driving range, purchase price, gender, ecological awareness and incentives such as tax exemptions also influence the choice. *Originality*. The preference for BEVs among German customers would increase if granted the opportunity of a driving experience and, more intensely when combined with car sharing opportunities. Increasing the availability of car sharing of electric vehicles seems an excellent way to penetrate the market.

KEYWORDS: Electric car, discrete choice models, multinomial logit model, incentives

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1. Introduction

The European Union has drawn up a roadmap to work towards a competitive low-carbon economy by 2050. To achieve this, the European Commission has set itself an ambitious ecological goal for 2020, namely, that the average emission of carbon dioxide (CO_2) from the EU's fleet of new vehicles should not exceed 95 grams per kilometer (European Union, 2012). There is a clear need to adopt a new mobility concept through a slowly substitution of so-called normal combustion vehicles (NCVs), i.e. equipped with a gasoline or diesel motor. The German Government, for example, approved a national development plan for electro-mobility in 2009 to minimize emissions. One million of electric vehicles (EVs) should be on the German roads by 2020 (Federal Government, 2009), that is, the sum of hybrid electric vehicles (HEVs) and battery electric vehicles (BEVs). With just 6,051 BEVs registered in 2013 and 25,502 in 2016, Germany remains in the initial phases of this plan (Federal Motor Vehicle Transport Authority, 2013b and 2016). To ensure successful market penetration and implementation of BEVs, and thus achieve the policy goals of the European Union and the German Government, it is clearly of interest to understand the factors influencing consumer preferences for BEVs and, ultimately, their purchasing decisions. The total number of passenger vehicles (Personenkraftwagen / PKW) registered in Germany exceeds 45,8 million, which is the official figure in 2017. The sale of electric vehicles (EVs) has remained sluggish in Germany despite discounts introduced and granted to buyers of green cars. In 2016, there were less than 80,000 electric cars on German roads. Plans to increase the number of electric vehicles by 2020 also serve as Germany's self-imposed deadline for cutting the nation's emissions by 40 percent.

The analysis conducted here includes initially the research approach taken by Hackbarth and Madlener (2013), who also examined the potential demand for EVs in Germany. Our analysis is the first to address potential demand for EVs since the first BEVs produced by a German car manufacture have become available, and consequently consumers have probably had the opportunity to experience it firsthand. Such introduction of the first mass-produced German BEVs might have a significant influence on purchase decisions of German consumers, as the market share of the current stock of vehicles in Germany is dominated by domestic brands with a 65% quota (Federal Motor Vehicle Transport Authority, 2014 and 2016). Our contribution to the literature confirms the findings of Jensen et al. (2013) for the Danish market that having experienced an electric vehicle has a significant influence on the preference for this type of car. We also find that the influence of having experienced an electric car is true even when controlling for indicators of environmental awareness of the decision maker and the use of car sharing opportunities.

Options chosen by consumers, when the vehicle attributes in the baseline choice set are modified, allow us to identify the factors driving their preferences. We can then examine which of these attributes results in people preferring a NCV to an EV, while a multinomial logit model shows which attributes influence the respondents' preference for a NCV, an HEV or a BEV. In particular, there are two main aims to be carried out in this study:

1) To use discrete choice models, both binary and multinomial, to find out the determinants (socio-demographic factors and preferences) of the probability of using EVs

2) To understand how changes in a set of specific attributes impact on the preferences for electric vehicles. It will allow us to understand where the government should focus its policy.

The rest of this paper is organized as follows. Section 2 summarizes research conducted to date on demand for EVs. Section 3 describes the survey design. Section 4, the methodology and model specifications are presented. In section 5, the results of the discrete choice models are examined. Finally, in section 6 conclusions are presented and further lines of research are discussed.

2. Background

The earliest papers examining consumer demand for EVs were published in the early eighties in response to the oil crisis a decade earlier. Beggs et al. (1981) and Calfee (1985) were the first to estimate potential demand for EVs using discrete choice models. Table 1 shows these and subsequent papers employing econometric models and reports the number and categories of the attributes included in their respective choice sets. Note that analyses of purchase price, driving range and acceleration are included in almost every study, while a new attribute, which of "emissions", was mostly introduced after 2000. With growing ecological awareness, this last attribute may be a good indicator as to why consumers might opt for an EV. Likewise, parameters as recharging time, fuel availability and recharging possibilities were introduced in the choice sets when the industry succeeded in making these technological advances for BEVs. Interestingly, Table 1 shows how studies of demand for EVs have evolved over time from the concerns raised by the oil crisis to those about the risks of global warming and the fear of the restrictions imposed by finite oil reserves. For instance, Dagsvik et al. (2002) noted the importance of purchase price and driving range for the full competitiveness of EV's, but later Heffner et al. (2007) concluded that concerns for social identity and the desire to support innovative technology also influence vehicle purchase decisions. Lane and Potter (2007) reported that personal values, beliefs, norms and knowledge all affect consumer concerns and serve in our understanding of pro-environmental purchasing decisions. Recently, Hackbarth and Madlener (2013) found that consumers with greater ecological awareness appear to be willing to pay a higher purchase price for more ecologically friendly vehicles.

Table 1
Electric vehicle studies adopting an econometric choice model approach.

Study	Econometric Model	Attributes Included	Findings
Beggs et al. (1981)	Ranked Logit	Purchase Price, Driving Range, Acceleration, Top Speed, Operating Costs, Fuel Costs, Seating Capacity, Air Conditioning and Warranty	Results indicate considerable dispersion in individual coefficients for the choice model.
Calfee (1985)	Disaggregate MNL	Purchase Price, Driving Range, Top Speed, Operating Costs and Number of Seats	Great diversity in individual trade-offs among attributes, with range and top speed generally being highly valued
Bunch et al. (1993)	MNL and Nested Logit	Purchase price, Driving range, Fuel Costs, Acceleration, Fuel Availability, Pollution, Dedicated versus Multi-Fuel	Range between refueling and fuel costs are important attributes.
Ewing and Sarigöllü (1998)	MNL	Purchase Price, Driving Range, Acceleration, Fuel Costs, Repair and Maintenance Costs, Commuting Costs, Recharging Time and Commuting Time	Differential commuting costs and times for cleaner vehicles have modest effects on vehicle choice.
Brownstone et al. (2000)	Joint Mixed Logit Model of Stated and Revealed Preferences	Purchase Price, Driving Range, Top Speed, Acceleration, Home Refueling Costs, Service Station Fuel Costs, Home Refueling Time, Service Station Availability, Tailpipe Emissions, Vehicle Size, Vehicle Type and Luggage Space	There are advantages of merging SP and revealed preference (RP) data. RP data appear to be critical for obtaining realistic body-type choice.
Potoglou and Kanaroglou (2007)	Nested Logit Model	Purchase Price, Acceleration, Annual Fuel Cost, Annual Maintenance Cost, Fuel Availability, Pollution Level, Vehicle Size and Incentives	Reduced monetary costs, purchase tax relieves and low emissions rates would encourage households to adopt a cleaner vehicle.
Hidrue et al. (2011)	Latent Class Random Utility Model	Purchase Price, Driving Range, Acceleration, Fuel Costs, Recharging Time and Pollution	Willingness to pay ranged from \$6000 to \$16,000 for electric vehicles with the most desirable attributes.
Achtnicht et al. (2012)	Standard Logit Model	Purchase Price, Engine Power, Fuel Costs, Fuel Availability and Emissions	Failure to expand the availability of alternative fuel stations represents a significant barrier.
Hackbarth and Madlener (2013)	Mixed Logit Model	Purchase Price, Driving Range, Fuel Costs, Refueling Time, Battery Recharging Time, Fuel Availability, Emissions and Policy Incentives	German car buyers are reluctant to buy alternative fuel vehicles.

Electric vehicle studies adopting an econometric choice model approach.

Jensen et al. (2013)	Joint Hybrid Choice Model	Purchase Price, Driving Range, Acceleration, Fuel Costs, Charging Possibilities, Battery Lifetime, Emissions	Individuals' preferences change significantly after a real experience with an electric vehicle

In addition to these studies, a considerable number of papers have adopted a qualitative approach to their analysis of the factors influencing the consumers' purchase decision. These studies conduct interviews or literature reviews to determine buyer profiles and in order to include characteristics not covered in the quantitative literature. Table 2 provides a summary of papers that adopt behavioral, sociological, psychological and managerial approaches, revealing that personal ecological awareness is as much a factor as the technical capabilities of electric cars. Massiani (2014) identified certain limitations in stated preference (SP) surveys for EVs and alternative fuel vehicles (liquefied petroleum gas, compressed natural gas, biofuels, hydrogen, etc.), and recommends the inclusion of several other relevant dimensions, including garage ownership, second vs. first car, and refueling conditions. He also points out that studies often neglect transitory technologies (the plug-in hybrid), which are important elements in the diffusion of EVs.

Table 2
Electric vehicle studies adopting a qualitative approach.

Study	Methodology	Car Type(s) and Country	Aim
Heffner et al. (2007)	Ethnographic Interviews and Semiotic Theory	HEV USA	Analysis of the influences of recognized social meanings and personal meanings on vehicle purchase and use
Lane and Potter (2007)	Literature Review of Consumer Attitudes/Roger's Innovation Diffusion Model	EV UK	Study of key factors influencing consumers' adoption and effective use of low-carbon products and systems at different phases of the adoption diffusion process
Daziano and Chiew (2012)	Literature Review of Past Studies and Proposal of a General Demand Model	NCV and EV USA	Development of a discrete vehicle-purchase choice model with endogenous latent explanatory variables for analyzing the new scenario of low-emission alternatives
Bohnsack et al. (2014)	Qualitative Analysis	EV Several Countries	Influence of incumbent and entrepreneurial firms' path dependencies on evolution of EV business models
Massiani (2014)	Literature Review of Past Studies and Comment Points to Improve SP Surveys Design	EV Several Countries	Analysis of how most of the SP surveys are fit for purpose but there are ways to improve them

Only a few studies have shown that experience of driving a BEV car can change consumer preferences. A two-wave stated preference experiment conducted in Denmark by Jensen et al. (2013) found that after driving an EV, major changes are recorded in preferences based on the attributes of driving range, top speed, fuel cost, battery life and charging in city centers and train stations. In line with other studies, environmental concerns had a positive effect on the preference for BEVs both before and after the test period. Recently, Bühler et al. (2014) in a six-month field trial involving 79 participants who were given the opportunity to drive a BEV in the Berlin metropolitan area, showed that experience can significantly change perception of BEVs.

Daziano and Chiew (2012) stressed that to understand the market penetration of EVs it is essential to model the consumer purchase decision. Recent studies have some limitations, Ziegler et a (2012) only focuses on prospective buyers, Schneidereit et al. (2015) and Plötz et al. (2015) only analyze early adopters and Gnann et al. (2015) claim that there is a great deal of uncertainty in the market evolution of plug-in EVs. Our study adds to the existing body of research because we compare preferences for conventional, hybrid and electric cars and control for consumers with experience of driving an EV and of car sharing schemes. The importance of car sharing is recognized by many authors like Danielis and Rotaris (2017) and -Kos-Łabędowicz and Urbanek (2017), among many others.

3. Survey design

The data were collected in a nationwide online-based survey between March and April 2014 conducted among German residents. The survey was designed to compare consumer preferences for either EVs, on the one hand, or NCVs, on the other, and included a stated choice experiment. Of the original 471 surveys conducted, 71 were discarded as they were incomplete. Consequently, a total of 400 respondents – the only restriction being that they had to be a holder of a driver's license – completed all the questions on the survey. Mmails and social media were used to contact respondents, but a control of the quota was thoroughly established so that the sample of respondents does not deviate from the socio-demographic structure of the German population. Participation was voluntary. We cannot discard that non-response could have introduced some bias, but given that the topic does not contain questions that may be considered intrusive, we believe that this non-response-bias would be non-existent. Non-response was low compared to this kind of email surveys as most of the contacts accepted to participate in the survey. The invitation letter contained the purpose our research and the fact that it was part of a pure research project with no involvement of third parties or publicity was very positively appreciated by the participants. Our approach seemed to be attractive to the respondents who understood that there was no conflict of interest in the request for participation.

The average sample age of 43 is similar to that of the German population, while the average income distribution is also similar to the German nationwide average income (Federal Statistical Office, 2014). However, the highly educated are overrepresented. The gender ratio provides a close match with actual statistics for German car owners, with every third car in Germany being owned by a woman (Federal Motor Vehicle Transport Authority, 2013b).

Table 3 summarizes all the study variables used in our models. Fuel type was chosen as the dependent variable in the choice models and the NCV always serves as the baseline category.

Table 3
Definition of the study variables.

Variable	Definition
NCV	Equals 1 if the chosen car's fuel type is a normal combustion vehicle and 0 otherwise
HEV	Equals 1 if the chosen car's fuel type is a hybrid vehicle and 0 otherwise
BEV	Equals 1 if the chosen car's fuel type is a battery electric vehicle and 0 otherwise
Electric Car Experience	Equals 1 if the respondent has driven an electric car before completing the questionnaire and 0 otherwise
Urban Drivers (> 60% City Traffic)	Equals 1 if the respondent's reported annual share of trips in cities exceeds 60% of all trips and 0 otherwise
Gender	Equals 1 if the respondent is male and 0 if female
Number of Cars	Number of cars owned by the household (to a maximum of 4, even if the respondent owns more vehicles)
Income	Equals 1 if the respondent's monthly household net income is below 2,000 €, 2 if 2,001-3,000 €, 3 if 3,001-4,000 €, 4 if 4,001-5,000 €, 5 if 5,001-6,000€ and 6 if more than 6,001 €
Residence	Equals 1 if the respondent lives in the city center, 2 if resident in the city but not in the center and 3 if resident in a rural area
Size of Household	Number of members in the household (maximum 5)
Children in Household	Number of children in the household (maximum 3)
Importance Car Size	Size of the car (1 = Not at all important to 5 = Very important)
Importance Ecological Car	Ecologically friendly car (1 = Not at all important to 5 = Very important)

Importance Purchase Price	Purchase price (1 = Not at all important to 5 = Very important)
Importance Fuel Costs	Fuel cost (1 = Not at all important to 5 = Very important)
Importance Refueling Availability	Fuel availability (1 = Not at all important to 5 = Very important)
Importance Driving Range	Driving distance range with one full tank (1 = Not at all important to 5 = Very important)
Importance Engine Power	Engine power (1 = Not at all important to 5 = Very important)
Importance Fuel Type	Fuel type (1 = Not at all important to 5 = Very important)
Importance Refuel Time	Refueling time (1 = Not at all important to 5 = Very important)
Importance Tax Reduction	Car tax and insurance cost (1 = Not at all important to 5 = Very important)
Consuming Green Electricity	Consumption of green energy (1 = It does not apply to me at all to 5 = It applies to me completely)
Turn off/Stand-by Devices	Turn off preferred to stand-by functions (1 = Not at all important to 5 = Very important)
Using Car Sharing	Equals 1 if the respondent is a user of car sharing groups and 0 otherwise

The survey comprised four parts. In the first part, respondents were asked about their car ownership, possible future car purchasing decisions and driving behavior including the percentage of their car mileage driven on certain road types (e.g. urban driving), vehicle fuel type and vehicle size. As earlier questions may influence how people respond to subsequent, questions order was taken random in each case in order to avoid a potential bias response. In the second part, a baseline choice set followed by six additional choice sets were presented to measure the influence of various car attributes on the choice process (see below for details). We have analyzed multiple scenarios, finally considering changes in the purchase price, driving range, fuel availability, refueling time and free parking options for electric cars. In the third part, respondents were asked how much importance they attached to various car attributes in a priority matrix so as to measure the influence of each personal opinion on the eventual purchase decision. Based on existing studies, the priority matrix comprised the following car attributes: prestige of the brand, vehicle segment, ecological awareness, purchase price, engine power, driving distance range, car tax, insurance costs, fuel type, availability and cost. In addition, questions regarding environmental awareness were included to provide a profile of the ecological opinions held by each respondent. The fourth part comprised a number of socio-demographic and socio-economic questions, regarding household characteristics, educational level, age and income.

The central part of this survey corresponds to the stated preference (SP) discrete-choice experiment. The baseline set of choices in relation to the three types of car is shown in Table 4. This baseline choice set reflects a real market scenario in which the attributes of each typology are taken from the manufactures' product descriptions as revealed preference (RP) data. The vehicle attributes of the VW Golf are taken as being representative of NCVs, those of the Toyota Prius as being representative of HEVs and those of the BMWi3 for BEVs. This design provides a choice set that is closer to reality (in terms of price and vehicle models) and so is better equipped to distinguish the impact of the individual attributes on the purchase decision. By making use of so-called pivot style SP data, where real-world attribute levels are used as pivot (e.g., Hess and Rose, 2009), it is possible to avoid two problems: first, if only RP data are included in the choice sets, problems of multicollinearity may arise; and, second, if only SP data are included in the choice sets, the estimated effects appear implausible as many real market attributes are missing. In order to avoid these two problems, we opted to merge SP and RP data in the choice sets (Brownstone et al, 2000). In the six additional choice sets presented, mostly one attribute level of the BEV alternative at a time is modified in order to capture the influence of that attribute on the respondent's choice of car.

The different attributes and levels provided for in the variations to the baseline choice set, which are presented in the Appendix, measure the influence of the retail purchase price, driving range, fuel availability, refueling time and free parking policy on the decision to opt for an electric car. The NCV values are taken as reference level for each characteristic.

Table 4
Baseline set of choices of the questionnaire: The so-called real case scenario.

Characteristic	Normal combustion vehicle (NCV)	Hybrid electric vehicle (HEV)	Battery electric vehicle (BEV)
Purchase Price	23700 €	26800 €	34950 €
Fuel Cost per 100 km	7.00 €	6.50 €	3.50 €
CO_2 Emissions	100%	75%	0%
Driving Range	1447 km	1154 km	190 km
Fuel Availability	100%	100%	14%
Refueling Time	5 min	5 min	420 min
Acceleration 0 up to 100 km/h	11.5 sec	10.4 sec	7.2 sec
No Motor Vehicle Tax	No	No	Yes
Free Parking	No	No	No

Note that the other choice sets are presented in Tables S1 to S6 (Appendix).

Each choice set in the SP discrete-choice experiment contains nine attributes for each of the three vehicles – BEVs, HEVs and NCVs. The first attribute is the purchase price (in euros) taken from the manufacturers' product descriptions. The second is the fuel cost (in euros per 100 km) based on the fuel consumption reported in the manufacturers' product descriptions and the price for petrol and electricity in 2014. The third is carbon dioxide emissions (%CO_2), where the baseline value of the emissions is set at 100% for NCVs, and then compared to absolute emissions of the HEVs and BEVs (although there certainly arise emissions during electricity generation, they are considered negligible for BEVs). The fourth is the driving range of the car calculated as the distance (km) that can be covered with one full tank or battery. In the case of the fifth attribute (fuel availability) we consider the network of petrol stations for NCVs as being accessible from anywhere in Germany. Thus, we use the number of petrol stations as the baseline for making a comparison with the number of public charging points for BEVs. In Germany in 2014, 14,622 petrol stations were in full operation, while only 2,033 public charging stations had been installed for EVs (Energie Informationsdienst, 2014, and German Association of Energy and Water Industry, 2013). As such, fuel availability provided by the public network for charging EVs stands at 14%. The sixth attribute is the refueling time (minutes), that is, the time it takes to refill the tank or recharge the battery of the respective vehicles. The seventh attribute is the vehicle's acceleration time (seconds) from 0 to 100 km/h as stated in the manufacturers' product descriptions. Finally, the last two attributes are related to public policy incentives. We include, on the one hand, the existing motor vehicle tax exemption for electric cars and, on the other hand, the possibility of a free parking policy for electric cars, which might be introduced in Germany to support its new mobility concept.

4. Methodological approach and model specification

Discrete choice models use econometric tools to make probabilistic statements about the occurrence of a 'choice event', where a preference is identified by a discrete set of additional choices. The primary aim is to study the influence of a range of both vehicle attributes and socio-economic factors on the potential buying decision. For this purpose, we can apply either a classical logistic regression model for binary choices or a multinomial logit model (MNL) for more than two alternatives.

In general, discrete choice models can be motivated by a so-called random utility model, so for the i-th respondent the utility function of option $j \in \{1, \dots, J\}$ is given by equation (1):

$$U_{ij} = \boldsymbol{z}'_{ij}\boldsymbol{\theta} + \varepsilon_{ij} \ . \qquad (1)$$

Therefore, the utility is divided in two parts. On the one hand, the utility provides a systematic and measureable component $\boldsymbol{z}'_{ij}\boldsymbol{\theta}$, where $\boldsymbol{z}'_{ij} = [\boldsymbol{x}_{ij}, \boldsymbol{w}_i]$ contains information about the vehicle attributes $\boldsymbol{x}_{ij}$ of the choice j and the specific characteristics $\boldsymbol{w}_i$ of the respondent i, such as their socio-demographic and socio-economic factors as well as the opinions they hold. On the other hand, there is a random component ε_{ij}, so that we assume that each ε_{ij} are independent and identically distributed under a univariate extreme value distribution, so that individual i chooses a particular alternative $j \in \{1, \dots, J\}$ in order to maximize his or her utility U_{ij}:

$$P\left(U_{ij} > U_{ik}\right) = 1 \text{ for all other } k \neq j \,. \tag{2}$$

In developing the baseline choice model, three assumptions need to be introduced in order to estimate the individual choice models:

1) The model exhibits independence-from-irrelevant alternatives, i.e., IIA axiom. Thus, the ratio of the probabilities of choosing one alternative (e.g., a NCV) over another (e.g., an HEV) should not be affected by the presence/absence of another alternative (a BEV) in the choice set.

2) The probability of a particular alternative being chosen must be greater than zero for all possible alternative sets, i.e., positivity axiom.

3) The random elements ε_{ij} in the utility function are independent across alternatives and identically distributed.

Overall, in discrete choice models, the extreme value type 1 (EV1, also called Gumbel) distribution is often applied. As exposed in equation (3), the EV1 cumulative distribution for each unobserved random component of utility is

$$F\left(\varepsilon_{ij}\right) = \exp\left\{-\exp\left(-\varepsilon_{ij}\right)\right\} , \tag{3}$$

and the variance is $\pi^2/6$, so we are implicitly normalizing the scale of utility. Applying equation (3), we are able to integrate out the operational component in order that we might develop a discrete choice model that is based only on the utility parameters associated with each attribute in the observed component of the random utility expression of equation (1) (Louviere et al., 2000).

4.1. Binary logistic regression

For the i-th consumer, $i = 1, \dots, n$, we want to estimate the probability π_i of choosing a NCV instead of opting for an EV. Consequently, we have a binary output variable Y_i which takes a value of 1 for an EV option (either HEV or BEV) and 0 for NCV.

Such probability is given in equation (4) by the binary logistic model,

$$\pi_i = Prob(Y_i = 1) = \frac{\exp(\boldsymbol{z}'_{i1}\boldsymbol{\theta})}{\exp(\boldsymbol{z}'_{i0}\boldsymbol{\theta}) + \exp(\boldsymbol{z}'_{i1}\boldsymbol{\theta})} = \frac{\exp(\boldsymbol{x}'_{i1}\boldsymbol{\beta} + \boldsymbol{w}'_i\boldsymbol{\alpha})}{\exp(\boldsymbol{x}'_{i0}\boldsymbol{\beta} + \boldsymbol{w}'_i\boldsymbol{\alpha}) + \exp(\boldsymbol{x}'_{i1}\boldsymbol{\beta} + \boldsymbol{w}'_i\boldsymbol{\alpha})}, \qquad (4)$$

where the set of parameters $\boldsymbol{\beta}$ reflects the impact of changes in $\boldsymbol{x}'_{ij}$ on the probability, and the vector $\boldsymbol{\alpha}$ fulfills the same task regarding $\boldsymbol{w}'_i$.

4.2. Multinomial logistic regression

The MNL is simple to estimate and has a closed-form specification. Moreover, the MNL is usually robust to the violation of strong behavioral assumptions if we have a rich and highly disaggregated dataset for the attributes of the alternatives and agents. This is especially true if the choosing behavior is independently and identically distributed among the alternatives in the choice set (Louviere et al., 2000).

The decision makers are faced with three alternative vehicles and, on the basis of their underlying preferences, they choose the option that maximizes their utility. In our MNL model, therefore, the individual chooses between an NCV, a BEV and an HEV. The alternative opted for is defined as the respondent's dependent variable. In models with unordered multiple choices, random utility models serve as the basis for developing the probability estimations (Greene, 2011).

Let Y_i denote a random variable which indicates the choice made by the i-th respondent, $i = 1, \dots, n$, who faces with J options, we obtain equation (5), which is defined as the conditional logit model or more often labeled as the multinomial logit model,

$$Prob(Y_i = j) = \frac{\exp(\boldsymbol{z}'_{ij}\boldsymbol{\theta})}{\sum_{k=1}^{J} \exp(\boldsymbol{z}'_{ik}\boldsymbol{\theta})} = \frac{\exp(\boldsymbol{x}'_{ij}\boldsymbol{\beta} + \boldsymbol{w}'_i\boldsymbol{\alpha})}{\sum_{k=1}^{J} \exp(\boldsymbol{x}'_{ik}\boldsymbol{\beta} + \boldsymbol{w}'_i\boldsymbol{\alpha})}, \qquad (5)$$

where n is the number of respondents and J is the total number of alternatives in the choice set. In the following section we use equation (5) to estimate with which are major socio-economic contributing factors to buy an NCV, a BEV or an HEV, thereby enabling to study the different profiles of the buyers. Note that after redefining the vector of explanatory variables, we can use the alternative model specification that is often used in practice, in which there is a different vector of parameters for every choice alternative except for that of the baseline. This is precisely the notation that we use in the results section.

For the MNL model, we expect ecologically aware consumers to be more likely to buy an electric car (an HEV or a BEV). If, however, consumers attach great importance to driving range, refueling time, purchase price and fuel availability, they are likely to opt for an NCV and so these explanatory variables will take a negative sign in the model. If consumers are more sensitive to fuel costs and value the tax advantages provided by a BEV, we assume that they will be more likely to prefer a BEV. In line with Jensen et al. (2013), who studied the stability of consumer preferences and attitudes before and after driving an electric car and found a significant switch in individual preferences, we expect the 'electric car experience' variable to present a positive sign (more likely to buy a BEV) in our model.

In order to apply the MNL model we first need to test that the IIA assumption is fulfilled. Hausman and McFadden (1984) suggest three possibilities for testing whether the *independence of irrelevant alternatives* is given: a Hausman specification test, a Wald test and a likelihood ratio test for the IIA applied in the appropriate nested logit model (NL). Here, we applied a Hausman specification test. The results of the estimated nested logit model and the Hausman test are available from the authors on request. Given that we are unable to reject the null hypothesis (H_0: IIA axiom is valid) at the 5% level of significance, the multinomial logit model is applied here.

5. Results

5.1. Modeling the customers preferences

We analyze the factors influencing the decision to purchase an electric car. First, the results of a binary outcome model are examined in order to study the impact on the choice between an NCV and an EV (thus combining the hybrid and battery electric vehicles into one group). Second, the multinomial logistic model is applied to define the attributes of the cars that significantly influence the decision to purchase either a battery or hybrid electric car in comparison to an NCV.

Results for binary choice models

The results from the binary outcome models tested are summarized in Table 5. These models are based on the decisions of the respondents to the baseline choice set presented in Table 4. In the first logit model only socio-economic and socio-demographic factors are included. The ecological awareness factors are added in the second logit model. The third model is extended to include the importance attached to the vehicle attributes, while the fourth model includes only certain attributes so as to measure their impact on the decision to prefer either an NCV or an EV. Prior driving experience of a BEV is not included in these models because the category EV includes both HEVs and BEVs.

Table 5
Parameter results from binary logistic regression. The dependent variable is the choice of electric vehicle (hybrid and battery electric cars combined) vs. normal combustion vehicles (baseline level).

Variable	Model 1	Model 2	Model 3
Constant	1.717	1.414	1.189
Gender	-0.164	-0.102	0.012
Age	-0.068	-0.096	-0.106
AgeSquared	0.001	0.001	0.001
Residence	0.045	0.048	0.056
Income	0.036	0.075	0.099
Number of Cars	-0.334 **	-0.266 *	-0.172
Size of Household	0.089	0.080	0.022
Children in Household	-0.068	-0.117	-0.196
Importance Car Size	-	-	0.092
Importance Ecological Car	-	-	0.291 **
Importance Purchase Price	-	-	-0.321 **
Importance Fuel Costs	-	-	0.124
Importance Refueling Availability	-	-	0.094
Importance Engine Power	-	-	-0.227 **
Importance Refuel Time	-	-	0.203
Importance Tax Reduction	-	-	0.041
Consuming Green Electricity	-	0.166 **	0.121 *
Turn off/Stand-by Devices	-	0.206 **	0.186 **
n	400	400	400
AIC	552.802	541.697	534.019

BIC	588.725	585.603	609.856
Likelihood Ratio	8.776	23.881	47.559
p-Value	0.362	0.008	< 0.001

* Significant at 10%, ** Significant at 5% and *** Significant at 1%.

In the first model, the socio-economic factor of the number of cars in a household has a statistically significant influence at the 5% level. This impact remains even when the ecological awareness factors are introduced. In the second model, a consumer who uses green electricity in the household is more likely to have a strong environmental awareness, and therefore to prefer an EV. If the respondent tends to turn off all electric devices rather than use the more wasteful stand-by function, the probability of choosing an EV also increases significantly. In the third model, the number of cars in the household does not have a significant influence on the choice decision. However, this extended model reveals the impact of specific car attributes; thus, customers who attach great importance to the ecological attributes of a car, including low fuel consumption and low CO_2 emissions, are more likely to prefer an EV. By contrast, those who consider the price and the power of a car's engine to be more important are more likely to choose an NCV. In this third model the influence of socio-economic factors disappears because of the introduction of the importance of the cars' attributes.

Results for multinomial choice models

We further develop the choice structure with the application of a multinomial logit model. In this way, we are able to estimate the choice probabilities of consumers preferring a BEV, an HEV or an NCV and to measure the influences of the regressors on the decision to choose a particular car type. Once again, this model is based on the baseline choice set in Table 4.

Table 6 shows the results for the specification of the MNL model, which contains the importance consumers attach to the power of the engine. We assume NCV as being the baseline category. Overall, MNL model 1 provides a better fit than MNL model 2: the AIC and BIC are both smaller and the likelihood ratio statistic is higher. Therefore, we opt to apply MNL model 1 in the illustrative examples.

The driving range of the BEV is clearly a major disadvantage and one that has a significant impact on the consumers' buying decision. The consumer that attaches an increasing degree of importance to the driving range is less likely to buy a BEV, preferring an NCV with a driving range that is seven times greater.

Table 6
Multinomial logit regression of choice between hybrid electric vehicle (HEV), battery electric vehicle (BEV) and normal combustion vehicle (NCV, baseline category).

Variable	MNL Model
Constant HEV	2.1886
Income HEV	0.1068
Gender HEV	-0.1620
Age HEV	-0.1320**
AgeSquared HEV	0.0013*
Urban Drivers (>60% City Traffic) HEV	- 0.7237***
Number of Cars HEV	-0.3408**
Importance Ecological Car HEV	0.3073**
Importance Driving Range HEV	0.1768
Importance Fuel Cost HEV	0.2063
Importance Engine Power HEV	-0.2477**
Importance Purchase Price HEV	-0.3022*
Importance Refuel Time HEV	0.3217**
Importance Tax Reduction HEV	-0.0498
Consuming Green Electricity HEV	0.1083
Electric Car Experience HEV	0.4517
Constant BEV	-1.3466
Income BEV	-0.0163
Gender BEV	-0.8035*
Age BEV	-0.1028

AgeSquared BEV	0.0014
Urban Drivers (> 60% City Traffic) BEV	-0.0285
Importance Ecological Car BEV	0.2127
Importance Driving Range BEV	-0.4060*
Number of Cars BEV	0.1963
Importance Fuel Cost BEV	0.4337
Importance Engine Power BEV	0.0713
Importance Purchase Price BEV	-0.5542**
Importance Refuel Time BEV	-0.1481
Importance Tax Reduction BEV	0.3804*
Consuming Green Electricity BEV	0.1677
Electric Car Experience BEV	1.3488***
NCV – Baseline Category	-
n	400
AIC	725.9951
BIC	853.7219
Likelihood Ratio	92.0799
p-Value	0.0000

* Significant at 10%, ** Significant at 5% and *** Significant at 1%.

A further attribute influencing the purchasing choice is a vehicle's eco-friendliness. A consumer that prefers a car with low CO_2 emissions and low fuel consumption is more likely to buy an HEV than an NCV. The power of the car's engine also has an impact on the consumer choice decision – the greater the importance attached to this attribute the more likely the consumer is to opt for an NCV. Interestingly, even though the choice sets show the acceleration of the HEV to be faster than that of the NCV, respondents continue to associate greater engine power with the NCVs. This serves to confirm that the introduction of EVs in Germany remains in a penetration phase, with consumers largely unaware of the potential of EVs. Additionally, the importance attached to the refueling time is another attribute influencing a consumer's decision, with respondents being more likely to choose an HEV than an NCV as they attach an increasing degree of importance to refueling time. Hackbarth and Madlener (2013) failed to find a statistical significance for this relationship, although they did not analyze this attribute separately for each EV. Here, we find a statistically significant and positive influence in favor of hybrid vehicles.

Women, rather than men, are more likely to buy a BEV than an NCV *ceteris paribus*. In our data set, fuel costs and the type of fuel are on average more important for women. Similarly, on average, women attach greater importance to owing an eco-friendly vehicle. Finally, women tend to have more of their driving in urban areas. All these factors would seem to have an influence on why a woman is more likely to buy an EV. Age, on the other hand, has a non-constant effect on the decision to purchase an HEV. Age HEV and age-squared HEV are both statistically significant. Therefore, we can compute when the probability of deciding in favor of an HEV is lowest using the following formula $\frac{dy}{dx} = \beta_{age} + 2\beta_{age^2}x$ and set it equal to 0 in order to obtain the minimum point $x_1 = -\frac{\beta_{age}}{2\beta_{age^2}}$. Thus, a consumer is least likely to purchase an HEV at the age of 51; while respondents younger and older than 51 are more likely to buy a hybrid car than an NCV.

Driving habits also influence the buying decision. As expected, drivers with experience of driving an electric car are more likely to prefer a BEV than an NCV. This finding coincides with the results of Jensen et al. (2013), who stress that EV experience makes respondents re-evaluate not only the characteristics of a BEV, but also those of an NCV. The interesting result here is that ecological awareness measured as proximity to green electricity seems to have no impact on the vehicle preference decision once the electric car experience is included in the model.

Besides the MNL model considered, a second model was also initially suggested, in which the influence of using car sharing was taken into consideration as an additional attribute. However, from Table S7 it is evident that the number of people currently using car sharing in each of the three categories is very small, and therefore there is not a large enough sample size to allow conclusions about car sharing to be drawn.

5.2. Main attributes to assess the preferences for EVs

In the baseline choice set, 167 respondents (41.8%) opted for a conventional NCV, 194 (48.5%) for an HEV and 39 (9.8%) for a BEV. Summary statistics are provided in the Appendix (Table S7).

Table 7 reports the switching in the respondents' purchase decisions as changes were made in these original attributes. Thus, we can analyze the impact on a respondent's decision when an attribute is enhanced. For instance, it appears that a better purchase price and improved fuel availability have a fairly weak effect in terms of getting the respondent to switch from a NCV or HEV to a BEV. In contrast, respondents switch their choice significantly if the electric car's driving range is increased or its recharging time is reduced. However, the final choice set – the combination of a reduction in price and in refueling time, a more extensive charging network, an increase in the driving range and the introduction of free parking for BEVs –

convinces most respondents to switch their original choice (i.e., that opted for in the baseline set of choices). Specifically, in the baseline choice set (Table S7 of Appendix) a total of 361 citizens opted for NCV or HEV, whereas in the final choice set 121 respondents changed their choices from a NCV to a BEV, and 167 changed their choices from a HEV to a BEV. It represents that finally 288 respondents out of 400 (72.0%) changed their choices from a NCV or HEV to a BEV.

Table 7
Respondents switching choice with the change in attribute from the baseline set of choices to a new choice set in the following sequence order: NCV to HEV or BEV and HEV to BEV. The EV is the union of BEV and HEV. The total of respondents is *n* = 400.

Choice set	Do not switch (%)	NCV to HEV (%)	NCV to BEV (%)	HEV to BEV (%)	Switch order (%)	Switch to BEV (%)	Switch to EV (%)
Choice set 1: The same price for all alternatives	222 (55.5)	79 (19.7)	44 (11.0)	53 (13.3)	2 (0.5)	97 (24.3)	176 (44.0)
Choice set 2: Increased recharging availability (improved network) for BEVs	228 (57.0)	29 (7.3)	63 (15.7)	79 (19.7)	1 (0.3)	142 (35.5)	171 (42.7)
Choice set 3: Free parking for BEVs	234 (58.5)	13 (3.3)	68 (17.0)	83 (20.7)	2 (0.5)	151 (37.8)	164 (41.0)
Choice set 4: Shorter refueling time for BEVs	165 (41.2)	16 (4.0)	87 (21.8)	130 (32.5)	2 (0.5)	217 (54.3)	233 (58.3)
Choice set 5: Higher driving range for BEVs	133 (33.3)	18 (4.5)	99 (24.8)	150 (37.5)	0 (0.0)	249 (62.3)	267 (66.8)
Choice set 6: Combination of attributes for BEVs (reduced price and recharging time, increased driving range and free parking policy)	98 (24.5)	11 (2.8)	121 (30.2)	167 (41.8)	3 (0.7)	288 (72.0)	299 (74.8)

In the baseline choice set, 167 respondents (41.8%) for a NCV, 194 (48.5%) opted for an HEV, and 39 (9.8%) for a BEV.

We note the importance of a reduction in the price of HEVs and BEVs, since 74.8% of the 400 respondents initially choosing an NCV switched their preference to an HEV or a BEV when the price was reduced. Other monetary incentives that influence consumer choice are the public policies that reduce the motor vehicle tax on BEVs and offer the possibility of free parking for BEVs. For example, Table 7 (third row, last column) shows that 164 of respondents (41%) initially opting for an NCV would switch to a EV if free parking was introduced.

6. Conclusions

We have examined consumer preferences for electric vehicles by estimating choice models, determining consumer profiles and examining preference shifts based on discrete choice data from Germany. Our research is based on a sample of individuals who participated in a discrete choice experiment, among whom one in four respondents had previously driven a BEV vehicle.

We identify eight main categories influencing consumer preferences: (i) the purchase price and operational costs, including fuel and car tax charges; (ii) range anxiety, including driving distance, and refueling time; (iii) pro-environmental preferences, such as eco-friendly car attributes and the consumption of green electricity; (iv) the drivability of the car, including the power of the car's engine; (v) car ownership characteristics, including the number of cars in a household; (vi) socio-demographic characteristics, such as gender and age; and, finally, (vii) driving habits, such as being primarily an urban driver; and (viii) having had prior experience of driving an EV.

Having previous experience of an electric car appears to be of special interest for the successful implementation of the new mobility concept represented by EVs. Yet, it seems that consumers in Germany continue to underestimate the power and drivability of EVs as they lack firsthand experience driving cars fitted with this new technology. This conclusion seems to confirm the findings reported by Jensen et al. (2013) regarding the switch in preferences recorded after gaining driving experience in a BEV and those of Bühler et al. (2014) regarding the change in perception of BEVs. These variables need to be taken into consideration in future research projects and should form part of the core of feasible policy options. For example, Bakker and Trip (2013) recommend organizing test-drive events in conjunction with car dealerships and introducing BEVs in car-sharing fleets.

Our findings regarding the impact of such factors as the purchase price, driving range, ecological awareness indicators and public policy incentives are in line with the conclusions drawn by previous studies. However, the influence of being primarily an urban driver is reversed, but this might be caused by spurious correlation as urban driver consumers tend to be younger. We also find a statistical significance on the stated preference of the respondent's age, the number of cars in the household, gender and refueling time. Having previous experience of driving an EV is crucial for enhancing the preference for electric cars when other factors are taken into account.

Bohnsack et al. (2014) already analyzed different business models for sustainable technologies in order to increase the attractiveness of electric vehicles as they seek to penetrate mainstream markets. One possibility is the introduction of car-sharing programs in cities with BEVs to avoid the high costs of leasing a battery and also to gain market share of new BEV drivers. The combination of Bohnsack et al. (2014) market penetration strategy for BEVs with car-sharing companies, and our finding that experience of driving an EV increases the probability of choosing a BEV, seems to be in line with the claim that membership of a car-sharing fleet could increase the likelihood of purchasing a BEV. Moreover, given that the profile of a car-sharing member is that of a young individual, the car industry has the opportunity to convince possible future purchasers of the advantages of this new mobility concept and thus bind new customers.

Overall, although electric vehicles face supply-side barriers, including certain vehicle attributes that can be improved and a deficient recharging infrastructure, German consumers are persuaded by new BEV technology once they have tested it. At this point, similar behaviors are expected in other European countries.

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APPENDIX

The following tables are supporting information that can be made available electronically as additional material.

Table S1

Choice Set 2: Same price for each car

Characteristic	NCV	HEV	BEV
Purchase Price	23700 €	23700 €	23700 €
Fuel Cost per 100 km	7.00 €	6.50 €	3.50 €
CO_2 Emissions	100%	75%	0%
Driving Range	1447 km	1154 km	190 km
Fuel Availability	100%	100%	14%
Refueling Time	5 min	5 min	420 min
Acceleration 0 up to 100 km/h	11.5 sec	10.4 sec	7.2 sec
No Motor Vehicle Tax	No	No	Yes
Free Parking	No	No	No

Table S2

Choice Set 3: Increasing recharging availability for battery electric vehicles

Characteristic	NCV	HEV	BEV
Purchase Price	23700 €	26800 €	34950 €
Fuel Cost per 100 km	7.00 €	6.50 €	3.50 €
CO_2 Emissions	100%	75%	0%
Driving Range	1447 km	1154 km	190 km
Fuel Availability	100%	100%	100%
Refueling Time	5 min	5 min	420 min
Acceleration 0 up to 100 km/h	11.5 sec	10.4 sec	7.2 sec
No Motor Vehicle Tax	No	No	Yes
Free Parking	No	No	No

Table S3

Choice Set 4: Free parking for battery electric vehicle

Characteristic	NCV	HEV	BEV
Purchase Price	23700 €	26800 €	34950 €
Fuel Cost per 100 km	7.00 €	6.50 €	3.50 €
CO_2 Emissions	100%	75%	0%
Driving Range	1447 km	1154 km	190 km
Fuel Availability	100%	100%	14%
Refueling Time	5 min	5 min	420 min
Acceleration 0 up to 100 km/h	11.5 sec	10.4 sec	7.2 sec
No Motor Vehicle Tax	No	No	Yes
Free Parking	No	No	Yes

Table S4

Choice Set 5: Shorter refuel time for battery electric vehicle

Characteristic	NCV	HEV	BEV
Purchase Price	23700 €	26800 €	34950 €
Fuel Cost per 100 km	7.00 €	6.50 €	3.50 €
CO_2 Emissions	100%	75%	0%
Driving Range	1447 km	1154 km	190 km
Fuel Availability	100%	100%	14%
Refueling Time	5 min	5 min	30 min
Acceleration 0 up to 100 km/h	11.5 sec	10.4 sec	7.2 sec
No Motor Vehicle Tax	No	No	Yes
Free Parking	No	No	No

Table S5

Choice Set 6: Higher driving range for battery electric vehicle

Characteristic	NCV	HEV	BEV
Purchase Price	23700 €	26800 €	34950 €
Fuel Cost per 100 km	7.00 €	6.50 €	3.50 €
CO_2 Emissions	100%	75%	0%
Driving Range	1447 km	1154 km	750 km
Fuel Availability	100%	100%	14%
Refueling Time	5 min	5 min	420 min
Acceleration 0 up to 100 km/h	11.5 sec	10.4 sec	7.2 sec
No Motor Vehicle Tax	No	No	Yes
Free Parking	No	No	No

Table S6

Choice Set 7: A combination of improved attributes for battery electric vehicles (decreasing price and recharging time, increasing driving range and free parking policy)

Characteristic	NCV	HEV	BEV
Purchase Price	23700 €	26800 €	26950 €
Fuel Cost per 100 km	7.00 €	6.50 €	3.50 €
CO_2 Emissions	100%	75%	0%
Driving Range	1447 km	1154 km	750 km
Fuel Availability	100%	100%	100%
Refueling Time	5 min	5 min	30 min
Acceleration 0 up to 100 km/h	11.5 sec	10.4 sec	7.2 sec
No Motor Vehicle Tax	No	No	Yes
Free Parking	No	No	Yes

Table S7

Number of responses and percentage preferences in the baseline choice set for the three different vehicles

Characteristic	NCV		HEV		BEV		Total	
Gender								
Woman	64	40.76%	77	49.04%	16	10.19%	157	100.00%
Man	103	42.39%	117	48.15%	23	9.47%	243	100.00%
Residence								
City center	62	48.44%	58	45.31%	8	6.25%	128	100.00%
Other	105	38.60%	136	50.00%	31	11.40%	272	100.00%
Income								
Below 2,000 €	25	39.06%	33	51.56%	6	9.38%	64	100.00%
2,001-3,000 €	38	38.00%	53	53.00%	9	9.00%	100	100.00%
3,001-4,000 €	48	45.71%	45	42.86%	12	11.43%	105	100.00%
4,001-5,000 €	29	50.88%	22	38.60%	6	10.53%	57	100.00%
5,001-6,000 €	14	36.84%	23	60.53%	1	2.63%	38	100.00%
Above 6,000 €	13	36.11%	18	50.00%	5	13.89%	36	100.00%
Urban Driver								
Mostly urban driver	58	50.00%	47	40.52%	11	9.48%	116	100.00%
Less than 60% city driving on average	109	38.38%	147	51.76%	28	9.86%	284	100.00%
Number of Cars								
0	23	30.67%	46	61.33%	6	8.00%	75	100.00%
1	78	43.82%	87	48.88%	13	7.30%	178	100.00%
2	55	44.00%	54	43.20%	16	12.80%	125	100.00%
3	9	50.00%	5	27.78%	4	22.22%	18	100.00%
4 or More	2	50.00%	2	50.00%	0	0.00%	4	100.00%
Size of Household								
1	30	41.67%	37	51.39%	5	6.94%	72	100.00%
2	73	40.56%	87	48.33%	20	11.11%	180	100.00%
3	28	40.58%	31	44.93%	10	14.49%	69	100.00%
4	24	45.28%	27	50.94%	2	3.77%	53	100.00%
5 or More	12	46.15%	12	46.15%	2	7.69%	26	100.00%
Children in Household								
0	126	40.38%	156	50.00%	30	9.62%	312	100.00%
1	19	47.50%	15	37.50%	6	15.00%	40	100.00%
2	17	48.57%	17	48.57%	1	2.86%	35	100.00%
3 or More	5	38.46%	6	46.15%	2	15.38%	13	100.00%
Importance Driving Range								
1 Not at all important	5	45.45%	3	27.27%	3	27.27%	11	100.00%
2	6	26.09%	10	43.48%	7	30.43%	23	100.00%
3	49	47.57%	43	41.75%	11	10.68%	103	100.00%
4	67	44.37%	75	49.67%	9	5.96%	151	100.00%
5 Very important	40	35.71%	63	56.25%	9	8.04%	112	100.00%
Importance Purchase Price								
1 Not at all important	2	50.00%	1	25.00%	1	25.00%	4	100.00%
2	5	41.67%	5	41.67%	2	16.67%	12	100.00%
3	25	34.25%	37	50.68%	11	15.07%	73	100.00%
4	59	38.31%	84	54.55%	11	7.14%	154	100.00%
5 Very important	76	48.41%	67	42.68%	14	8.92%	157	100.00%
Importance Tax Reduction								
1 Not at all important	8	53.33%	5	33.33%	2	13.33%	15	100.00%
2	19	39.58%	25	52.08%	4	8.33%	48	100.00%

3	49	42.24%	55	47.41%	12	10.34%	116	100.00%
4	65	42.21%	81	52.60%	8	5.19%	154	100.00%
5 Very important	26	38.81%	28	41.79%	13	19.40%	67	100.00%
Importance Ecological Car								
1 Not at all important	4	36.36%	3	27.27%	4	36.36%	11	100.00%
2	13	59.09%	9	40.91%	0	0.00%	22	100.00%
3	51	58.62%	30	34.48%	6	6.90%	87	100.00%
4	64	44.44%	74	51.39%	6	4.17%	144	100.00%
5 Very important	35	25.74%	78	57.35%	23	16.91%	136	100.00%
Importance Refuel Time								
1 Not at all important	9	45.00%	4	20.00%	7	35.00%	20	100.00%
2	22	48.89%	19	42.22%	4	8.89%	45	100.00%
3	61	44.53%	64	46.72%	12	8.76%	137	100.00%
4	61	41.22%	75	50.68%	12	8.11%	148	100.00%
5 Very important	14	28.00%	32	64.00%	4	8.00%	50	100.00%
Using Green Electricity								
1 Does not apply to respondent	52	53.61%	38	39.18%	7	7.22%	97	100.00%
2	18	42.86%	21	50.00%	3	7.14%	42	100.00%
3	21	52.50%	18	45.00%	1	2.50%	40	100.00%
4	11	40.74%	14	51.85%	2	7.41%	27	100.00%
5 Does apply to respondent	65	33.51%	103	53.09%	26	13.40%	194	100.00%
Importance of Turn off/Stand-By								
1 Not at all important	20	50.00%	18	45.00%	2	5.00%	40	100.00%
2	27	60.00%	16	35.56%	2	4.44%	45	100.00%
3	33	47.14%	29	41.43%	8	11.43%	70	100.00%
4	49	38.89%	68	53.97%	9	7.14%	126	100.00%
5 Very important	38	31.93%	63	52.94%	18	15.13%	119	100.00%
Electric Car Experience								
Have driven a battery electric vehicle before	31	31.00%	51	51.00%	18	18.00%	100	100.00%
Have not driven a battery electric vehicle before	136	45.33%	143	47.67%	21	7.00%	300	100.00%
Using Car Sharing								
Is user of a car sharing group	140	43.48 %	154	47.83%	28	8.70%	322	100.00%
Is not user of a car sharing group	27	34.62 %	40	51.28%	11	14.10%	78	100.00%
Age (mean)	42.65		41.29		47.79		42.58	

Some importance attributes not found to have a significant influence in the choice preference models are not reported.