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MASTER'S THESIS

Households' adoption of energy-efficient technologies in Greece: Independently or Jointly?

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Declaration of Authorship

The author hereby declares that she compiled this thesis independently, using only the listed resources and literature, and the thesis has not been used to obtain a different or the same degree.

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During the preparation of this thesis, the author did not use any tool or service other than statistical software to estimate the models of this study. The author reviewed and edited the content as necessary and takes full responsibility for the content of the publication.

Prague, April 30, 2024 Dimitra Spyropoulou

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Abstract

The main goal is to analyse the individual preferences of Greek consumers for alternative-fueled passenger vehicle technologies, including battery electric and plug-in hybrid electric vehicles. Considering the low electric vehicle uptake and the large solar energy potential in Greece, I investigate the impact of public support of a combination of photovoltaics and battery electric vehicles when these two technologies are supported jointly on consumers' decisions. I use discrete choice experiments to estimate the preferences and willingness to pay of a representative sample of potential car buyers in Greece for monetary, technical and policy attributes of vehicles. I find a positive attitude of consumers towards battery electric and plug-in hybrid electric vehicles and that the installation of photovoltaics is instrumental in exploiting the full benefits of electric vehicles. The results indicate that vehicle price, operating costs, normal charging time and subsidization for wallbox installation are the key factors affecting the adoption of electric vehicles. I also explore both unobserved and observed consumer preference heterogeneity. Policy recommendations include joint support, when possible, of the adoption of electric vehicles with the installation of photovoltaics and wallbox, the reduction of the upfront price, and the increase in consumers' knowledge of technologies and related policies.

JEL Classification	C15; D12; D90; Q42; Q55
Keywords	Battery Electric Vehicles; Photovoltaics; Consumer choices; Stated Preference; Discrete Choice Experiments; Mixed Logit; Willingness to Pay
Title	Households’ adoption of energy-efficient technologies in Greece: Independently or Jointly?

Abstrakt

Hlavním cílem práce je analyzovat individuální preference řeckých spotřebitelů voblasti technologií osobních vozidel s alternativní palivem, včetně bateriových elektrických a plug-in hybridních elektrických vozidel. Vzhledem k nízkému rozšíření elektrických vozidel a velkému potenciálu solární energie v Řecku zkoumám dopad veřejné podpory kombinace fotovoltaiky a bateriových elektrických vozidel, pokud jsou tyto dvě technologie podporovány společně, na rozhodování spotřebitelů. K odhadu preferencí a ochoty platit reprezentativního vzorku potenciálních kupců automobilů v Řecku za peněžní, technické a politické atributy vozidel používám experimenty diskrétní volby. Shledávám, že spotřebitelé mají pozitivní vztah k bateriovým elektrickým a plug-in hybridním elektrickým vozidlům a že instalace fotovoltaiky je nástrojem pro plné využití výhod elektrických vozidel. Výsledky ukazují, že cena vozidla, provozní náklady, běžná doba nabíjení a dotace na instalaci wallboxů jsou klíčovými faktory ovlivňujícími přijetí elektrických vozidel. Zkoumám také nepozorovanou i pozorovanou heterogenitu spotřebitelských preferencí. Politická doporučení zahrnují společnou podporu přijetí elektrických vozidel s instalací fotovoltaiky a wallboxů, pokud je to možné, snížení počáteční ceny a zvýšení znalostí spotřebitelů o technologiích a souvisejících politikách.

Klasifikace	C15; D12; D90; Q42; Q55
Klíčová slova	Bateriová elektrická vozidla; Fotovoltaika; Spotřebitelské volby; Uvedená preference; Experimenty s diskrétní volbou; smíšený Logit; Ochota platit
Název práce	Přijímání Energeticky Učinných Technologií Domácnostmi v Řecku: Nezávisle nebo Společně?

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Acronyms

AC Alternating Current

ACEA European Automobile Manufacturers' Association

ASC Alternative Specific Constant

BEV Battery Electric Vehicle

BES Battery Energy Storage

CNG Compressed Natural Gas

CO2 Carbon Dioxide

CL Conditional Logit

CV Conventional Car

DC Direct Current

DCE Discrete Choice Experiment

EAFO European Alternative Fuels Observatory

EEA European Environment Agency

EU European Union

EV Electric vehicle (include BEV, PHEV, and HEV)

GHG Greenhouse Gas

HEV Hybrid Electric Vehicle

ICE Internal Combustion Engine

IIA Independence of Irrelevant Alternatives

kWh Kilowatt-Hour

kWp Kilowatts Peak

LNG Liquefied Natural Gas

MXL Mixed Logit

NO2 Nitrogen Dioxide

PHEV Plug-in Hybrid Electric Vehicle

PM Particulate Matter

PV Photovoltaic

RES Renewable Energy Sources

RP Revealed Preferences

SP Stated Preferences

Master's Thesis Proposal

Author: MS. Dimitra Spyropoulou
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Proposed Topic:
Households' adoption of energy-efficient technologies in Greece: Independently or Jointly?

Motivation:
The adoption of energy-efficient and low-carbon technologies has been an instrumental strategy for governments to reduce greenhouse emissions (Hesselink & Chappin, 2019). As a part of the European Green Deal, the EU has proposed stringent targets for significant mitigation of GHG emissions and increased use of renewable sources in its Fit for 55 policy package (EC, 2019). The package also includes an extension of the EU emission Trading System to the Buildings and Transport sector, an increase in the share of renewable sources and clean transport technologies, and enriching the infrastructure for low-carbon vehicles, which all will affect the relative prices of fossil fuels and the cost of conventional technologies compared to their low-carbon alternatives.

Each member state needs to reach national targets through the implementation of policies aiming to reduce its carbon footprint. Policymakers need to understand the existing barriers identified through literature and provide incentives to all sectors of the economy for the adoption of energy-efficiency technologies. Examples of barriers can be related to the energy supply, economic reasons, or social and behavioural differences (Hesselink & Chappin, 2019). Economic barriers are an important issue for many households in Greece since a majority of them cannot afford the investment in new technologies, the renovation of the old building they live in, or the purchase of low-carbon vehicles. Households need to be provided with the right incentives that will be effective and make carbon transition socially affordable. Also, consumers' capabilities and their preferences shall be taken into account.

According to the "world in data", in 2020, Greece produced almost 60 per cent of its total energy using fossil fuels, increasing the share of renewable resources to almost 40 per cent. However, the dependence on imports for fossil fuels and the excessive increase in their prices, along with the climate change issues, indicate the need for the adoption of energy-efficient and low-carbon technologies. From the renewable sources, only barely 9 per cent of electricity production belongs to solar energy, despite the incentives that have been given by the government since 2010 and the high source of natural sunlight in the country.

According to the report on the EU progress of Greece on climate action, the transportation sector is one of the sectors with the lowest emission reductions, since it succeded to reduce its emissions between 2005 and 2019 by only 21 per cent. Electric cars are considered a necessary choice for GHG reduction but the demand for electric vehicles in Greece remains considerably low compared to other countries due to the absence of incentives and the low availability of charging points (Lioutas, Adamos & Nathanail, 2020). Only recently, the government has announced measures that promote the swift toward electric vehicles with tax reductions, circulation laws in Athen's centre, and subsidies (Geronikolos & Potoglou, 2021). Although electric vehicles comprise a better choice compared to diesel and petrol vehicles, their production and their charging still use fossil fuels. For real exploitation of the benefits that electric vehicles can offer, it is interesting to examine what are the links between the adoption of different energy-efficient technologies and how the investment in one of them, or the incentives provided for one of them, can affect the adoption of another and contribute to a total, significant reduction of energy demand and emissions.

Hypotheses:

1. Hypothesis #1: Households owning PVs and other energy-efficient technologies are more likely to own or buy an EV.
2. Hypothesis #2: The availability and the cost of charging points for electric cars are significant for respondents' choice to purchase an EV.
3. Hypothesis #3: The demand for electric cars can be significantly increased if the households are provided with energy from solar panel parks or if they can produce their solar energy for the charging of EVs.
4. Hypothesis #4: Subsidies and support programs related to PVs and solar energy influence positively and significantly the will of households to purchase an EV.
5. Hypothesis #5: Incentives for the promotion of electric mobility alone are not sufficient to significantly increase EV purchases.
6. Hypothesis #6: Subsidies and programs focusing on the promotion of PVs, energy-efficiency technologies and renovations can be combined with electric mobility incentives and significantly increase EV purchases in the Greek market.
7. Hypothesis #7: Low-income households have significantly lower WTP for an EV compared to higher-income households even after they are provided with subsidies.

Methodology:

Data

We will use individual, household-level, data collected from our own designed original survey. The data will be collected through online surveys using (Computer-Assisted-Web-Interviewing, CAWI) and self-interviewing (Computer-Assisted-Self-Interviewing, CASI). The cost of the data collection will be covered by one of the research projects coordinated by my supervisor, Milan Ščasný, as a part of a remuneration for my work as a research assistant at the Environment Centre of Charles University.

A sample of about 1000 respondents, residents of Greece, will be interviewed. In addition to standard socio-economic, demographic, and building data, the surveys will include questions related to the energy-efficiency technologies households are using or intend to purchase, including the subsidies households might have received or intend to apply for.

Methodology

We elicit stated preferences for the adoption of the new low-carbon technologies, specifically for BEV and PV, through discrete choice experiments, following previous work, for instance Ščasný et al. 2017. Technical, policy (incl. subsidies), and monetary characteristics of several alternatives of the technology will be described on the choice card to examine the preferences of respondents between choices related to the purchase of electric vehicles and a set of different attributes for the vehicles such as the cost, the charging points, the sources of energy, and programs, subsidies or measures already introduced or discussed by the Greek government. The design of the discrete choice experiments (DCE) will be prepared in collaboration with my supervisor, Milan Ščasný, and his colleagues.

We posit choices of individuals are driven by the random utility model (McFadden, 1974), assuming that an individual's utility function can describe the preferences of an individual among the available alternatives, and individuals are able to choose the alternative that maximizes his/her utility. Estimation of utility parameters, households' implicit WTP for the characteristics of energy-efficient technologies, will allow me to derive and examine the trade-off between the different attributes. The estimated probability will inform about the potential market share of concerned technologies.

Based on the literature and a presurvey I will conduct in Greece, I will choose the monetary, technical, infrastructure, and policy-related attributes and their levels for the DCE design. The combination of these attributes will be a significant step to avoid offering the respondent a preferred, dominant choice. The design will include, as one of the attributes, subsidies and programs already offered by the government aiming to increase the energy-efficiency, the use of RES, or EV purchases, and theoretical subsidies or programs which will be a combination of implemented or discussed incentives. We will pay special attention to situations when the two technologies might be purchased independently or jointly, and when fuel-mix and hence emission-intensity of generating electricity will be changing over time.

The data from the surveys will be econometrically analysed, estimating Conditional Logit, including the test of hypotheses mentioned above. To examine the differences in consumers' choices, random parameters (mixed logit) models will be estimated, which assumes that individual consumers' preferences follow some a priori specified parametric distribution (Revelt and Train, 1998), allowing for unobserved preference heterogeneity in the model structure.

Expected Contribution:

Although the literature has extensively dealt with the barriers to the adoption of energy-efficient technologies and the different characteristics of electric car buyers, little or no literature has focused on the greek economy.
Also, I will focus on solar energy as a renewable, highly available in the country, source of energy, and one of the energy-efficient technologies possible to adopt. I will attempt to find the links between the subsidies provided for PVs and the demand for electric cars.
I intend to examine what is the best combination of incentives for greek households which can positively affect their WTP for an EV.
An understanding of the links between the different energy-efficiency technologies will assist policymakers to introduce more efficient incentives, motivating lower-income households, increasing EV purchases in the country, and reducing the money spent by the government for the different targeting subsidies.

Outline:

Introduction: I will focus on the importance of the reduction of GHG emissions and the use of renewable-based and energy-efficient technologies. I will mention the present energy sector situation and possibilities in Greece.
Literature review: I will review relevant to my topic research and its results. I will identify potential research gap.
Data: I will describe in detail the process followed to collect the data, and how the experiment was built.
Methodology: Theoretical model (RUM) will be described, followed by a description of the econometric approaches used to estimate the data and test the hypotheses.
Results: I will discuss the results, their explanation, and their importance.
Conclusion: I will summarize my research and explain how the results could be used in policy-making in Greece and other similar climate countries.

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1 Introduction

Measures to mitigate GHG emissions are taken globally and regionally to tackle the increasing threats to human health and well-being caused by climate change and air pollution (EEA, 2024; IPCC, 2023). To accomplish that, the increasing adoption of energy-efficient and low-carbon technologies, such as EVs, PVs, BESs, and micro-CHP units, is an instrumental strategy for governments (Hesselink & Chappin, 2019). Specifically, the mass adoption of EVs is of great importance in destabilising "automobility regimes based on fossil fuels" (Skjølsvold & Ryghaug, 2020, p.1). EV diffusion is supported by the hypothesis that EVs are an eco-friendlier technology than CVs, and consequently, increasing the EV fleet would be a step towards a more sustainable society. However, it is suggested that EV diffusion needs to be combined with charging from decarbonised electricity by RES (Friis, 2020; EEA, 2016). For instance, solar PV systems allow households to produce their electricity, and they can be seen as a motive to adopt other energy-efficient technologies such as EVs (Hesselink & Chappin, 2019).

The EU, as a part of the European Green Deal, has proposed stringent targets for significant mitigation of GHG emissions and increased use of RES in its Fit for 55 policy package (EC, 2019). The package also includes an extension of the Trading System for building and road transport fuels, an increase in the share of RES and clean transport technologies, and enrichment of the infrastructure for low-carbon vehicles. The EU aims to reduce GHG emissions from new cars, compared to 2021 levels, by at least 55% from 2030 to 2034 and by 100% for new cars and vans from 2035 by reducing the use of conventionally fueled vehicles in urban transport (EC, 2023).

Following the EU directive for sustainability and a climate-neutral economy, each European member state needs to reduce its carbon footprint by reaching national targets (EC, 2019). The revised National Energy and Climate Plan (NECP) for Greece, introduced in 2023, sets new ambitious targets regarding electromobility, aiming for the increased deployment of EVs, adequate charging infrastructure development and the increased share of RES in electricity used for EV charging. The main target for Greece is for 30% of newly registered vehicles to be BEVs by 2030 (NECP, 2023). The government introduced in 2020 policies and incentives,

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such as tax reductions, purchase subsidies, circulation law in Athen's centre, and free parking (Geronikolos & Potoglou, 2021).

Despite the government's support for the technology in the last few years, the adoption of EVs remains significantly low globally (Rotaris et al., 2021). The current EV adoption in Greece is considerably lower than that of other European countries, mainly due to the absence of incentives till 2020 and the low availability of charging points (Lioutas et al., 2020). Specifically, Greece is still in the initial phase of EV uptake, with only 0.20% and 0.31% of the total fleet of passenger cars being BEVs and PHEVs, respectively (EAFO, 2024).

In addition, Greece is implementing reforms in the energy sector and has set targets to reduce GHG emissions by more than 56% by 2030 compared to 2005 (Dianeosis, 2021). The strong deployment of solar and wind in energy and electricity production is crucial for the shift to RES. Therefore, the promotion of RES is supported by auctions and the simplification of licensing procedures for renewable energy projects that facilitate the deployment of solar PV and onshore wind, as well as subsidies for households to install PV systems at their houses (Dianeosis, 2021).

I focus on solar energy and household PVs for four reasons. First, solar energy has a high potential due to the country's abundant natural sunlight. Second, studies have shown that solar energy is preferable among RES (Stauch, 2021). Third, the government has been offering incentives and subsidies for installing small PV systems on the roofs of households since 2010 (Dianeosis, 2021), with installed PV capacities exceeding, for the first time in 2021, those of other energy sources, such as wind (IEA, 2021). Fourth, although wind turbines can generate much more energy than solar PVs, their installation requires much space in rural and forest areas, far from the urban areas that need more energy, and can potentially hurt wildlife (Elemental Green, 2021). In contrast, solar PVs do not need much space and can be installed in any building.

To achieve the ambitious targets the Greek government has set, the factors that influence the adoption of EVs by Greek households are important to be investigated. In addition, for the real exploitation of the benefits that EVs can offer, it is interesting to examine what are the links between the adoption of different energy-efficient technologies, such as EVs and PVs, and whether the incentives provided for one of them can affect the adoption of the other. By understanding what motivates or prevents households from adopting EVs and consumers'

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unique capabilities and preferences, policymakers can provide effective incentives to households to make the carbon transition faster and socially affordable.

The literature indicates a wide range of EV-related attributes that affect consumers' decisions, such as purchase price, operation costs, charging infrastructure and time, and driving range (Li et al., 2020). I test the hypothesis that the availability of PVs in households can increase the demand for EVs by giving the opportunity to households to install a wallbox (home charger) and charge their vehicles at the convenience of their house with electricity produced by their installed PV systems. To do so, I use DCEs to elicit consumers' preferences for all the main available types of vehicles in the market (CVs, HEVs, PHEVs and BEVs), providing a combination of BEV and PV installation as an alternative to all other types of vehicles. Although the literature has extensively dealt with the factors influencing the adoption of EVs and, to a smaller extent, of PVs, little or no literature has focused on the Greek economy. To my knowledge, this is the first study that aims to elicit the preferences of Greek households using DCEs for all types of vehicle technologies in combination with PVs

For this study, an original survey and two DCEs were created. A sample of more than 1,000 potential car buyers residing in Greece were interviewed. Monetary, technical and policy characteristics related to both vehicles and PVs were provided to respondents who were asked to examine and compare a set of alternatives in hypothetical scenarios and choose their preferred alternative. I posit that the choices of individuals are driven by the random utility model (McFadden, 1974), assuming that an individual's utility function can describe the preferences of an individual among the available alternatives, and individuals are able to choose the alternative that maximises their utility. The estimated probability provides information on the potential market share of the studied technologies. The data are econometrically analysed using CL (conditional logit) and MXL (mixed logit) models. The latter assumes that individual consumer preferences follow some a priori specified parametric distribution, allowing for unobserved preference heterogeneity in the model structure (Revelt & Train, 1998).

Results show a positive attitude of Greek consumers towards EV technologies, although CVs remain the prevalent car technology. Expanding options for consumers by allowing them to install PVs along with their BEV purchase can potentially shift their preferences towards BEVs. Although both BEVs and PHEVs are attractive options for Greek consumers, financial barriers prevent the adoption of the technology. Car purchase price and operating costs are

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important factors for Greek consumers when considering their next car purchase. In addition, a subsidy for installing a wallbox to charge their EVs at home is very significant for Greek consumers, increasing their WTP. Normal charging time is also an important barrier to increasing EV adoption. Surprisingly, PV price and capacity do not significantly impact consumers' decisions, while a higher driving range of BEVs seems to affect their WTP negatively. However, it is worth noting that the results indicate high preference heterogeneity. Finally, I observe the need for more knowledge and information about EV and PV technologies and related incentives.

The remainder of the text is organised as follows. *Background Section* explains the need for reforms in the transportation and energy sector, provides information regarding electromobility and the current market situation, and describes the incentives introduced in Greece for EV and PV deployment. *Literature Review* provides a detailed overview of the most recent studies regarding those attributes affecting EV adoption. *Methodology* presents the DCEs design and the model specification. *Data* describes the data collection process, the survey structure, and the profile of potential car buyers in Greece. *Results* present the findings of the analysis. *Discussion* explores the implications of the findings while suggesting ideas for future research. Finally, *Conclusion* summarises the entire content of this thesis.

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2 Background Section

2.1. The Need to Shift Towards a Climate-Neutral Economy

Energy combustion, industrial processes, and transportation are the sectors producing the most GHG emissions globally (IEA, 2023). Global energy-related CO2 emissions reached a new high of over 36.8 Gt in 2022 due to the gas-to-coal switch for electricity and heat generation, the energy price shocks, rising inflation, and disruptions to traditional fuel trade flows, but the increased deployment of clean energy technologies such as RES, EVs, and heat pumps prevented an additional 550 Mt increase in CO2 emissions. Specifically, the contribution of solar PV and wind was significant since their use in the generation mix of electricity increased by 15% (from 2021 to 2022) and overtook the use of gas and nuclear power, preventing the release of almost 75 Mt CO2 of emissions in the atmosphere (IEA, 2023).

Greece remains among the OECD's ten most carbon-intensive economies due to the prevalence of lignite for power generation and reliance on diesel on the non-interconnected islands, despite the country's significant GHG emissions reductions in the last decades (OECD, 2021). However, according to the "World in Data", Greece has already succeeded in producing almost 40% of its total energy using RES (Ritchie & Roser, 2022). In 2022, for the first time, RES was the main source of the country's electricity generation mix. Specifically, 37.36% of electricity was produced by gas, 20.76% by wind, 12.42% by solar, 10,47% by coal, 9.04% by hydro, 9.00% by other fossil fuels and 0.96% by bioenergy (Ritchie & Roser, 2022).

In Greece, increasing the share of solar energy in electricity production is considered crucial for the successful shift to RES (Dianeosis, 2021). Due to PVs' environmental advantages, as well as the increasing support for PV technology by governments, the growing efficiency of the technology and the continuous decreases in the cost of PV panels, PVs have had a fast and stable growth in Europe since 2007 (Gu & Feng, 2020). Therefore, solar energy has become the main RES, with the largest number of installations both in Europe and in Greece (Gu &

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Feng, 2020; IEA, 2021). Specifically, in Greece, in 2022, 207.4 MW of new RES capacities were installed, of which 153.2 MW were solar power plants (Todorović, 2023).

The transportation sector accounts for more than 37% of global CO2 emissions (7.98 Gt) due to the sector's high reliance on fossil fuels, which is higher than any other end-use sector (IEA, 2023). Road transport, namely, road vehicles, including cars, trucks, buses, and two- or three-wheelers, is responsible for most of the sector's CO2 emissions, pollutants, such as NOx and particulate matter, and noise pollution (EEA, 2024). In Europe, road transport emissions account for 25% (in 2023) of total GHG emissions, while private cars only account for almost 44% of the EU's transport-related GHG emissions (EEA, 2024). Moreover, air pollution produced by road transport is of particular concern in urban areas, considering that cities are already globally responsible for 60% of GHG emissions production, and the anticipated urbanisation is expected to exaggerate the problem (Anastasiadou & Gavanas, 2022).

It is worth noting that the transportation sector in Greece is one of the most pollutant sectors of the country's economy due to its high dependence on oil (Dianeosis, 2021). The transportation sector has the largest share of the final energy consumption in Greece, with 39% of final consumption, consuming 5.9 million toe (tons of oil equivalent) in 2018. In the same year, 97% of the energy consumption in the transport sector was produced by petrol, oil and diesel, while electricity was responsible only for 0.29% of it. The average age of vehicles in Greece is also high, 17 years, contributing to the GHG emissions since vehicles use engines of older technology, which consume more energy and produce more emissions (Dianeosis, 2021). In addition, transportation is the sector with the lowest emission reductions in the country, with a total reduction of only 21% in its emissions between 2005 and 2019 (Dianeosis, 2021). All of the above indicate the immediate need for resolutions in the sector and a shift towards alternative energy sources and transport modes, but at the same time, highlight the opportunities that still exist for a high decrease in the country's total GHG emissions.

2.2. Electromobility

One central policy to mitigate emissions from road transport is the promotion of electromobility (e-mobility) (EC, 2019). Electromobility refers to a clean, quiet, and energy-efficient mode of transportation using electric vehicles (EVs) powered by batteries or hydrogen fuel cells

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(Murphy, 2023). An EV is powered by a battery pack and uses one or more electric motors that can either assist a conventional internal combustion engine (ICE) or power the car completely, depending on the type of EV

This study focuses only on the three most popular (to this date) EV technologies: BEV, PHEV, and HEV. Below, these three different types of EVs and the currently massively used CVs are described as reported by Report No 20/2016 (EEA, 2016).

- Conventional vehicle (CV): uses fossil fuels (e.g., petrol or diesel) to power an internal combustion engine. The main advantages of CVs due to the years of technology's development are the variety of vehicles available in the market and the high availability of repair and refuelling stations. Nevertheless, CVs depend on fossil fuels, produce air and noise pollution, and have low energy efficiency, with only 18% - 25% of the energy from the fuel used to move the car on the road.
- Battery electric vehicle (BEV): is powered solely by an electric motor, using electricity stored in an onboard battery. The battery is charged by plugging the car into a charging point connected to the local electricity grid. BEVs have high efficiency since they can convert about 80% of the energy into motion, can be recharged at home or work, have low engine noise, and produce zero CO2 emissions. On the other hand, some of the main disadvantages of the technology currently are the low recharging station availability, the long recharging time, and the low driving range (compared to CVs).
- Plug-in hybrid electric vehicle (PHEV): is powered by an electric motor and an internal combustion engine. The onboard battery can be charged from the grid, and the combustion engine supports the electric motor when needed. Like BEVs, PHEVs have high energy efficiency and can be recharged at home or work. In addition, since they also use an internal combustion engine, they have the advantage of a sizeable refuelling station availability. The CO2 emissions produced by this technology depend on the mode the vehicle is used. Finally, the main disadvantage of PHEVs is the complexity of the technology.
- Hybrid electric vehicle (HEV): combines an internal combustion engine and an electric motor that assists the conventional engine during, for example, vehicle acceleration. The battery gets charged during regenerative braking and cannot be charged from the grid. The main advantages of HEVs are the high energy efficiency and availability of refuelling stations. On the other hand, this technology shares the same disadvantages as

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CVs, producing high CO_2 emissions and noise pollution due to its dependence on fossil fuels.

For simplicity purposes, I follow the suggested terminology as described above, where the term EVs includes all three relative technologies; that is, HEVs, PHEVs and BEVs. However, note that some of the incentives and infrastructure refer only to BEVs and PHEVs. For example, only the latter two technologies can be charged by the grid and hence can exploit the advantages of micro renewable energy sources in the generation mix of electricity.

Several papers show that EVs could decrease GHG emissions and reduce air and noise pollution (De Rubens et al., 2018; Gnann et al., 2018; Knobloch et al., 2020). In addition, energy savings are projected due to the high energy efficiency of EVs (Figenbaum & Kolbenstvedt, 2013a, as cited in Lindberg & Fridstrøm, 2015). Specifically, the reduction in energy use by a BEV compared to a CV is estimated to exceed 75%. Nevertheless, the final impact of EVs is highly dependent on the electricity generation mix and the manufacturing and battery recycling processes (Koroma et al., 2020; Capata & Calabria, 2022). Indeed, although BEVs do not directly produce GHG emissions, and PHEVs can use primarily electricity and emit less emissions when they are on the road compared to CVs, their overall environmental footprint depends on the sources used for producing the electricity used in charging. Therefore, the most significant environmental benefits occur when BEVs and PHEVs are powered by electricity from RES.

Regardless of the environmental benefits related to EV technology and the global efforts to increase its deployment, the adoption of EVs remains significantly low globally, with only a few exceptions (Rotaris et al., 2021). According to the latest ACEA report (2023), in 2021, in the EU, 51.1% of the vehicles used were petrol cars, and 41.9% were diesel cars. Hybrid cars accounted for 2.3% of the vehicles in use, while BEVs and PHEVs accounted for only 0.8% and 0.7%, respectively. The leading countries in EV adoption are Norway (27.4%) and Iceland (15.2%), while several countries such as Bulgaria, Lithuania, Czech Republic, Poland, Estonia, Slovakia, and Greece are still in the initial phase of EV uptake. As a result of incentives introduced in most of the European countries after 2020, the adoption of EVs is increasing. During the third quarter of 2022, BEVs recorded the greatest growth of all fuel types, increasing their share by 22%, with 259,449 units registered across the EU (ACEA, 2023). In addition,

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HEVs increased by 6.9%, with 492,011 units sold. On the other hand, registrations of PHEVs fell by 6% in the third quarter of the year.

The total number of alternative fuel vehicles is 3.93% (about 259,591 vehicles) of the total fleet in Greece, which is 6,600,530 passenger cars (EAFO, 2024). The majority of alternative fuel vehicles are LPG vehicles. From 2022 to 2023, the number of registrations of BEVs and PHEVs almost doubled. However, by the end of 2023, there were only 13,315 BEVs and 20,643 PHEVs, representing 0.20% and 0.31% of the total number of passenger cars, respectively (EAFO, 2024). In the first quarter of 2024, newly registered BEVs and PHEVs (passenger cars) as a percentage of the total number of registrations was 3.51% and 6.25%, respectively. The main target of Greece regarding electromobility is for 30% of new total vehicle registrations in 2030 to be BEVs (NECP, 2023).

2.3. Incentives Supporting EV and PV Technologies in Greece

In Greece, the decarbonisation of the transportation sector has been promoted by policies and incentives since 2020 (Geronikolos & Potoglou, 2021). Based on the related literature review and the context of this study, the following policies and incentives targeting EV adoption were chosen for the DCEs of this study: registration fees, subsidy for the purchase of a BEV, free parking, and subsidy for the installation of a wallbox (home charger). Below, I provide more information regarding these incentives.

First, the government provides tax incentives to EV users, such as discounts or exemptions from traffic fees, registration fees, the presumption and luxury living tax, and road tax (Geronikolos & Potoglou, 2021). Specifically, BEVs are excluded by the registration fees applied to the car's initial price during the purchase (Car and Driver, 2021). In addition, fees for petrol- or diesel-based cars depend on the emissions the car produces, aiming to lower the demand for them. Finally, although HEVs are also charged based on the emissions produced, the registration fees are 50% lower than those for CVs. All of the above aim to enhance EV deployment.

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Second, the government has introduced a subsidisation program that covers 30% of the retail price before taxes for purchasing or leasing a BEV.[1] The maximum subsidy amount someone could receive is €8,000. The applicants can receive an additional €1,000 for scrapping their old vehicle. Moreover, disabled people or young people up to 29 years old can receive an additional bonus of €1,000 to purchase a BEV. Similarly, families with at least three children can get an extra €1,000 bonus (€1,000 for three children and an additional €1,000 for every other child, up to €4,000).

In addition, applicants of the subsidy "I move electrically" can receive €500 for purchasing a wallbox (home charger) if they own a parking spot. The latter supports the charging of EVs at home. Currently, about 80% of the charging happens at home or work (EEA, 2016; Ščasný et al., 2018). Charging at home can be convenient for EV owners since they can charge at night when not using their vehicles. It is also economically beneficial if combined with RES electricity or a cheaper night electricity bill (Mpoi et al., 2023).

Although a home charger can benefit EV owners, charging infrastructure development is significant for the higher EV uptake because not all households can install a charger due to financial or technical reasons (e.g., they do not own a parking lot) (Mpoi et al., 2023). Specifically, the lack of private parking lots in Greece, especially in Athens, where about 80% of the total population of the country is located, is significant. As a result, most Greek residents need to park on the streets or seek public parking spaces. The NECP agenda includes a plan for the installation of more public charging points across the country. Specifically, the target is for 25,000 charging points to be installed by 2030. Currently (Q1, 2024), the total number of recharging points in Greece, based on the AFIR (Alternative Fuels Infrastructure Regulation) classification, is 3,110 AC and 314 DC charging points (EAFO, 2023).[2]

An additional motive for promoting electromobility is the exemption of BEV and PHEV owners from paying parking fees for two years. The owners of BEVs and PHEVs (models emitting CO2 up to 50 g/km) can park for free in the controlled urban parking zones (Car & Motor Team, 2022). The process requires the drivers of these vehicles to print a special badge

[1] Information regarding the subsidization program for BEVs in Greece is available in the related section of the Greek government's website: https://kinoumeilektrika2.gov.gr.

[2] AC and DC refer to the two kinds of "fuels" used in EVs. The power coming from the grid is AC, but EVs can store DC power. So, as happens with any other device, every time an EV has been charged, the plug converts AC power to DC. The converter, the so-called onboard charger, is built inside the car. However, a DC charger can give the car power directly without needing the onboard converter, resulting in faster charging (Wallbox, n.d.).

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they will find electronically and then place it through their car's windscreen every time they park in a controlled zone. This way, the municipal police officers carrying out checks will recognize the car as a model exempted from any charges. Note that currently, the average cost of charging an EV in Greece is about €0.171/kWh.[3] However, in some cases, municipalities nationwide might provide free public charging to promote electromobility (Energy Press, 2023; Iefimerida, 2021).

Finally, in this thesis, in addition to EV-related incentives, I present an essential for the PV deployment incentive. Since 2011, Greece has successfully provided incentives for households to promote the installation of PVs on the rooftops of houses, and thus, the share of solar energy has increased (Dianeosis, 2021). Specifically, PVs on the roofs accounted for 298 MW in 2012 and rose to 351 MW in 2019. The program "PVs on the roof" is a subsidy given by the Greek government in order to cover part of the expenses related to PV installations, such as the purchase of PVs, inverters or cables, installation of a BES, and any fees for the study of the building and the installation (Demertzis, 2022). The latest round of the subsidy started in April of 2023 and will last until the amount dedicated to this program is spent (deadline at the end of June 2024) [4]

Beneficiaries of the subsidy are households and farmers who want to install a small PV system (Odigostoupoliti, 2023). In the latest round of the subsidy, PV installation is combined with a BES. The subsidy almost entirely covers the cost of the purchase and installation of the BES, which is considered obligatory for households but not for farmers. Figure 2.1 shows the percentage of the total cost covered for PVs and BES and the maximum amount that can be given to each applicant. A special bonus of 10% is provided for people with disabilities or the spouses and dependent members of people with disabilities, as well as single-parent, three-child, and large-child families. Despite the program's name, 'PVs on the roof", applicants can install PVs on the roof, terrace, or any other auxiliary areas of the building or their agricultural area. Residents and tenants in apartment buildings can install PVs if they have the written consent of all the owners of the apartments in the building.

[3] Information about global cost of EV charging can be found in: https://www.comparethemarket.com/car-insurance/content/cost-of-charging-an-electric-car-globally/. Last retrieval date: April 2024.
[4] Information regarding the subsidization program for PVs on the roofs of households in Greece is available in the related section of the Greek government's website https://www.gov.gr/ipiresies/polites-kai-kathemerinoteta/periballon-kai-poioteta-zoes/photoboltaika-ste-stege.

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In this study, I focus on the PV systems households install on their roofs or other auxiliary areas to produce their own energy. The energy produced can be used directly to support the household's energy needs or converted into electricity (Gu & Feng, 2020). Households can use electricity produced by PV systems for their basic energy needs, sell it, or return it back to the grid (Net-metering) and charge their EVs (EVbox, 2023; Gu & Feng, 2020). That way, households can reduce both their electricity bills and the operating costs of recharging their vehicles in the future. At the same time, they produce fewer emissions and relieve the pressure on the electric grid (Gu & Feng, 2020).

Category	Household Type	PV				Battery Storage System			
		Percentage of expenses that subsidy covers		Maximum amount of subsidy		Percentage of expenses that subsidy covers		Maximum amount of subsidy	
		Capacity<= 5kWp	5kWp<Capacity<=10.8kWp	Capacity<= 5kWp	5kWp<Capacity<=10.8kWp	Capacity<= 5kWp	5kWp<Capacity<=10.8kWp	Capacity<= 5kWp	5kWp<Capacity<=10.8kWp
A	Low income households (personal income <= €7,000 or family income <=€21,000)	65%	60%	€1,200/kWp	€830/kWp	100%	100%	€890/kWp	€820/kWp
B	personal income<=€20,000 or family income <=€40,000	35%	25%	€650/kWp	€350/kWp	100%	100%	€890/kWp	€820/kWp
C	personal income>€20,000 or family income >€40,000	30%	20%	€560/kWp	€280/kWp	90%	90%	€800/kWp	€750/kWp
D	Farmers	40%	40%	€450/kWp	€450/kWp	90%	90%	€600/kWp	€600/kWp

Figure 2.1. It illustrates the percentage of the total cost covered for PVs and BES and the maximum amount that the subsidy "PVs on the roof" can give to each applicant. Source: (Odigostoupoliti, 2023).

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3 Literature Review

3.1. Introduction

The factors that influence the demand for energy-efficient technologies, and especially the demand for EVs, have been extensively studied, indicating a wide range of important EV-related attributes, but with no general agreement on which ones are the most influential for consumers (Anastasiadou & Gavanas, 2022). The results vary mainly due to consumer preference heterogeneity (Anastasiadou & Gavanas, 2022; Vilchez et al., 2019). However, most studies agree that some of the most important factors affecting consumers' preferences for EVs are price, operation costs, charging infrastructure and time, and driving range (Li et al., 2020). Below, I present the main results regarding EV adoption from the most recent available literature. In addition, I explain how literature supports the idea of the combination of EVs and PVs. The review is mostly based on papers using DCE as an estimation method. The key determinants are separated into categories as follows: product attributes, charging infrastructure, policies, micro renewable energy sources, and consumers characteristics.

3.2. Key Determinants

3.2.1. Product Attributes

To begin with, operating costs and purchase price are two of the most influential product attributes for consumers when deciding on their next vehicle purchase. Whether the purchase price, the operating costs, or another attribute is the primary concern of consumers when making decisions varies among studies, mainly based on the country or area under study and the sensitivity of different groups of consumers assigned to specific attributes. For instance, Rotaris et al. (2021) find that the price is more important than other attributes for Italian

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consumers, while the driving range and operating costs are more important than other attributes for Slovenian consumers. In addition, Chinese consumers value lower annual operating costs more than the purchase price, a result that could be explained by the long-term-oriented Chinese culture (Qian et al., 2019).

Nevertheless, the high upfront cost of EVs hinders consumers' adoption of the technology. In all the DCEs reviewed, the coefficient of price is statistically and practically significant and with a negative sign, indicating that the higher the price, the lower the likelihood the consumer will choose to buy any EV (Bansal et al., 2021; Danielis, 2020; Huang et al., 2022; Qian et al., 2019; Wang et al., 2017). Additionally, Vilchez et al. (2019) explore the factors that influence the decision-making of consumers regarding EV and fuel cell car technologies in Europe using a sample of 1,248 car owners from France, Germany, Italy, Poland, Spain, and the United Kingdom and find the purchase price to be the most important attribute for all the countries. Note that the estimated coefficients of price are found to vary by car size, showing that those who want to buy a large car have a higher sensitivity to price (Vilchez et al., 2019).

Operating costs refer to what consumers pay on average in a specific period or for a specific number of kilometres for refuelling or recharging their vehicles. The results indicate that the higher the operating costs, the lower the likelihood of choosing an EV (Choi et al., 2018; Gong et al., 2020; Jia & Chen, 2021; Li et al., 2020; Li et al., 2022; Oryani et al., 2022; Qian et al., 2019). Below, results from the literature regarding the estimated WTP from an additional reduction of operating costs are presented.

Danielis (2020) finds that Italians are willing to pay an additional €300.40, while Oryani et al. (2022) find that Iranians are willing to pay an additional $1,103.78 (≈ €1,028.12) to reduce costs by about €1 per 100 km. Qian et al. (2019) measure consumers' WTP for an annual decrease of ¥1 (≈ €0.13) in operating costs to be equal to ¥10 (≈ €1.28). Bansal et al. (2021) calculate that Indian consumers are willing to pay 9.3 thousand INR (≈ €104.17) to see a reduction of ₹100 (≈ €1.12) per week in operating costs. Choi et al. (2018) find WTP for operating costs to be equal to ₩111.691 (≈ €79.48) for every ₩1 (≈ €0.00071) less per km. Finally, Greene et al. (2018), reviewing 20 papers using Stated Preferences Surveys, estimate the MWTP for reduced operating costs by $0.01 per mile (≈ €0.0092/1.609km) to be equal to $1,225 (≈ €1,122.16) and $2,866 (≈ €2,625,40) using fixed and random coefficients, respectively, in the estimation method.

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Moreover, the driving range is also a very impactful product attribute for consumers when making decisions regarding EVs due to range anxiety related to the technology (Aravena & Denny, 2021; Danielis, 2020; Liao et al., 2019; Qian et al., 2019; Rotaris et al., 2021; Ščasný et al., 2018; Wang et al., 2017). Qian et al. (2019) and Jia and Chen (2021) find the driving range to be significant only for BEVs and not for PHEVs, showing that maybe range anxiety is closely related to vehicles running only on electricity since consumers are worried about how many kilometres they can drive before they need to recharge their vehicles, considering the low availability of charging points. On the other hand, some studies find the driving range to be only slightly significant or non-significant for consumers (Abotalebi et al., 2019; Li et al., 2022). In addition, findings show that consumers who prefer a large car, those familiar with BEV policies, and consumers with higher income, knowledge and confidence in EVs' safety, reliability, and technology maturity care less about the driving range of EVs (Wang et al., 2017).

The WTP for higher driving ranges varies in the literature. Aravena and Denny (2021) find WTP for 1 km of additional range to be equal to €11.04 and €21.30 before and after learning and short-term experience with BEV, respectively. Jia and Chen (2021) argue that EV owners have about 7.4 times greater MWTP ($113 per mile increase) for range than non-EV owners, indicating that those with better knowledge of EVs care more about the driving range. Qian et al. (2019) and Huang et al. (2022) estimate WTP for BEVs to be ¥587 (€74.84) for 1 additional km of range and ¥571.43 (€72.86) for the next level of improvement in range, respectively. Ščasný et al. (2018) estimate WTP for additional driving range to be equal to €506 for PHEVs and €1,067 for BEVs. Finally, Danielis (2020) estimates WTP for 1 extra km of range for Italians to be €28.7.

Furthermore, some studies identify a decreasing marginal range value at higher values of driving range. That means the utility consumers get from the additional range decreases while the base range increases (Noel et al., 2019; Bansal et al., 2021). For example, consumers in Norway and Iceland are willing to pay €302 to increase the range from 150 km to 151 km, while they are willing to pay only €113 to increase the range from 400 km to 401 km (Noel et al., 2019). Similarly, Bansal et al. (2021) estimate that Indian consumers are willing to pay ₹298,000 (≈ €3,302) to increase the range from 200 km to 300 km, while they are willing to pay less ₹119,000 (≈ €1,318) to increase the range from 500 km to 600 km.

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Finally, a wide range of other car characteristics has been examined and received mixed results, such as the cars' size, speed, performance and acceleration, and battery warranty (Abotalebi et al., 2019; Aravena & Denny, 2021; Li et al., 2020; Li et al., 2022; Noel et al., 2019; Rotaris et al., 2021). Vilchez et al. (2019) identify vehicle attributes such as depreciation, insurance cost and the car's brand, comfort, and safety as important for European consumers. In addition, Singh et al. (2020), reviewing previous literature, find that technological factors such as top speed and power generation affect EV adoption. They also argue that consumers are more concerned about vehicle safety, comfort, and maintenance costs than choosing a vehicle with an automatic transmission or a popular brand name.

3.2.2. Charging Infrastructure

First, regarding the speed of charging, studies that do not distinguish between fast and slow charging find this attribute to be essential for consumers. The coefficient of charging time in these cases is significant and negative, meaning that the less time it takes for cars to be charged, the higher the likelihood for people to choose an EV (Huang et al., 2022; Aravena & Denny, 2021; Tchetchik et al., 2020; Noel et al., 2019; Li et al., 2019). WTP for a 1-hour reduction in charging time is calculated to be equal to ¥571.43 (≈ €74.23) (Huang et al., 2022) and between €324.83 and €344.29 (Aravena & Denny, 2021) for consumers in China and Ireland, respectively. On the other hand, Noel et al. (2019) find that consumers in the Northern countries have much higher WTP for 1-hour reduction in charging time. That equals €7,643 for Norway, Iceland, and Denmark and €4,373 for Sweden.

Although results vary in literature when the researcher distinguishes between the two types of charging speed, most studies agree that only fast charging time is significant for consumers (Bansal et al., 2021; Danielis, 2020; Li et al., 2020; Qian et al., 2019; Ščasný et al., 2018). In this case, WTP for a 1-minute reduction in fast charging time is calculated to be ¥2,424 (≈ €315) for Chinese consumers (Qian et al., 2019) and €86.8 for Italian consumers (Danielis, 2020). Similarly, Bansal et al. (2021) estimate the WTP for a 10-minute reduction in fast charging time to be between ₹14,400 (≈ $160) and ₹20,900 (≈ $233) for Indian consumers.

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Li et al. (2020) argue that a potential reason for the prevalent importance of fast charging is that it fills the battery to 80% within 30 to 60 minutes, representing the time cost to the consumer. In contrast, individuals are usually home for more than eight hours per day, which indicates that 6 to 10 hours of slow charging time at home will have less effect on their schedule. On the other hand, some studies find fast charging time to be insignificant for consumers (Li et al., 2022; Rotaris et al., 2021). Finally, Qian et al. (2019) find that those living in bigger cities with a faster pace of life value charging speed more.

Second, charging infrastructure availability and charging station density are found to be positive and significant in some studies, indicating that an increase in the number of charging points or a decrease in the distance between them could increase EV adoption (Choi et al., 2018; Huang et al., 2022; Oryani et al., 2022). According to findings by Choi et al. (2018) and Oryani et al. (2022), consumers are willing to pay ₩80,489(≈ €56) and $43.02 (≈ €40) more for an increase of 1% in the availability of charging stations, respectively. Estimations by Huang et al. (2022) show that consumers are willing to pay ¥170,000 (≈ €22,076) for a 20% increase in charging density. On the contrary, Qian et al. (2019) find the coverage of charging public stations to be insignificant, and Danielis (2020) and Bansal et al. (2021) indicate that the availability of fast charging stations does not influence consumers' choices regarding EV adoption.

In addition, Jia and Chen (2021) show that for respondents living in Virginia, USA, the impact of charging infrastructure availability is significant only for BEVs (not for PHEVs) and only for those without garages at their houses. Similarly, Qian et al. (2019) find that the effect of the permission to install a home charger is significant and large, even though the availability of public charging stations is insignificant. The latter may indicate a preference of consumers for the convenience that charging at home provides. Specifically, consumers are willing to pay ¥91,039 (≈ €11,822) more for a BEV if they have permission to install a charger at home (Qian et al., 2019).

Last but not least, the results from the techno-economic modelling of Wu et al. (2022) show that the charging cost comprises one of the main concerns for EV owners. Most EV owners prefer to charge their vehicles at home using rooftop PV and BES systems (or using green energy from the grid). They can also benefit from the lower electricity cost and exploit the time

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when they do not use their vehicles (Falchetta & Noussan, 2021). However, installing PVs and BES is not economical for many households (Wu et al., 2022).

Overall, public charging infrastructure for EVs in many countries, including Greece, remains inadequate and only complementary to home and work charging (Geronikolos & Potoglou, 2021). Nevertheless, the adequate development of public charging stations and their strategic placement and allocation around the country are instrumental to enabling long-distance and outside-of-urban areas travel (Geronikolos & Potoglou, 2021) and support EV adoption from middle- and lower-income households which cannot afford home chargers (Engel et al., 2018). Indeed, EV owners prefer to charge their vehicles every day or every two days during the night at home, while the main reasons for choosing public charging stations are the nonavailability of home chargers and the long trips (EEA, 2016).

3.2.3. Policies

Policymakers attempt to introduce efficient policies and incentives to facilitate faster EV diffusion (Caulfield et al., 2022; Hesselink & Chappin, 2019). In recent years, many studies have examined whether the policies implemented or discussed can indeed increase EV adoption. Anastasiadou and Gavanas (2022), reviewing over 70 papers regarding EV adoption, find that financial and non-financial incentives play a significant role in consumers' intention to buy an EV. Below, findings regarding a wide range of financial, non-financial, and market-oriented incentives are provided.

In Europe, subsidies for BEV purchases and reductions in the annual vehicle circulation tax are the two most implemented policies targeting the adoption of BEVs (ACEA, 2023). Purchase subsidies are applied once during the purchase of the car, target the barrier of the high upfront cost of EVs, and are proven to increase EV adoption (Abotalebi et al., 2019; Cerruti et al., year; Gong et al., 2020; Jia & Chen, 2021; Qian et al., 2019; Tchetchik et al., 2020). On the other hand, Cerruti (2023), using the differences in differences model, finds reductions in circulation taxes to be only slightly or not at all significant for consumers. Circulation taxes usually depend on vehicle characteristics such as weight, engine size, and power, and their benefits are connected to the entire vehicle's life cycle (Cerruti, 2023). The authors argue that the results show consumers' preference for the subsidies over the circulation taxes due to the direct benefit

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they can get from them. Finally, exemption from taxes and fees such as road tolls, purchase tax, circulation tax, Vehicle and Vessel tax (V & V), and insurance fees can positively affect EV adoption (Jia & Chen, 2021; Li et al., 2022; Wang et al., 2017). Although subsidies and tax discounts can be instrumental in the promotion of EV technology, they are two very high financial expenditures for governments (Cerruti, 2023). Thus, they are expected to be terminated in the future (Wang et al., 2017).

Another widely implemented financial incentive is the parking fee discounts targeting the EV promotion. The latter has a notably lower cost than subsidisation, but their impact receives mixed results in the literature. Some studies find discounts on parking fees to increase EV attractiveness (Gong et al., 2020). Similarly, Wang et al. (2017) and Danielis (2020) find parking fee exemption to be significant but of relatively less importance compared to other policies. The latter studies calculate WTP for parking fee exemption of ¥10,440.76 (≈ €1,356) and €1.8 for Chinese and Italian consumers, respectively. In contrast, Aravena and Denny (2021) and Bansal et al. (2021) show that this policy does not influence consumers' preferences. Additionally, free public charging increases consumers WTP for EVs (Li et al., 2019; Wang et al., 2017). Finally, Gong et al. (2020) find one of the most preferred policies for EV adoption in Australia to be the energy bill discount, which is "an innovative support designed to attract EV users and can be extended with other green energy infrastructure" such as installation of PVs at home.

Furthermore, purchase restriction exemption and driving restriction exemption are two non-financial policies of high influence on EV adoption (Oryani et al., 2022; Wang et al., 2017). Additionally, access to specialised lanes, such as bus or HOV (high-occupancy vehicle) lanes, has a positive and significant, but relatively smaller than other policies, impact on BEV adoption (Gong et al., 2020; Oryani et al., 2022; Wang et al., 2017). On the contrary, other studies find the access to specialised lanes non-important for consumers, especially when the deployment of EVs is very low, and consumers are mainly concerned with different aspects related to EVs, such as those described above (Abotalebi et al., 2019; Bansal et al., 2021).

In addition, the lack of information regarding EV technology appears to be a prevalent barrier in literature (Hesselink & Chappin, 2019). Authors conducting DCEs argue that consumers' knowledge of EV-related incentives may affect their choices (Jia & Chen, 2021; Li et al., 2020; Noel et al., 2019). Therefore, policies increasing consumers' familiarity with EVs are necessary

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to assist in EV deployment (Li et al., 2022). For example, information campaigns, test-driving possibilities, exhibitions, conferences, EV rental and sharing programs could promote EV adoption (Anastasiadou & Gavanas, 2022; Hardman et al., 2017).

Lastly, in the last few years, there has been an increasing exploration of the effects of various alternative policies on EV adoption. I will briefly present the results regarding some of those policies. In China, free-licensing regulation significantly increases consumers' WTP for EVs (Qian et al., 2019). In addition, the lack of battery recycling policies hinders consumers' willingness to adopt EVs (Huang et al.,2022). Also, carbon trading policies, such as PCT (Personal Carbon Trading), TDC (Tradable Driving Credit) and CT (Carbon Tax), are considered significant by consumers and potentially able to enhance EV deployment without affecting CV adoption (Li et al., 2020; Li et al., 2022). There is also increased attention on the V2G (Vehicle-to-Grid) possibility that can offer control over energy by transferring power in a duo channel between an EV and the charging network, and it is found to add attractiveness to EVs (Singh et al., 2020; Noel et al., 2019). Boström et al. (2021) argue that V2G can assist the use of PVs by storing the produced electricity in the EV battery. Finally, market-oriented policies such as battery or vehicle leasing can help in the adoption of EVs (Liao et al., 2019). Specifically, leasing is the preferred option for BEVs, and battery leasing is the least preferred option. For PHEVs, the traditional purchase business model remains the most popular method.

3.2.4. Micro Renewable Energy Sources

As mentioned before, for the total exploitation of EV environmental benefits, the increased participation of RES in the electricity mix used for EV charging is instrumental. Choi et al. (2018) investigate whether an eco-friendly electricity generation mix could assist EV promotion. Although BEVs are currently the least preferred type of car, the most preferred generation mix of electricity is the RES-oriented mix. Thus, the authors argue that a combination of RES-oriented electricity mix, higher availability of charging infrastructure, and decreased fuel cost could increase consumers' BEV adoption. Specifically, by changing the electricity generation mix from one based on fossil fuels and natural gas to a RES-oriented mix, consumers are willing to pay, on average, an additional 9 million KRW (≈ €6,235) for the purchase of a BEV (Choi et al., 2018).

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Similar results occur from the DCE conducted by Noel et al. (2019) for Nordic countries, where fuel type is one of the most important attributes for consumers, with the coefficients of renewable and hydro energy to be positive, large, and statistically significant for all the countries. Results show that consumers are willing to pay much more for the energy source used to recharge their vehicles to be generated by RES. Specifically, WTP for RES is €25,551 for Norway and Sweden, €24,487 for Iceland, and €16,274 for Denmark and Finland.

Due to their potential benefits, PVs and EVs comprise two key elements for energy decarbonisation (Hutty et al., 2021). Furthermore, Delmas et al. (2017) illustrate that people are similarly interested in buying EVs and PVs, and it is likely to purchase both but maybe not simultaneously. Finally, Stauch (2021) investigates whether bundles of highly complementary products, such as EVs and PVs, can increase car buyers' WTP. His findings show that bundling these products adds value to EVs for potential consumers, increasing their WTP for an EV. Similarly, EV ownership or the intention to purchase an EV impacts the demand for PVs (Gu & Feng, 2020). Indeed, Gu and Feng (2020) explore the Austrian households' preferences for PVs and heat pumps and find that the combination of EV ownership and PV installation increases the attractiveness of the two technologies.

The literature argues that this combination is also very beneficial financially for households. It is estimated that PVs combined with a BES and an EV is the most profitable configuration for households, reducing their average energy consumption by up to 39.6% compared to the case when a household does not own an EV, BES, or PV (Wu et al., 2022). Gu and Feng (2020) cite, among others, the results by Ritte et al. (2012) and Coffman et al. (2017), arguing that a household that uses EVs and PVs simultaneously can significantly reduce both electricity bills and total costs of EV charging.

3.2.5. Consumers Characteristics

Psychological and attitudinal factors, experiences, perceived behavioural control, emotions, beliefs, and morality are displayed in the literature as significant variables for EV adoption (Singh et al., 2020) and are able to explain some of the heterogeneity in consumers' preferences (Tchetchik et al., 2020). For example, consumers inclined towards innovation (Tchetchik et al., 2020), EV-tech believers, and early adopters are more likely to choose an EV (Bansal et al.,

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2021). Moreover, studies show that societal influence, family and peer pressure, and whether consumers know someone who drives or would drive an EV affect their preferences (Singh et al., 2020). Finally, Tchetchik et al. (2020) find that those located higher on the driving hedonism scale (pleasure, excitement, and enjoyment of driving) are less willing to adopt BEVs. The latter might explain why those with higher annual mileage show less willingness to adopt a BEV (Danielis, 2020; Jia. & Chen, 2021).

In addition, environmental awareness, a progressive attitude towards the environment, perceived environmental benefits, climate change acceptance, and subjective norms play an important role in whether consumers intend to adopt an EV technology (Abotalebi et al., 2019; Bansal et al., 2021; Danielis, 2020; Li et al., 2022; Rotaris et al., 2021). However, the high purchasing price of EVs, the belief that EVs are not beneficial for the environment, and the lack of knowledge about EV technology may hinder their motivation to buy an EV (Aravena & Denny, 2021; Singh et al., 2020).

Furthermore, consumers' demographic and socioeconomic characteristics seem to affect their preferences for EVs (Hidrue et al., 2011). To begin with, although the impact of consumers' age varies in the literature, most of the studies agree that younger people are more likely to use technologies that protect the environment and consequently to choose an EV (Abotalebi et al., 2019; Danielis, 2020; Ferguson et al., 2018; Geronikolos & Potoglou, 2021; Huang et al., 2022; Hidrue et al., 2011; Jia & Chen, 2021; Noel et al., 2019; Qian et al., 2019).

Regarding gender, many studies support that women are more likely to choose an EV (Ferguson et al., 2018; Qian et al., 2019). Rotaris et al. (2021) and Li et al. (2022) find that female consumers are more concerned about the environment and have higher perceived environmental characteristics. In addition, Bansal et al. (2021) show that females, although they have low trust in EV technology, have a stronger belief that EVs can contribute to climate change mitigation, so they are more likely to adopt an EV. On the other hand, Jia and Chen's (2021) results show that males are more likely to choose an EV.

The education level and income of consumers are the most commonly examined socioeconomic characteristics. Higher-educated people seem more interested in buying EVs (Abotalebi et al., 2019; Bansal et al., 2021; Ferguson et al., 2018; Jia. & Chen, 2021). Surprisingly, Danielis (2020) findings show that higher education negatively impacts the utility

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people derive from BEVs. Furthermore, Caulfield et al. (2022), Jia and Chen (2021), and Wang et al. (2017) find that, as expected, the lower income households are more concerned about the purchase price and the likelihood of EV adoption increases with income. Interestingly, several studies indicate a negative relationship between income and EV adoption, arguing that the higher the income, the lower the likelihood that consumers will choose an EV (Liao et al., 2019; Qian et al., 2019; Singh et al., 2020). For instance, Qian et al. (2019) argue that the latter might be due to the context of the Chinese car market and consumers considering EVs to be of lower quality than CVs.

Nevertheless, even if lower-income households are more positive towards EV technology, they are not very likely to purchase an EV if they have no adequate financial help since the high purchase price of EVs is the primary concern of low-income households (Caulfield et al., 2022; Falchetta & Noussan, 2021; Geronikolos & Potoglou, 2021). Indeed, lower-income households often experience financial barriers to shifting from a CV to an EV, such as a lack of financial resources or access to credit (Caulfield et al., 2022; Schleich, 2019).

EV ownership can be very beneficial for low-income households since transportation is the second largest component of household expenditures, and the costs related to it (insurance, maintenance, and fuel costs) can comprise a significant financial burden (Bauer et al., 2021). Although these costs are expected to be reduced as the technology is improved and adopted by more people (Bauer et al., 2021), currently, low income may be a significant barrier for consumers. That indicates that the transition towards electromobility could exacerbate exclusion, injustice, and inequality since EVs might be accessible only to rich people (Caulfield et al., 2022; Gomez Vilchez et al., 2019; Sovacool et al., 2019).

Gu and Feng (2020) show that heterogeneity in consumer preferences also exists for home energy equipment such as PVs, with income being highly impactful on decision-making. An interesting result from their research is that although low-income households have lower WTP to install RES equipment such as PVs than high-income households, the combination of PVs and EVs is more attractive to them. Specifically, the ownership of EVs or the intention to own an EV can increase the probability of installing PVs by 5% and 10% for lower and higher-income households, respectively (Gu & Feng, 2020).

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Along with household income, ownership and the size of the house also affect consumers' preferences regarding home energy equipment. Since lower-income households tend to rent and live in smaller houses, they often lack the space for PV installation, resulting in lower WTP for PVs (Gu & Feng, 2020). Finally, Schleich (2019) provides evidence from the literature regarding the adoption of energy-efficiency technologies by low-income households in the EU. He argues that since low-income households spend in total a higher share of their income to cover their energy needs, the adoption of energy-efficient technologies will be instrumental in the reduction of their expenses and contribute to the reduction of energy poverty, which is prevalent in the whole of Europe and increasing in the Southern European countries such as Greece.

Finally, results regarding car ownership and the number of vehicles owned vary in the literature (Singh et al., 2020). Qian et al. (2019) find that car owners are more likely to buy an EV, whereas Noel et al. (2019) show that those who already own one or more cars are more reluctant to change their current vehicle for an EV. Ščasný et al. (2018) find that those with a higher number of vehicles are more likely to purchase a BEV or a PHEV. On the other hand, Abotalebi et al. (2019) find car ownership to be a non-significant factor in consumers' choices. Finally, BEVs seem more appealing to those interested in small, economy vehicles (Ferguson et al., 2018) and residents of urban areas (Caulfield et al., 2022).

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4 Methodology

4.1. Stated Preferences and Discrete Choice Analysis

The SP (Stated Preferences) method has been widely used to estimate the performance of non-market goods, meaning products or services that have not yet penetrated or have been newly introduced to the market, for which there is a lack of data regarding people's preferences (Merino, 2003). SP method has received increasing acceptance since the mid-1990s in several research domains such as agricultural, environmental, health and transport economics, where the availability of data is scarce, and the RP (Revealed Preferences) data cannot be obtained (Louviere et al., 2010; Merino, 2003). EVs are a newly introduced technology, and its penetration in most countries worldwide, including Greece, is still in the initial stage. Therefore, SP is an appropriate method to explore people’s preferences for EVs in Greece.

SP data can be collected by using techniques such as contingent valuation, conjoint analysis, and discrete choice analysis (Merino, 2003). The current study uses discrete choice analysis, in which respondents are asked to consider a few hypothetical options through a survey (Merino, 2003). With this method, it is possible to elicit consumers’ preferences and derive consumers’ WTP by asking them to assess value trade-offs amongst the product attributes (Merino, 2003). Finally, discrete choice analysis is suitable for evaluating market products with multiple attributes, such as EVs.

4.2. Experiment Design

4.2.1. Efficiency and Choice Sets

The tool for discrete choice analysis is the DCEs (Discrete Choice Experiments) (Train, 2003). In the DCEs, respondents are asked to reply in a few hypothetical scenarios and choose their

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preferred product or service among a series of alternatives. A set of alternatives in a DCE is called a choice set. The main characteristics of a choice set are that it is exhaustive, and the alternatives in each choice set are mutually exclusive and finite.

The five important features, according to Mariel et al. (2021), that need to be considered when designing a DCE are the number of attributes, the number of levels used to describe the corresponding attribute, the range of the attribute levels, the number of alternatives presented in a choice set and the number of choice sets. The extent to which the number and size of these features affect the results of DCEs varies significantly in the literature. Mariel et al. (2021) argue that researchers must provide respondents with relevant choices and the maximum possible informational content. The selection of these features for this study was made based on a discussion with the researchers of the Environment Center of Charles University, the available literature, the reality of the Greek market and economy, and the purpose of this study.

Two different experiments were created based on the survey questions. For an efficient DCE design, N-gene software and D-efficiency optimisation were used (Mariel et al., 2021; ChoiceMetrics, 2018). D-efficiency is the most commonly used measure in the literature, used to minimise the standard errors on the diagonal AVC matrix that summarises all the uncertainty associated with the parameters of interest while controlling for the degree of correlation between the parameters (Mariel et al., 2021). Prior information from relative literature was used for the initial design, as well as any additional knowledge regarding the parameters by the estimates from a pilot study was used to improve the design (ChoiceMetrics, 2018). Bayesian priors and a median of 1000 Sobol draws as an indicator of the central tendency were used to evaluate the efficiency of the design (ChoiceMetrics, 2018). Last but not least, the design of DCEs in the N-gene software was completed under the guidance of my supervisor, Milan Ščasný, and the DCEs in the environment of the survey were programmed by Martin Kryl, a researcher at the Environment Center of Charles University.

For the first DCE, 48 choice sets were produced, separated into 12 blocks of four choice sets each. For the second DCE, 60 choice sets were produced and separated into 10 blocks of six choice sets each. The blocks and choice sets presented to each respondent, the order of choice sets, and the order and colour of each alternative were randomised across respondents. A specific number of choice sets was presented to respondents, and they were asked to choose the vehicle they would buy considering their available income and the available attributes of each alternative provided.

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If respondents had already installed PVs in their households and they believed that their capacity was enough to charge their EVs in the future, they were provided with two blocks of the first DCE (40 respondents). Each block includes four choice sets, and each choice set presents four alternative cars (CV, HEV, PHEV and BEV). Figure 4.1 shows an example of a choice set for the first DCE as respondents received it through the survey. On the contrary, if respondents had not installed PVs or they believed that the capacity of their installed PVs would not be enough for charging a EV, they were provided with one block of the first DCE plus one block of the second DCE (1,036), which includes six choice sets, with five alternatives each (CV, HEV, PHEV, BEV and BEV+PV). An example of a choice set from the second experiment is illustrated in Figure 4.2.

Thus, in the first case, respondents had to reply to 8 hypothetical choice scenarios (2 x 4), while in the second case, respondents had to reply to 10 hypothetical choice scenarios (4 + 6). Using two different DCEs, I can observe and estimate whether some consumers shift their choices if they have one extra purchase option. That is the option to combine the purchase of a BEV with the installation of PVs at their houses. Finally, all the respondents had an opt-out option, meaning they could choose not to buy any of the available alternatives. The opt-out choice is added to the choice scenario to ensure consistency with economic theory and the choices any consumer would have in real-life scenarios (Merino, 2003). The opt-out choice's impact on the efficiency of the DCE design receives mixed results in the literature, with some studies arguing that it can reduce the hypothetical bias of the DCE (Mariel et al.,2021).

4.2.2. Attributes and Levels

The choice of attributes and their levels for each alternative were chosen after considering the available literature and their relevance to Greek households. Note that changes were made in the levels of some attributes based on the data acquired from the pilot. Below, I describe in detail all the attributes and levels used in the experiments before and after the pilot. Table 4.2 summarises all the attributes and their levels used in the main wave of the data collection.

First, the car purchase price represents all the one-time vehicle purchase expenses. The base price for all vehicles was calculated based on participants' responses in the survey regarding the car they intend to purchase. A pivoted design and default prices based on the car categories were set in case respondents had not marked up their preferred price. The price of CVs is always the calculated base price. The price of HEVs, PHEVs and BEVs is expected to be relatively

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1. Επιλογή	Επαναφορτιζόμενο (plug-in) Υβριδικό Όχημα	Συμβατικό Όχημα (Βενζίνη, Ντίζελ)	Υβριδικό Όχημα	Αμιγώς Ηλεκτρικό Όχημα
Βασική Τιμή Επίδομα/ Τέλη Τελική Τιμή	16.000 € 1.600 € 17.600 €	12.000 € 2.400 € 14.400 €	13.000 € 1.300 € 14.300 €	14.000 € -3.500 € 10.500 €
Λειτουργικά έξοδα (κατά μέσο όρο ετησίως)	6€ για κάθε 100 χλμ. (600 € τον χρόνο)	17€ για κάθε 100 χλμ. (1.700 € τον χρόνο)	17€ για κάθε 100 χλμ. (1.700 € τον χρόνο)	2€ για κάθε 100 χλμ. (200 € τον χρόνο)
Αυτονομία	900 χλμ + 100 χλμ (μπαταρία)	600 χλμ	750 χλμ	700 χλμ
Κανονική Φόρτιση	4 ώρες	-	-	10 ώρες
Γρήγορη Φόρτιση	Όχι εφικτό	-	-	30 λεπτά
Πολιτικές/Κίνητρα	Ελεύθερη Στάθμευση	-	-	500 € επίδομα για την αγορά wallbox (έξυπνου φορτιστή)
Ποιο αυτοκίνητο θα επέλεγες;	Επαναφορτιζόμενο	Συμβατικό Όχημα	Υβριδικό Όχημα	Αμιγώς Ηλεκτρικό

Δεν θα επέλεγα κανένα από τα παραπάνω.

Figure 4.1: Example of a choice card from the first DCE.
Note: The choice cards are in Greek, as displayed in the original survey.

1. Επιλογή	Αμιγώς Ηλεκτρικό Όχημα+(Φ/Β)	Επαναφορτιζόμενο (plug-in) Υβριδικό Όχημα	Συμβατικό Όχημα (Βενζίνη, Ντίζελ)	Υβριδικό Όχημα	Αμιγώς Ηλεκτρικό Όχημα
Βασική Τιμή Επίδομα/ Τέλη Τελική Τιμή	16.000 € -3.200 € 12.800 €	16.000 € 1.600 € 17.600 €	12.000 € 1.200 € 13.200 €	12.000 € 600 € 12.600 €	14.000 € -3.500 € 10.500 €
Χωρητικότητα (Φ/Β)	3kWp	-	-	-	-
Αρχ. Τιμή (Φ/Β) Επίδομα Τελική Τιμή (Φ/Β)	3.000 € -900 € 2.100 €	- - -	- - -	- - -	- - -
Συνολική Τιμή	14.900 €	17.600 €	13.200 €	12.600 €	10.500 €
Λειτουργικά έξοδα (κατά μέσο όρο ετησίως)	0€ για κάθε 100 χλμ. (0 € τον χρόνο)	12€ για κάθε 100 χλμ. (1.200 € τον χρόνο)	30€ για κάθε 100 χλμ. (3.000 € τον χρόνο)	30€ για κάθε 100 χλμ. (3.000 € τον χρόνο)	15€ για κάθε 100 χλμ. (1.500 € τον χρόνο)
Αυτονομία	300 χλμ	600 χλμ + 50 χλμ (μπαταρία)	900 χλμ	900 χλμ	650 χλμ
Κανονική Φόρτιση	10 ώρες	2 ώρες	-	-	4 ώρες
Γρήγορη Φόρτιση	1 ώρα	Όχι εφικτό	-	-	20 λεπτά
Πολιτικές/Κίνητρα	500 € επίδομα για την αγορά wallbox (έξυπνου φορτιστή) Ελεύθερη Στάθμευση	Ελεύθερη Στάθμευση	-	-	500 € επίδομα για την αγορά wallbox (έξυπνου φορτιστή)
Ποιο αυτοκίνητο θα επέλεγες;	Αμιγώς Ηλεκτρικό+(Φ/Β)	Επαναφορτιζόμενο	Συμβατικό Όχημα	Υβριδικό Όχημα	Αμιγώς Ηλεκτρικό

Δεν θα επέλεγα κανένα από τα παραπάνω.

Figure 4.2. Example of a choice card from the second DCE.
Note: The choice cards are in Greek, as displayed in the original survey.

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higher since, currently, the price of most EVs available in the market is higher than that of CVs. Thus, the price of HEVs was assumed to be 0%, 10% or 20% higher than the base price. The price of PHEVs was originally set to be 10%, 20%, 30% or 40% higher than the base price, but after the analysis of pilot data, the 40% level was reduced to 35%. The latter decrease was intended to better fit the currently lower prices of PHEVs in the market and enhance their competitiveness in the choice sets. Finally, the price of BEVs was assumed to be 10%, 20%, 30%, 40%, or 50% higher than the base price.

Although CVs' prices are usually lower than those of EVs, the registration fees on fuel-based vehicles or the subsidies for purchasing EVs can alter the initial prices. In the choice sets, respondents could see the initial purchase price, the amount of fees or subsidisation applied to the initial purchase price, and the final price they would have to pay. The CVs' price could take no change or increase by 10%, 20%, 30% or 40% due to registration fees for fuel-based vehicles. The 40% increase was removed from the design after the pilot due to the effect extreme taxation had on respondents' choices. Taxation on HEVs is expected to be half of that of CVs. Therefore, the HEV purchase price was assumed to take no change or increase by 5%, 10%, 15%, or 20%. Similarly, the 20% increase was removed from the design after the pilot.

For PHEVs, the initial price could decrease if subsidies were provided to promote this technology or increase if registration fees were applied for the technology due to CO2 emissions. So, PHEVs' price could take no change, decrease by 10% or 20%, or increase by 10% or 20%. Finally, since subsidies for BEVs are provided, and BEVs emit no CO2 emissions, the original design assumed that BEVs' price could take no change or decrease by 20%, 25%, 30% or 35%. Analysing the pilot data, it was noticeable that BEVs were surprisingly preferred over CVs. The latter was assumed to occur because of the very high registration fees for CVs and HEVs and the significant decrease in BEV prices due to high subsidisation. Therefore, for the main wave, the BEVs' price was assumed to take no change or decrease by 10%, 20%, 25%, or 30%.

Next, respondents were provided with the operating costs for each alternative car, which refer to the amount of money someone must pay for every 100 km to refuel or recharge his vehicle. The following values were calculated based on the average fuel and electricity prices available in the market. Operating costs per 100 km for CVs could be 15, 17, 20, 30, or 40 euros. For HEVs, slightly lower operating costs were assumed. Specifically, operating costs for HEVs could equal 13, 15, 17, 20 or 30 euros per 100 km. Operating costs can be much lower for

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PHEVs and BEVs since the price of electricity is lower than that of gasoline or diesel. Therefore, PHEVs' operating costs, including both refuelling and recharging, may be 6, 8, 12, 16 or 10 euros per 100 km. Finally, BEVs' operating costs could be 0, 2, 4, 5, 8, or 15 euros per 100 km. The assumption of zero operating costs happens in the case someone only charges at home using electricity that he/she produces (e.g., from solar PVs) or charges at free public charging stations. In addition to the cost per 100 km, respondents could see the average operating costs per year, which were calculated based on the expected mileage they indicated in the survey. In the case that no information about mileage was provided, an average default value of 10,000 km per year was assumed for a Greek car owner.[5]

In addition, respondents were provided with the driving range of each vehicle, which represents the maximum distance a car can travel with a full tank of fuel or a fully charged battery. The range of different types of vehicles can vary based on the fuel or drive they use and their size, and in the future, also due to technological advancements. Respondents were provided with different values of driving range according to the car category respondents had chosen in the survey as their preferred for the next vehicle purchase. Note that car categories are separated into three size groups as described in the Data.

First, the driving range for CVs, HEVs and PHEVs had the same three levels for each car size (small, medium, and large). For convenience, I refer to this driving range as CV range throughout the rest of the text. The first level of the CV range was 600 km for all car sizes. The CV range could take values equal to 700 km, 750 km and 800 km in the second level and 800 km, 900 km and 100 km in the third level for small, medium and large cars, respectively. PHEVs can also be charged by the grid, and thus, the electric driving range was calculated and presented to the respondents. The electric range for PHEVs could be 50 km, 75 km, 100 km, or 125 km, regardless of the car size. Finally, five levels of electric range were available for BEVs. In the first level, the range could be 200 km, 300 km, and 400 km for small, medium, and large cars.

Similarly, the values of the electric range could take the values 300 km, 400 km, and 550 km in the second level, 400 km, 550 km and 700 km in the third level, and 500 km, 650 km and 800 km in the fourth level. In the fifth level, the electric range could be 600 km, 700 km, and 1,000 km for small, medium, and large cars, respectively. The latter, which assumes a range as

[5] Based on information for car drivers' yearly driven kilometers in Europe available in: https://www.odyssee-mure.eu/publications/efficiency-by-sector/transport/distance-travelled-by-car.html.

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high as CVs, was added to the experiment based on the idea that although the range of BEVs is much lower than that of CVs, technological progress is fast and promising a higher electric range in the next few years. Specifically, the automobile company TOYOTA announced the addition of advanced solid-state batteries in BEVs by 2025, significantly cutting the charging time and increasing the driving range to almost 1,000 km (Davies, 2023b).

In this study, there is a distinction between normal (slow) and fast charging time for the battery of BEVs and PHEVs. Since most PHEV models currently cannot be charged in fast DC charging stations, the only available attribute for PHEVs is the normal charging time. The time is given in hours and refers only to the time of charging the battery of a PHEV and not to the time of refuelling the petrol/diesel tank. The normal charging time for a PHEV was calculated based on the electric range previously assigned to the car. Specifically, four levels with the values 0.5, 1, 1.5, and 2 were assumed for the PHEV and then included in the following equation to calculate the time:

Normal charging time [in hours] = {0.5,1,1.5, 2} * Electric Driving Range [PHEV]/ 50

The normal charging time for BEVs has four levels and varies based on the size of the car. For BEVs, normal charging time could be 3, 5, 7 or 9 hours for a small car and 4, 6, 8, or 10 hours for a medium or large car. Finally, the fast charging time for BEVs could take the values 20, 30, 45 or 60 minutes, regardless of the vehicle size. Note that the refuelling time for CVs and HEVs was not included in the design, but respondents were asked to consider that even refuelling the tank of these vehicles would require some time.

Finally, two policies implemented in Greece targeting EV promotion were added to the experiment for BEVs and PHEVs, and they were coded as dummies. The message “500€ subsidy for the purchase of a wallbox (smart charger)” was provided to the respondents if it was assumed that PHEV or BEV purchase could be combined with this additional benefit of buying a wallbox (home charger) for charging their vehicle at home. In addition, the message “free parking” was provided to the respondents if it was assumed that PHEV or BEV was excluded from parking fees.

In the second DCE, three attributes related to PVs were added. Note that the fifth alternative, which includes a combination of a BEV with PV installation, had the same levels for all attributes related to BEVs. The only difference was the additional attributes. First, respondents could see the capacity of the PVs that would be installed in their households in that specific hypothetical scenario. The total capacity installed could be 3, 5, 7 or 10 kWp.

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Previous to the choice sets, respondents were provided with adequate information regarding PV capacity and its potential. Specifically, respondents were asked to consider that the capacity of the PV system is given in kilowatts peak (kWp), which is the peak power of the PV system or a panel, meaning how much energy the system will generate at peak performance, such as on a sunny day in the afternoon. In addition, Table 4.1 was available to them as an indication of the potential of the PV system. Table 4.1 shows the maximum (at peak performance) annual electricity production from PVs based on their capacity, what percentage of a household's annual consumption would be possible to cover using this amount of electricity, or how many km of electric driving range could be charged.

Table 4.1: Potential of a PV system at peak performance based on its capacity in kWp.

Capacity	3kWp	5kWp	7kWp	10kWp
Annual electricity production from PVs	4,500 kWh	7,500 kWh	10,500 kWh	15,000 kWh
Percentage of household’s annual consumption covered	64.19%	107.14%	150%	214.29%
Km could be charged	22,500 km	37,500 km	52,500 km	75,000 km

Next, the purchase price of PVs was provided. PV purchase price refers to all the costs related to PV system installation, such as the purchase of PVs, inverters, or cables, and any fees for the study of the building and the installation. As it was explained in the Background Section, in the latest round of the subsidy (started in April of 2023), PV installation is combined with the installation of a BES, the cost of which is almost fully covered (90%-100%) by the subsidy, and therefore it is excluded from the price of PVs. The price had three levels, but each level could take different values based on the assumed capacity of the PV system. Specifically, if the capacity installed was 3 kWp, the price could be 3, 4.5 or 6 thousand euros. If the capacity installed was 5 kWp, the price could be 4, 7, or 10 thousand euros. If the capacity installed was 7 kWp, the price could be 6, 9, or 12 thousand euros. If the capacity installed was 10 kWp, the price could be 8, 12, or 18 thousand euros.

In addition, the government subsidises PV installation. To avoid complicated calculations based on respondents' socioeconomic characteristics, such as their income, and to provide a

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personalised level of subsidy based on reality (Figure 2.1), five levels of subsidy that cover all the cases of subsidisation were assumed for the pilot data. Therefore, someone could take no subsidy at all or receive a subsidy covering 20%, 30%, 50% or 70% of the initial PV price. After the analysis of pilot data, the fifth level of 70% subsidy was removed so the final price of PVs could better represent reality and avoid presenting alternatives that were clearly better than all the other alternatives. All respondents could see the initial purchase price for PV installation, the discount they would get based on the subsidy, and the final price they would need to pay. Finally, respondents could also see the total price for the bundle product. That is the final price of the BEV plus the final price of PVs.

Table 4.2. Summary of the attributes and levels of the DCE design.

		CV	**HEV**	**PHEV**	**BEV**	**BEV+PV**
Car Attributes	**Car Size**			**Levels**		
Purchase Price (€)	All	Base stated by the respondent (PP0)	1) PP0 2) 1.1*PP0 3) 1.2*PP0	1) 1.1*PP0 2) 1.2*PP0 3) 1.3*PP0 4) 1.35*PP0	1) 1.1*PP0 2) 1.2*PP0 3) 1.3*PP0 4) 1.4*PP0 5) 1.5*PP0	Same as for BEV
Fees or subsidy (€)	All	1) 0% 2) +10% 3) +20% 4) +30%"	1) 0% 2) +5% 3) +10% 4) +15%	1) -20% 2) -10% 3) 0% 4) +10% 5) +20%	1) 0% 2) -10% 3) -20% 4) -25% 5)-30%	Same as for BEV
Operating Costs (€/ 100 km)	All	1) 15 2) 17 3) 20 4) 30 5) 40	1) 13 2) 15 3) 17 4) 20 5) 30	1) 6 2) 8 3) 12 4) 16 5) 20	1) 0 2) 2 3) 4 4) 6 5) 8 6) 15	Same as for BEV
Driving Range (km)	Small	1) 600 2) 700 3) 800	1) 600 2) 700 3) 800		1) 200 2) 300 3) 400 4) 500 5) 600	Same as for BEV
	Medium	1) 600 2) 750 3) 900	1) 600 2) 750 3) 900	1) G-Range + 50 * 2) G-Range + 75 3) G-Range + 100 4) G-Range + 125	1) 300 2) 400 3) 550 4) 650 5) 700	
	Large	1) 600 2) 800 3) 1000	1) 600 2) 800 3) 1000		1) 400 2) 550 3) 700 4) 800 5) 1000	

Normal Charging Time (h)	Small	-	-	1) 0.5 ** 2) 1 3) 1.5 4) 2	1) 3 2) 5 3) 7 4) 9	Same as for BEV
	Medium & Large	-	-		1) 4 2) 6 3) 8 4) 10	
Fast Charging Time (Min)	All	-	-	-	1) 20 2) 30 3) 45 4) 60	Same as for BEV
500€ Wallbox Subsidy	All	-	-	1) Yes 2) No	1) Yes 2) No	Same as for BEV
Free Parking	All	-	-	1) Yes 2) No	1) Yes 2) No	Same as for BEV
PV Attributes	**PV capacity**			**Levels**		
PV capacity		-	-	-	-	1) 3 2) 5 3) 7 4) 9
Purchase Price for the installation of PVs (1,000 €)	3 kWp	-	-	-	-	1) 3 2) 4.5 3) 6
	4 kWp	-	-	-	-	1) 4 2) 7 3) 10
	7 kWp	-	-	-	-	1) 6 2) 9 3) 12
	10 kWp	-	-	-	-	1) 8 2) 12 3) 18
PV subsidy						1) 0% 2) -20% 3) -30% 4) -50%

* G refers to the petrol/diesel (Gasoline) driving range.
**Normal Charging Time for PHEVs is calculated as: {0.5,1,1.5, 2} * Electric Driving Range [PHEV]/ 50.

4.3. Method of Estimation

According to McFadden (1986), a decision-maker is assumed to be rational and attempt the maximisation of their utility. Therefore, every respondent is assumed to choose from a set of alternatives, one that offers them the highest level of utility. According to the Random Utility

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Theory, unobservable utility is defined as a random variable with two components: the deterministic component, which reflects the tastes of the population and the stochastic component, which reflects the idiosyncrasies of an individual in tastes for an alternative with specific attributes (McFadden, 1986; Train, 2003). The assumptions made for the utility, the function and the distributions of the random components derive different models (Train, 2003).

The CL model is widely used because of its simplicity. It provides a simple closed form for the potential choice probabilities without any requirement of multivariate integration (Hausman & McFadden, 1981). However, the CL model has the disadvantage of the restrictive IIA assumption (independence of irrelevant alternatives), meaning that no unobserved correlation exists across alternatives. In reality, taste heterogeneity exists in individuals' choices (Train, 2003).

The MXL model does not exhibit IIR restriction, allowing for unobserved heterogeneity. The MXL is a flexible and computationally simple model that, according to McFadden and Train (1997), can approximate any Random Utility Model (under an appropriate choice of variables and mixing distribution). The advantages of the MXL model are that it allows for random taste variation, unrestricted substitution patterns, and correlation in unobserved factors over time (Train, 2003). Finally, MXL is an appropriate model to efficiently estimate repeated choices made by the same customer as occurs in the DCEs presented in this study (Revelt & Train, 1998).

Following the estimation specification by (Ščasný et al., 2018), the MXL utility function takes the form:

$$U_{njt} = ASC_{njt} + \beta \, x \, \boldsymbol{X_{njt}} + \gamma\left(Y_n - PRICE_{njt}\right) + \varepsilon_{njt,} \quad (1.1)$$

where U_{njt} is the indirect utility consumer n gets from alternative j of J available alternatives in a choice set t, ASC_{njt} is the Alternative Specific Component, which captures all technology-related characteristics other than those shown on the choice cards, and X_{njt} is a vector of the vehicles' characteristics. The vector X_{njt} includes all the non-monetary attributes, including policy attributes, plus the operating costs. For the first DCE, the vector X_{njt} includes six variables {COST, RANGE, NCHARGE, FCHARGE, WALLBOX, PARKING}. For the second DCE, two more attributes are added in the vector X_{njt} {CAPPV, $PRICE^{PV}$}, where $PRICE^{PV}$ represents the final price of PVs, including the amount of subsidy applied to it. β is a

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vector of all the coefficients of the attributes included in X_{njt}. Note that all coefficients would get the subscript n for all random factors in the MXL model.
In addition, Y_n represents the income of consumer n, and γ is the marginal utility of income. In most specifications, I assume that $PRICE_{njt}$ in (1.1) represents the final purchase price of the vehicle, including the amount of tax or subsidy applied to it, i.e. $PRICE_{njt}^{VEH}$. However, in a model presented in the Appendix (Appendix Table P), I assume that $PRICE_{njt} = PRICE_{njt}^{VEH} + PRICE_{njt}^{PV}$. Finally, ε_{njt} is the stochastic part of the utility.

To estimate the model, I use maximum likelihood techniques (Ščasný et al., 2018). Each consumer n chooses the alternative j from J available alternatives in the choice set t if $U_{njt} > U_{nkt}$, for all $k \neq j$. The probability that alternative j is chosen from a set of J alternatives is given by the following probability function:

$$P(J) = \frac{exp(ASC_{njt} + \beta_n X_{njt} + \gamma_n(Y_n - PRICE_{njt}))}{\sum_{k=1}^{J}(ASC_{nkt} + \beta_n X_{nkt} + \gamma_n(Y_n - PRICE_{nkt}))} \quad (1.2)$$

Although there is no closed form of the probability function in (1.2) when applying a random parameter logit model, it can be simulated by averaging over D draws from the assumed distributions. I use 50 draws to simulate the probability function in (1.2). The simulated loglikelihood function takes the form:

$$lnL = \sum_{n=1}^{N}\sum_{t=1}^{T}\sum_{k=1}^{J} y_{nkt} ln(P(J)) \quad (1.3)$$

Where y_{nkt} is a dummy taking the value 1 when the alternative is chosen in the choice set t, and value 0 otherwise. The maximisation of the log-likelihood function in (1.3) gives the estimates for the parameters of (1.1). Note that the number of alternatives differs for each DCE; thus, J equals five or six (including the opt-out option) based on which DCE respondents are replying to. Also, T differs among respondents since some of them respond to eight choice sets and some others to 10 choice sets.

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To compare the results from CL and MXL, I calculate two model selection criteria, AIC and BIC (Mohammed et al., 2015b). Akaike information criterion (AIC) is an in-sample fit that estimates the likelihood of a model to predict or estimate future values calculated as:

$$AIC = -2 * \ln L + 2 * k \quad (2.1)$$

Bayesian information criterion (BIC) measures the trade-off between model fit and complexity of the model, and it is calculated as follows:

$$BIC = -2 * \ln L + 2 * \ln N * k \quad (2.2)$$

In equations 2.1 and 2.2, L is the value of the loglikelihood, N is the number of observations, and k is the number of estimated parameters. Lower values of AIC or BIC indicate a better fit of a model (Mohammed et al., 2015b). Finally, STATA software is used to estimate and test all the models.[6]

4.4. Willingness to Pay

WTP is the maximum amount an individual is willing to give up to acquire a good or avoid a bad (Varian, 1992, as cited in Greene et al., 2018). From respondents' choices in choice sets, it is possible to elicit consumers' preferences and derive consumers' WTP, which here means the additional money someone is willing to pay for a vehicle to receive or enjoy an improvement on a specific attribute (Merino, 2003).

WTP can be calculated either as the ratio (3.1) of the values of utility changes caused by a specific attribute and the purchase price when everything else remains equal (ceteris paribus) (Greene et al., 2018) or by directly estimating the model in WTP-space (Train & Weeks, 2005). I calculate WTP using the first method, taking the ratio of an attribute's estimated coefficient over the price's estimated coefficient (Greene et al., 2018) as:

$$dU = (\partial U / \partial X_k) dX_k + (\partial U / \partial p) dp, \quad (3.1)$$

where U(X, p) is the indirect utility function of a respondent, X is the vector of k attributes, and p is the price of vehicles (or price of PVs).

[6] All the code used to analyse and estimate the data is provided in the attachment file.

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5 Data

5.1. Data collection

An original survey in Greek was created for the data collection. The survey was conducted using the method of computer-assisted web self-interviewing (CASI) by the market research agency ThreeSixtyOne, which is located in Athens, Greece, and is a member of ICC/ ESOMAR (International Chamber of Commerce/ European Society for Opinion and Market Research). A pilot survey was administered from 1st December 2023 to 11th December 2023, and the main wave from 2nd February 2024 to 17th February 2024. The cost of the data collection was covered by one of the research projects coordinated by the thesis supervisor, Milan Ščasný. [7]

The survey aimed to elicit the preferences of Greek households for EVs and PVs. The target population was Greek residents between 18 and 69 years old who intended to buy a passenger car within the next three years. For the sample to be representative of the Greek population, quota sampling based on the age, gender, education, and residence (region) of the participants was set. The quota represents demographic statistics for car users in Greece, augmented by 10% to include potential car buyers who do not currently use a car, such as younger people.[8] Appendix Table A presents the quota for the survey.

It is important to note that permanent residents of Greek islands were excluded from the target population to avoid any complexity due to differences between the islands and the mainland, deriving mainly from the peculiarities of the Greek energy system and geomorphology of the country (Georgiou et al., 2011). Till 2019, 61 Greek islands were electrically autonomous and characterised as Non-Interconnected Islands (NII). The connection of the NIIs (mainly operating with coal, fuel oil or diesel, or completely with RES) to the grid of the mainland is

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[7] The data collection was funded by the Charles University Environment Center, and any request regarding the data shall be directed to the supervisor, Dr. Milan Scasny.
[8] As for the region, the quota used Eurostat information for NUTS 1, https://ec.europa.eu/eurostat/web/gisco/geodata/reference-data/administrative-units-statistical-units/nuts.

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either under process or recently completed (IETO, n.d.; Vima, 2019). In addition, there is great heterogeneity between the islands and the mainland, as well as among the islands (Katsoulakos, 2019). Differences exist in the permanent population, infrastructure, habits, lifestyle, shares and potentials of energy sources, stability of energy system, and accessibility. Considering the purpose of this study, all of the above could make the derivation of conclusions for potential Greek car buyers and their preferences more challenging.

5.2. Survey Design

The survey consisted of seven sections. The structure was almost identical to a survey conducted in the Czech Republic by Ščasný et al. (2023), with new sections added.[9] First, two screening questions identified respondents' suitability based on the survey's target population. Participants who intended to purchase a passenger car within the next three years and agreed to the terms of participation were allowed to enter the survey.

The first section of the survey included questions about socio-demographic characteristics such as age, gender, education, region, and town size. In the second section, the participants were asked to provide information regarding their household's electricity and energy consumption and PV installation. In the third and fourth sections of the survey, respondents replied to questions related to the current car or cars they own and the car they intended to buy. For example, questions about the price, category, age, fuel, and power of the car were asked.

The fifth section of the survey included the two DCEs. The design of these experiments is explained in the Methodology section. The participants were provided with hypothetical choice scenarios similar to those illustrated in Figure 4.1 and Figure 4.2 and were asked to choose their preferred alternative. Prior to the DCEs, adequate information regarding the alternative products (vehicles and PVs) and their attributes was presented to the respondents. Hence, all the respondents had the same and sufficient knowledge to reply to the choice scenarios. Finally, respondents were asked to provide information about the way they made choices.

In the sixth section of the survey, respondents replied to a few questions in the form of a 7 Likert rating scale regarding their beliefs, expectations, and motivations. Note that in order to

[9] Survey's structure follows a common order as suggested, for instance, by Bateman et al. (2002).

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limit as much as possible the length of the survey and thus the time required to be completed, additional questions regarding the lifestyle, travel habits, and beliefs related to climate change and the environment, which have been proven by literature to affect consumers preferences for EVs, were not added in the survey. In the seventh and last section of the survey, respondents' socioeconomic characteristics, such as their household type and income, were collected. At the end of the questionnaire, all the respondents could write comments regarding the survey.

5.3. Sample and Observations

In total, a sample of 1,367 complete surveys were collected. After removing the speeders, the final sample consisted of 1,311 valid observations. Note that a speeder is defined as someone who spent at the survey less than 48% of the median time required as computed from all the completed surveys (Mitchell, 2014). The average survey time for those who completed the survey is 22 minutes and 22 seconds, while the median time is 17 minutes and 1 second. Thus, 56 participants who spent less than 8 minutes and 10 seconds to complete the survey were removed from the final valid sample. Of 1,311 observations, 200 were collected from the pilot study, while the rest, 1,111 observations, were collected during the main wave.

The purpose of the pilot data was to calculate the average and median survey time to allow for the completion of the survey after the necessary number of surveys and to perform corrections and changes in the survey and experimental design. Several changes were made after analysing and testing the pilot data results. First, as described in the Methodology section, the levels of the prices and subsidies of both cars and PVs were slightly changed to better represent reality. Second, a question related to the preferred car brand was added to the survey. Third, after noticing that the base price was significantly high and was largely affecting the initial prices for EVs, the default prices based on the categories were lowered down, and the logarithm used for the calculation of the base price was transformed to consider the differences between new and used car prices. As a result, more realistic prices, which better represented the current market situation, were presented to respondents in the main wave. Fourth, a mistake in the design was identified and corrected. That mistake was that during the pilot, the driving range for PHEVs appeared to the respondents to be equal to the CV range in all the hypothetical scenarios.

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Due to these changes in the survey and DCEs design, it was important to identify the impact of the pilot data in the final data and choose whether it would be included in the final sample used for the analysis. The same estimations were performed both with and without the pilot data. In addition, the final data was estimated by adding interactions between a dummy for pilot data with the car price, the CV range, and the PV price (Appendix Table B). The results show that pilot data affect the coefficients of the attributes and their statistical significance. First, as was expected, the CV range is greatly affected by the pilot data (due to the mistake in the pilot's design). Also, when the pilot data is included in the sample, the share of people choosing BEVs (with and without PVs) is much higher than expected due to very high initial prices and high subsidies for PVs and EVs in the pilot design. Therefore, pilot data, 200 respondents, was removed from the estimation of the main effects of this study.

In addition, an exploration of the impact of luxury cars, which can be considerably more expensive than others, was performed. Luxury cars are defined as those which receive a base price above €50,000. Estimations were run again, both with and without luxury cars. The data was estimated by adding to the model an interaction between the car price and a dummy for luxury cars (Appendix Table B). Results indicate that the preferences of respondents who were considering buying a luxury car differ. The absence of luxury cars slightly improves the estimated coefficients. Also, the results show that the interaction between car prices and luxury cars is positive and statistically significant. Finally, there are only 35 respondents who intend to plan a luxury car. Therefore, these respondents were removed from the final sample used for the analysis.

After removing the speeders, pilot data, and those who intend to buy a car with a price higher than €50,000 (luxury car), the final sample used to estimate the main effects includes 1,076 respondents. Data from DCEs need to be reshaped (P’erez-Troncoso, 2020). By transforming the dataset from wide-shape to long-shape, the available final total number of observations is 59,616, that is, the number of respondents multiplied by the number of choice tasks multiplied by the number of alternatives in each choice task.

5.4. Descriptive Statistics

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5.4.1. Socio-Demographic Characteristics

Table 5.1 contains the descriptive statistics of the final sample used for the estimation of the main effects, which consists of 1,079 respondents after excluding speeders, pilot data and respondents who plan to buy a car for more than €50,000. The representativeness of the sample was tested with a one-sided t-test for equal means to test the statistical equality of the final sample and the quota set for the target population (Appendix Table C)[10]. The results do not indicate that the means of variables are equal to the quota. Nevertheless, the sample's representativeness of the target population for all variables (gender, age, education, region) is accurate at a level between -3.25% and 2.13%.

The sample consists of 523 male respondents and 553 female respondents. The younger respondents, between 18 and 34 years old, are 30% of the sample, while older respondents, between 50 and 65 years old, are 37% of the sample. I separate the highest level of education respondents have attained into two groups: basic education, which includes all levels of education up to secondary, and higher education, which includes those who have at least received a bachelor's university degree. Sixty seven percent of the sample have attained basic education (up to secondary), and 34% have obtained a higher education degree. About 46% of the respondents live in Attica, 31% live in North Greece, and 23% live in Central Greece. More than 75% of the respondents live in urban areas. Specifically, 33.64% of the sample live in metropolitan cities with more than 500 thousand residents (Athens or Thessaloniki), and 41.45% of the sample live in big cities with more than 50 thousand residents. On the other hand, 17% of the respondents live in small towns or big villages with 10-50 thousand residents, and only 8% live in rural areas.

Table 5.1: Summary of respondents' socio-demographic characteristics.

Demographic Characteristics (N=1,076)	Frequency	Percentage
Gender		
Male	523	48.61%
Female	553	51.39%
Age		
Young (18-34)	322	29.93%
Middle age (35-49)	357	33.18%
Older (50-65)	397	36.90%

[10] Tests for the representativeness of the sample did not exclude those who plan to buy a luxury car.

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Education		
Basic (Up to Secondary)	721	67.01%
Higher	355	32.99%
Region		
Attica	491	45.63%
North Greece	337	31.32%
Central Greece	248	23.05%
Town		
Metropolitan Area (>500K)	362	33.64%
Big city (>50K)	446	41.45%
Small town/ Big Village(10-50K)	183	17.01%
Rural (<10K)	85	7.90%
Monthly Household Income		
Less than 500€	35	3.63%
501€- 1000€	184	18.03%
1001€- 1500€	255	23.70%
1501€- 2500€	297	27.32%
2501€ - 4000€	155	14.41%
More than 4000€	34	2.42%
Household Size (People living in the household)		
1 member	71	6.60%
2 members	272	25.28%
3 members	312	29.00%
4 members	287	26.67%
More than 5 members	134	12.45%
Number of Kids in the Family (N=1,005)		
Families with no kids	517	51.18%
Families with 1 kid	268	26.94%
Families with 2 kids	167	16.82%
Families with more than 3 kids	53	5.28%
Type of House		
Family house-detached house	356	33.09%
Family house-semi-detached house	135	12.55%
Family villa with separate apartments	33	3.07%
Apartment building with less than 10 apartments	310	28.81%
Apartment building with more than 10 apartments	233	21.65%
Other	9	0.84%

Regarding the households the respondents live in, more than 60% are located in the city centre or the wider city centre. In addition, 33% of the respondents live in family house-detached houses, 13% live in semi-detached houses (a house with two separate apartments), and about 50% of the respondents live in apartment buildings. In addition, 51% of the respondents are owners of their households, and 29% of the respondents rent their houses. More specifically, almost 80% of those living in detached or semi-detached houses stated that those or other

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members of their families own the house. In comparison, nearly 60%. of those living in apartment buildings own their house.

About 80% of the respondents live in families consisting of two, three or four members, and more than 50% of all families (with two or more members) are childless. Moreover, about 52% of the respondents are employees for more than 30 hours per week, about 15% are self-employed, about 9% are students, and merely 5% are retired. Respondents were asked to provide information regarding the total net monthly income of the entire household they live in from all sources after the deduction of taxes and levies. About 18% of households gain between €500 and €1,000 per month, 24% of households gain between €1,000 and €1,500 per month, 27% of households gain between €1,500 and €2,500 per month, and 14% of households gain between €2,500 and €4,000 per month. Finally, almost 2% of households gain more than €4,000 per month, while 4% of households gain less than €500 per month.

5.4.2. Energy and PVs

In addition, I present the information that was collected regarding energy sources and PVs. The findings about the energy sources are illustrated in Figure 5.1 and Figure 5.2. The respondents were asked to choose all the energy sources used to cover all the energy needs of their households and for heating alone. In both cases, electricity and heating oil are the prevalent sources of energy. Natural gas and wood also have a high share in the energy needs of households, with almost 19% of the households using natural gas and 19% of the households using wood, among other energy sources, for heating their houses.

In addition, almost 23% of households use solar energy for their energy needs, but merely 9% of them use solar energy for heating. Interestingly, only 2 households, 0.19% of the sample, stated that solar energy is the only energy source their households use. Finally, 24% of respondents stated that their households use merely electricity, while about 11% of the households use only heating oil, and 9% of the households use only natural gas for heating.

The results indicate that only 9% of the respondents have already installed PVs; of those, almost 38% received the subsidy "PVs on the roof", while an impressive share of them, 24%, are unaware of the subsidy. About 40% of the respondents who already owned PVs believe that their installed capacity is adequate for charging an EV in the future. In comparison, about 35% of them answered that they do not know if the installed capacity could be enough for this

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purpose. Less than half of the respondents, 43%, who have installed PVs have also installed a BES. It is important to mention that almost 63% of the respondents who had received the subsidy applied for it before April 2023, when the installation of BES became obligatory.

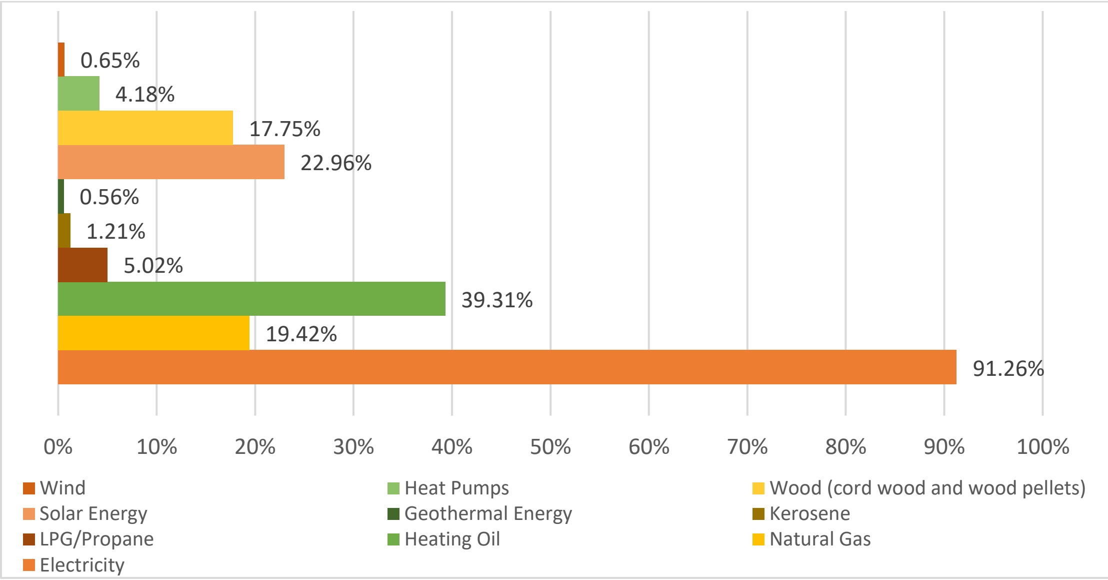

Figure 5.1: Share of households that use a particular type of energy for any purpose; multiple answers were possible (N=1,076).

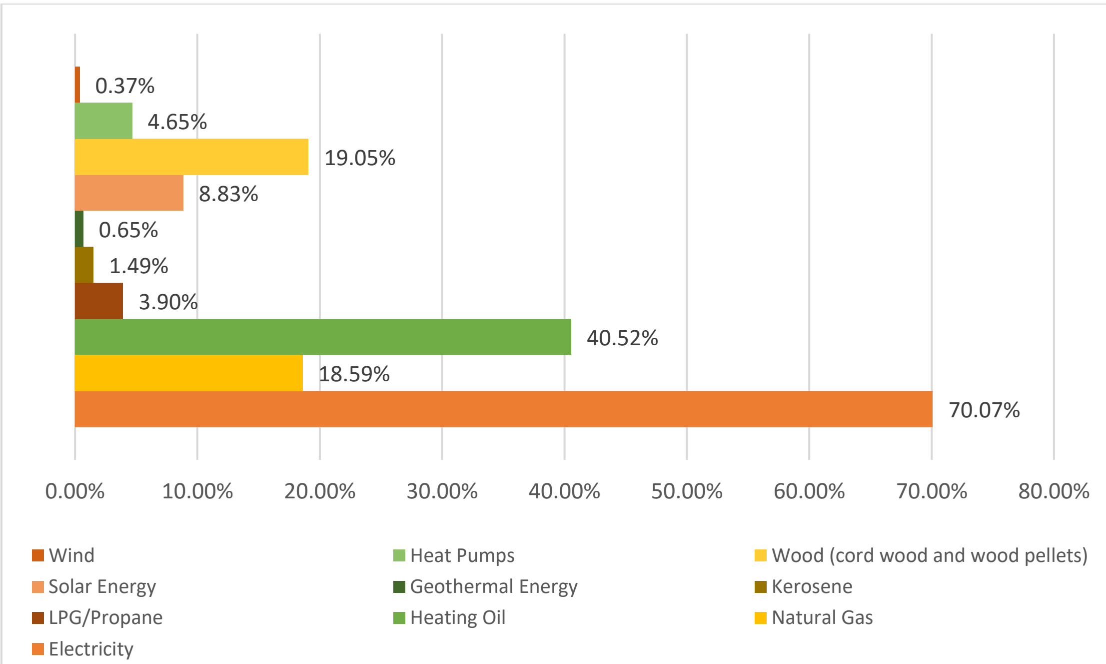

Figure 5.2: Share of households that use a particular type of energy for heating; multiple answers were possible (N=1,076).

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On the other hand, 91% of the respondents have not installed PVs. Of those, about 28% stated that they intend to install PVs in the future, and 27% do not intend to install PVs, while a large share of them, 46%, are uncertain. About 40% of the respondents who are positive or unsure about a future PV installation are thinking of installing PVs in the next two to four years. Interestingly, more than 50% of these respondents who have not yet installed PVs are not aware of the subsidy "PVs on the roof". However, 54% of those respondents who are aware of the subsidy were thinking of applying for the subsidy.

Table 5.2. Summary of descriptive statistics regarding PVs.

PV buyers' information	Frequency	Percentage
Have you installed solar panels in your household (e.g. terrace/roof)?	(N=1,076)	
Yes	101	9.39%
No	976	90.61%
Those who have already installed PVs:		
Is the capacity of the installed solar panels on your roof enough to charge an EV in the future?	(N=101)	
Yes	40	39.60%
No	25	24.75%
I don't know	36	35.64%
What is the total capacity of the installed solar panels in your household?	(N=101)	
<0.5 kWp	7	6.93%
0.5-1 kWp	10	9.90%
1-2 kWp	21	20.79%
2-3 kWp	12	11.88%
3-5 kWp	9	8.91%
>5 kWp	6	5.94%
I don't know	36	35.64%
When did you install the solar panels in your household?	(N=101)	
In 2023	10	9.90%
In 2022	10	9.90%
In 2021	17	16.83%
In 2020	11	10.89%
In 2019	13	12.87%
Before 2019	30	29.70%
I am not sure	10	9.90%
Do you have a battery storage system installed in your household?	(N=101)	
Yes	43	42.57%
No	43	42.57%
I don't know	15	14.85%

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Did you use the "PVs on the roof" subsidy for installing solar panels?	(N=101)	
Yes	35	34.65%
No	29	28.71%
No, and I am not aware of this subsidy	26	25.74%
I don't know	11	10.89%
When did you apply for the "PVs on the roof" subsidy?	(N=35)	
After April 2023	8	22.86%
Before April 2023	22	62.86%
I am not sure.	5	14.29%
What do you do with the energy you produce?	(N=101)	
I consume all the energy produced for the energy needs of my household.	65	64.36%
I sell all the energy produced back to the grid.	16	15.84%
I use only a part of the energy produced and I return the rest back to the grid (Net-Metering Program).	20	19.80%

Those who haven't installed PVs yet:

Are you intending to install solar panels in your household in the future?	(N=975)	
Yes	271	27.79%
No	259	26.56%
I don't know	445	45.64%
When are you thinking of installing solar panels in your household?	(N=716)	
Within next year	50	6.98%
In 2 years	141	19.69%
In 3-4 years	139	19.41%
In 5-7 years	51	7.12%
Later than 8 years	24	3.35%
I don't know	311	43.44%
Are you aware of the "PVs on the roof" subsidy?	(N=716)	
Yes	237	33.10%
No	367	51.26%
I am not sure	112	15.64%
Are you thinking of applying for the subsidy "PVs on the roof" in order to install solar panels on the roof of your household?	(N=237)	
Yes	128	54.01%
No	22	9.28%
I don't know	87	36.71%
What are you planning to do with the energy you will produce?	(N=716)	
I will consume all the energy produced for the energy needs of my household.	351	49.02%
I will sell all the energy produced back to the grid.	49	6.84%
I will use only a part of the energy produced and return the rest to the grid (Net-Metering Program).	316	44.13%

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Furthermore, the respondents were asked to provide information about their motivation to install PVs or the reasons they would not invest in this technology. Those who already owned PVs had to choose the prevalent motivation to install PVs. The results showed that more than 50% of the respondents installed PVs to save money, while the main motivation of about 24% was that PVs are considered environmentally friendly. Those who still needed to install PVs could give multiple answers regarding their motivation. In the case when respondents were positive or uncertain about future PV installation, the results are illustrated in Figure 5.3. It is obvious that economic reasons overcome environmental benefits since 85% of the respondents are considering the installation of PVs in order to save money, and 36% believe that they could also earn money by selling the produced electricity. Nevertheless, more than 50% of the respondents stated that the possible environmental benefits of PVs consist of a reason why they would invest in the technology.

Similarly, those who were negative or uncertain about a future PV installation were asked to provide all the reasons why they would not install PVs in their households (Table 5.4). As expected, the majority of respondents, about 57% of them, stated that PV installation has a high initial investment cost. The second and third most important reasons preventing them from installing PVs are the lack of adequate space and technical difficulties. Finally, a considerable 12% of the respondents stated that they did not have enough knowledge or trust in the technology. Still, only 2% think that PVs are associated with high pollution during manufacturing.

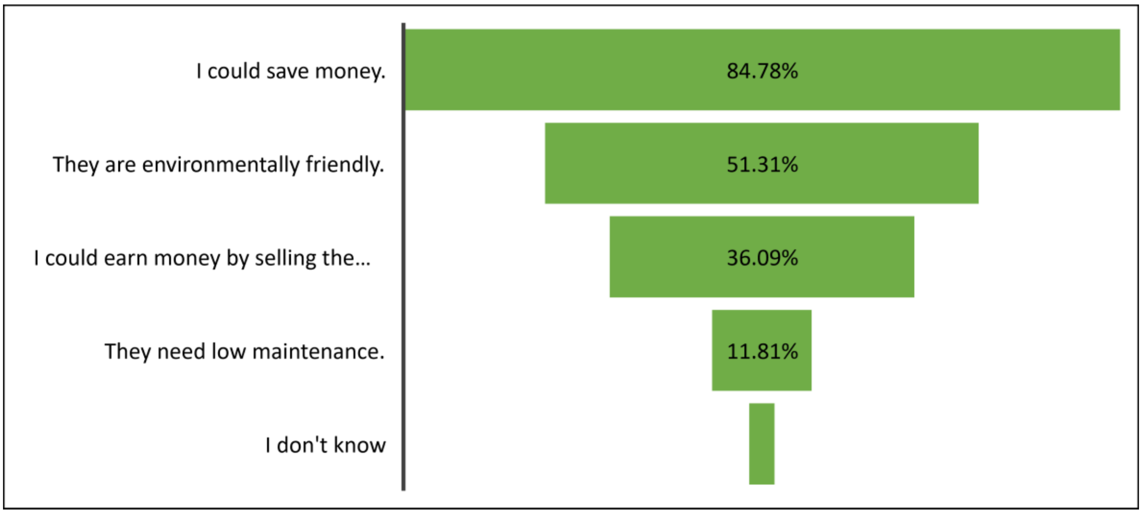

Figure 5.3: Share of respondents who would install solar panels for the particular reason; multiple answers were possible (N=716).

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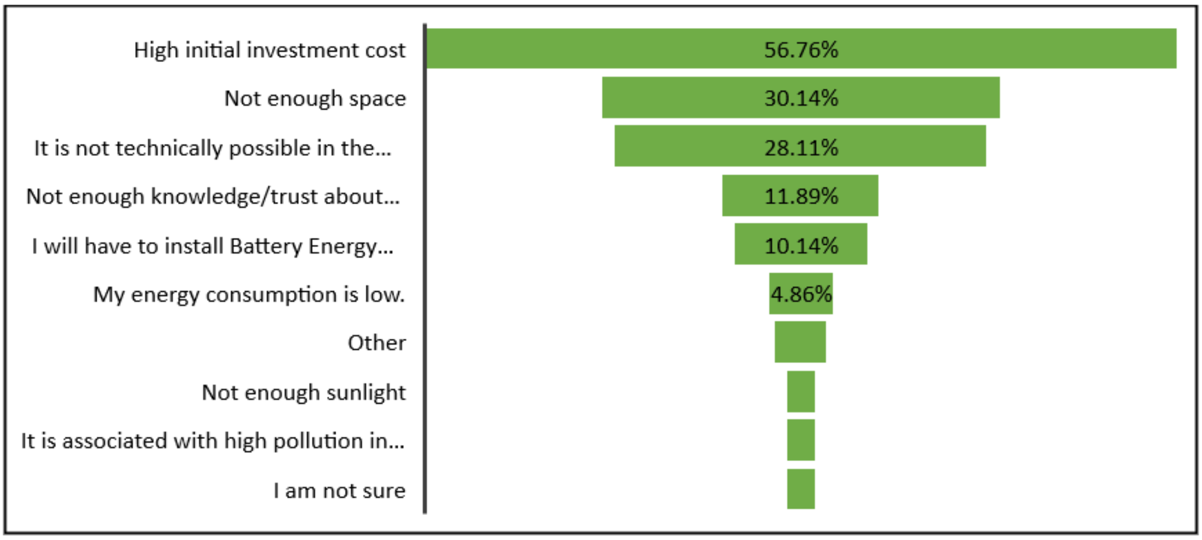

Figure 5.4: Share of respondents who would not install solar panels for the particular reason; multiple answers were possible (N=704).

5.4.3. Potential Car Buyers Profile

Of the available sample, only 107 respondents stated that they currently have no driver's license and 83% of those replied that another member of the household drives. Overall, about 19% of the respondents are the main drivers in their households since no other members of the household drive a car. The majority of households own only one or two vehicles. Specifically, 52% of the households own only one vehicle, and 35% of the households own two cars. Also, 8% of the households do not currently own a car. Thus, the vehicle they are considering buying in the next three years, which is the focus of this study, will be the family's first vehicle. Finally, merely 5% of the households have a family fleet size of three or more vehicles.

For comparison, it is interesting to have information about both respondents' current vehicles and the future vehicles they are considering buying. Therefore, all respondents, except for those who do not currently own a car, were asked to provide information about the vehicles their households currently own. In case they own more than one vehicle, they were asked to consider the one they use more often. The average year of purchase for the current cars was 2013, while the average year of manufacture was 2010. Fifty one percent of the respondents stated that the vehicle they already own was purchased as new, and 47% of them bought a used car. In addition, respondents were asked how many km had driven in the last 12 months. About 70% of them stated that they had driven up to 10,000 km in a year (about 626 - 833 km per month).

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Respondents also had to provide information about the category of their vehicles. For analysis purposes, the 14 categories of different cars from which respondents could choose were separated into three groups based on their size. The car categories class A and B, SUV B, and MPV B comprise the group of small cars. The car categories class C and D, along with SUV C, comprise the group of medium cars. Finally, car categories class E and F/G, sports vehicles, SUV D and SUV E, MPV E, and pick-up cars comprise the group of large cars. More than 70% of the respondents own a car from class B, C, or D. Based on the car size, 43% of the respondents currently own small cars, 48% own medium cars, and 8% own large cars.

Regarding the price of the current vehicle, almost 35% of the households paid between €2,500 and €10,000 for the purchase of their car. A large group of respondents, 12%, paid between €12,000 and €15,000, and 11% paid between €10,000 and €15,000. Of course, the price depends on the car's size and whether it is new or used. For example, almost 90% of the newly purchased vehicles' price was between €7,500 and €35,000, while nearly 90% of the used vehicles' price was lower than €15,000.

Furthermore, the information regarding the fuel or alternative drive of the vehicles respondents currently own confirms the low uptake of EVs from Greek consumers. Respondents could choose more than one answer regarding the types of fuels. As expected, the share of petrol and diesel cars is significantly higher than all the other types of fuels and alternative drives. Specifically, 80% of respondents answered that they use petrol, 11% use diesel, 3% use CNG, and 5% use LPG. On the other hand, the shares of EVs are below 1% for each case. Specifically, 8 households use mild-hybrid vehicles, 7 of them use HEVs, 1 of them uses PHEV, and 2 of them use BEV. Finally, as stated by respondents, the average fuel consumption for petrol and diesel cars is 8.84 litres per 100 km. There are no adequate observations to make any conclusions regarding the consumption of vehicles using natural gas (8 observations) or electricity (1 observation).

In addition, it is essential to look at the characteristics that consumers want their future vehicles to have. To begin with, almost 39% of the respondents are considering buying a new car and 40% a used car, while 21% have yet to decide. In addition, more than 50% of respondents are considering replacing the old vehicle with a new one. Small and medium cars are the preferred size for 48% and 45% of the respondents, respectively. Similar to the driving habits respondents already have, the majority of them, 67%, are expecting to drive up to 10,000 km per year. Moreover, 65% would like to purchase a vehicle with an engine capacity between 1 and 1.8

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thousand cc. However, a large share of them, 17%, still need to decide the engine capacity they would prefer.

The respondents' preferences regarding the fuel or alternative drive of their future cars differ from those they currently own. Although petrol remains the prevalent type of fuel, there is a significant increase in all other fuels and alternative drives. About 24% are considering buying a diesel vehicle, and almost 16% of them are considering a car that uses CNG. Most importantly, around 37% of respondents are at least considering a type of EV for their next purchase, with 6% of the respondents considering buying a BEV.

Respondents chose the preferred price of the future vehicle based on whether they are considering buying a new or used car. The detailed statistics are available in Table 5.3. More than 75% of the respondents who want a new vehicle prefer a price between €12,500 and €30,000. Meanwhile, about 75% of those who want to purchase a used car (or are still uncertain whether they want a new or used car) prefer a price between €1,200 and €15,000.

Moreover, respondents chose all the characteristics their future vehicles would like to have in comparison to those they already own. Their answers are illustrated in Figure 5.5. It is not a surprise that over 50% of them want their new vehicle to be more economical and have less fuel consumption than the old one. The next more desired car characteristics are safety, better equipment, eco-friendliness, and reliability. Interestingly, about 20% of the respondents would like to have a car that is more or less the same as the one they already own.

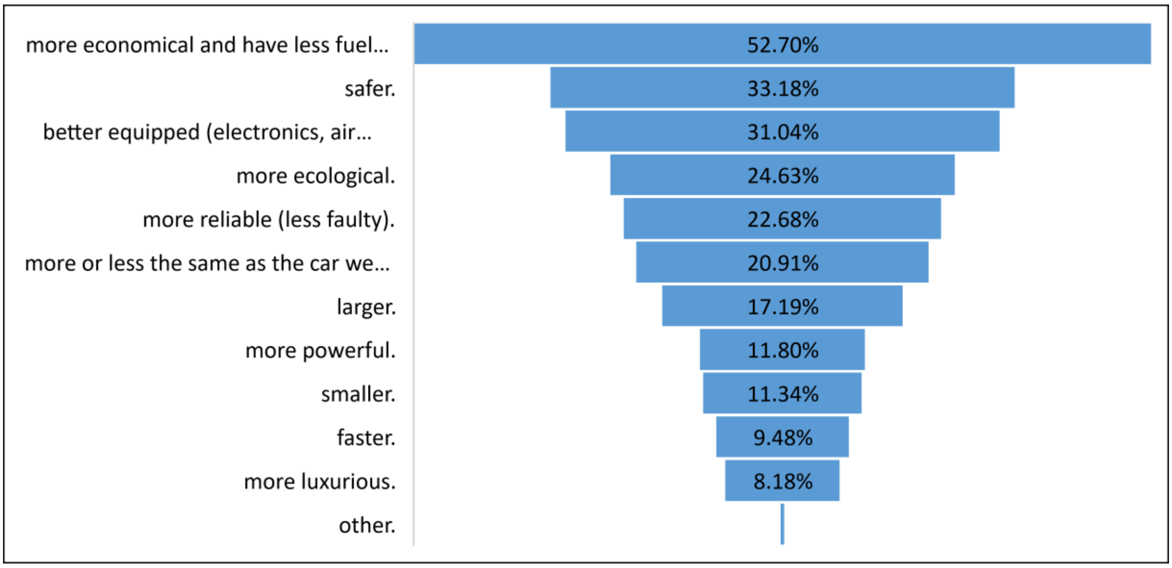

Figure 5.5: Share of respondents who want the particular characteristic for their next vehicle; multiple answers were possible (N=1,076).

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Finally, I provide a brief insight into respondents' beliefs, expectations, and motivations, as stated through questions on a 7-point Likert rating scale. First, although the majority of respondents, 88%, trusted that the information provided in the survey regarding EVs and PVs is real, their trust in the application of the policies presented, especially on subsidies and free parking, is ambiguous. Second, respondents were asked how likely it is that they will buy an EV the next time they buy a car. The results indicate that there is strong heterogeneity in their responses. Notwithstanding, more than 50% of the respondents assigned a likelihood of a future EV purchase on a scale between 4 and 6, showing that Greek consumers might be positive towards EVs but still reluctant. Third, Greek consumers tend to believe that if they purchase an EV, it is likely that they will contribute to reducing dependence on oil imports and to better air quality in the country and will support the development of new technologies. Last but not least, more than 85% of the respondents strongly agree that a sufficient network of public charging stations in Greece, more choices between EVs with different features, and a similar number of service points for EVs, as there is for CVs, would make it easier to choose an EV. On the contrary, as expected, the worsening of the financial situation of consumers or the increase in EV prices can prevent them from buying an EV.

Table 5.3: Summary of potential car buyers' characteristics and preferences.

Car Byers Profile (N=1,076)	Frequency	Percentage
Family Fleet Size		
0	78	7.25%
1	575	53.44%
2	373	34.67%
3 and more	50	4.64%
New or Used Vehicle		
New	419	38.94%
Used	424	39.41%
I don't know yet	233	21.65%
Replace old vehicle or not		
Use the new car along with the old car.	363	36.37%
Replace the old car with the new car.	551	55.21%
I don't know yet	84	8.42%
Size of Car (Based on the Category)		
Small	514	47.77%
Medium	485	45.07%
Large	77	7.16%
Type of Fuel or Alternative Drive		
Benzine	628	54.18%
Diesel	282	24.33%

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Natural gas (CNG)	173	14.93%
Liquefied Petroleum Gas (LPG)	66	5.69%
Biofuels (e.g. E85)	9	0.78%
BEV	73	6.30%
Mild-Hybrid	178	15.36%
HEV	102	8.80%
PHEV	67	5.78%
Hydrogen	13	1.12%
I don’t know	109	9.40%
Expected km Driven per Year		
Up to 5 thousand km	476	44.24%
5-10 thousand km	249	23.14%
10-20 thousand km	167	15.52%
More than 20 thousand km	42	3.91%
I don’t know	142	13.20%
Engine Capacity		
Less than 1000cc	32	2.97%
1,000 – 1,199 cc	188	17.47%
1,200 – 1,399 cc	272	25.28%
1,400 – 1,599 cc	203	18.87%
1,600 – 1,799 cc	116	10.78%
1,800–1,999 cc	47	4.37%
2,000 and more	37	3.06%
I don't know yet	181	16.82%
Price of the Car		
New Cars	(N= 419)	
Less than 10000 €	16	3.82%
10001 €- 12500 €	37	8.83%
12501 €- 15000 €	70	16.71%
15001 €- 17500 €	49	11.69%
17501 €- 20000 €	64	15.27%
20001 €- 25000 €	80	19.09%
25001 € 30000 €	59	14.08%
30001€ -50000€	37	8.83%
More than 50000 €	0	0.00%
I don’t know	7	1.67%
Price of the car		
Used Cars	(N=657)	
Less than 1200 €	6	0.91%
1201 €- 2500 €	45	6.85%
2501 €- 4000 €	100	15.22%
4001 €- 7500 €	132	20.09%
7501 €- 10000 €	98	14.92%
10001 €- 12500 €	67	10.2%
12501 € 15000 €	57	8.68%
15001 €- 17500 €	30	4.57%
17501 €- 20000€	36	5.48%
20001 €- 25000 €	28	4.26%
25001 €- 30000 €	11	1.67%
More than 30000 €	12	1.83%
I don’t know	35	5.33%

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6 Results

6.1. Tendency of Greek Consumers

To begin with, I will comment on the overall tendency of Greek consumers towards different car technologies. Table 6.1 summarises the variable choice, which is the dependent variable of the estimations. Variable choice is binary, taking the value 1 if the respondent chose the specific alternative and 0 if otherwise. As expected, CV is the alternative chosen most often. However, the second most preferred option is the BEV. HEVs and PHEVs follow, indicating consumers might be more reluctant towards these two technologies. By offering one more alternative to respondents, that of BEVs combined with PVs, a share of respondents who would choose CVs, HEVs or PHEVs move towards BEVs. As a result, BEVs are becoming the most preferred option. Indeed, by adding the shares for BEVs from both alternatives (with and without PVs), I conclude that Greek consumers prefer BEVs over CVs.

Table 6.1: How often given alternative was chosen (in percentages).

choice	alt1 CV	alt2 HV	alt3 PHEV	alt4 BEV	alt5 BEV+PV	alt6 opt-out
All data	29.3	17.1	16.9	21.1	16.0	6.3
DCE 1	31.6	18.8	18.7	24.6		6.3
DCE 2	27.7	15.8	15.5	18.6	16.0	6.3

DCE 1 includes only data from the first DCE with no PV installation available, while DCE 2 includes only data from the second DCE, where a fifth variable with PV installation is added. The sum across the rows equals naturally to 100%.

After completing their choices in DCEs, respondents replied about how they made their choices and how important the attributes were for them when choosing. Fifty-seven percent of the respondents chose based on several car attributes, while 30% of respondents made choices based on one car attribute. In addition, 10% of them replied that important features of the cars

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were missing, making it impossible for them to make a realistic choice. Finally, only 3% of them stated that they chose randomly. Figure 6.1 below provides a preliminary overview of the importance of the attributes as stated by respondents. Note that they had to choose the level of importance on a 7 Likert rating scale, where 1 means that the attribute is not important at all, and 7 means that the attribute is very important.

Overall, all the attributes included in the experiment are important for consumers since more than 20% of respondents replied that each one of the attributes was very important, assigning them a scale of 7. Respondents assigned great importance to monetary attributes such as the price of cars and PVs, subsidies and taxation, and operating costs. Car-related monetary attributes play a more critical role for consumers in their choices than PV-related, with 57% considering the car's purchase price very important and 37% considering the car subsidy or taxation very important. On the other hand, only about 28% and 23% consider the final price of PVs and the subsidy for PVs very important, respectively. Both fast and normal charging times are less important for consumers than other car attributes. Finally, the two policies, free parking and wallbox subsidy, show the biggest heterogeneity of preferences among all car-related attributes.

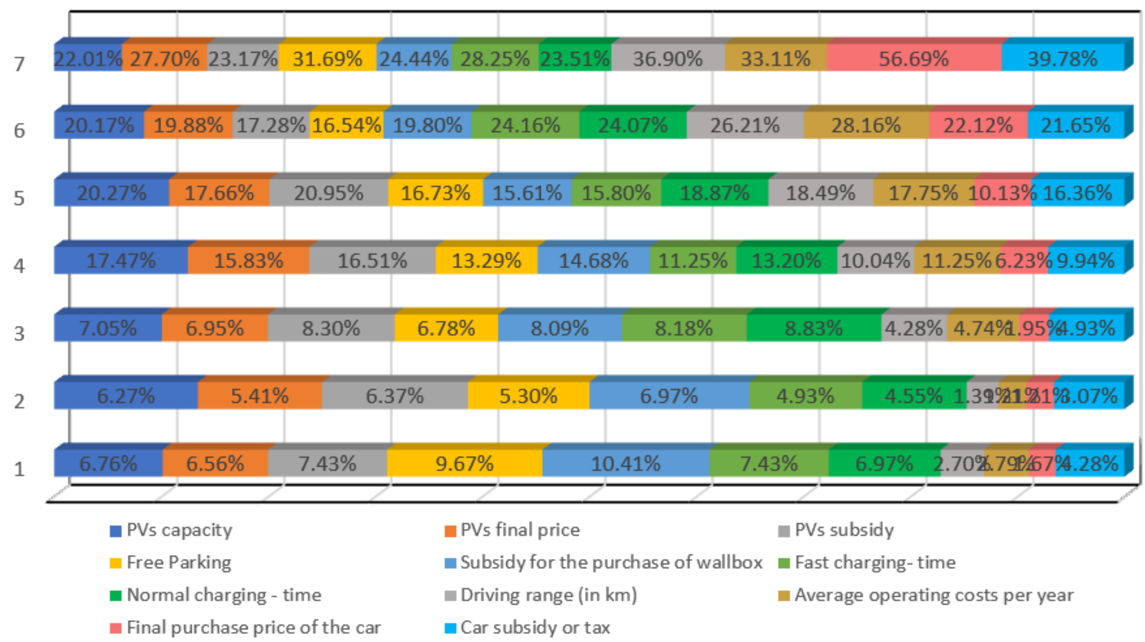

Figure 6.1: Importance of attributes for respondents when making choices in the DCEs.
Note: Percentages represent the share of respondents who assigned a specific level of importance to each attribute. 1 = not important at all, 7 = very important. N=1,076 for all attributes except for PV-related attributes, for which N=1,036.

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6.2. Main Effects and WTP

Table 6.2 summarises the values of all the attributes used in the following estimations of the main effects. It shows each attribute's average, standard deviation, minimum, and maximum values. To provide more information, Table 6.3 illustrates the values of the car purchase prices presented to the respondents through the DCEs based on each alternative and whether the car respondents consider purchasing is new or used.

Table 6.2: Summary of attributes' values presented to respondents on the choice cards in both DCE experiments.

Attribute	Mean	Std. Dev.	Min	Max
Range petrol/diesel (100 km)	7.293	1.124	6	10
Range electric PHEV (100 km)	0.877	0.279	0.5	1.25
Range electric BEV (100 km)	4.711	1.712	2	10
Normal Charging time (h)	4.882	32.879	0.5	10
Fast Charging time (min)	38.785	15.227	20	60
Wallbox subsidy (dummy)	0.230	0.421	0	1
Free parking (dummy)	0.231	0.422	0	1
PVs capacity (kWp)	6.768	4.563	3	10
PV price (1,000 EUR)	6.768	4.563	1.5	18
Operating costs (EUR/ 100 km)	14.971	9.219	2	40
Car price (1,000 EUR)	22.185	12.081	1.4	74.4

Data excluding speeders, pilot data, and respondents who plan to buy a luxury car. Respondents=1,076 and choice scenarios = 10,680.

Table 6.3: Descriptive statistics of the car purchase price presented to respondents through DCEs based on new/used cars and the available alternatives.

Car price (1,000 EUR)		Obs.	Mean	Std. Dev.	Min	Max
New	All	18,924	28.457	12.135	7	74
	CV	4,140	28.278	10.990	9	60
	HV	4,140	29.206	11.568	9	63
	PHEV	4,140	30.516	13.538	8	74
	BEV	4,140	26.775	12.045	7	69
	BEV + PV	2,364	26.802	11.919	7	69
Used	All	30,012	18.230	10.231	1	74
	CV	6,540	18.120	9.562	2	60
	HV	6,540	18.740	10.033	2	63
	PHEV	6,540	19.638	11.168	2	74
	BEV	6,540	17.107	10.005	1	69
	BEV + PV	3,852	17.062	10.024	1	69
ALL	All	48,936	22.185	12.081	1.4	74.4
	CV	10,680	22.058	11.283	2	60
	HV	10,680	22.797	11.811	2	63
	PHEV	10,680	23.855	13.247	2	74
	BEV	10,680	20.855	11.820	1	69
	BEV + PV	6,216	20.767	11.774	1	69

Data excluding speeders, pilot data, and respondents who plan to buy a luxury car, respondents=1,076, observations=59,616. Note that for those who replied “I don’t know” to the question about new/used cars, their choice was treated as a used car.

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Below, I interpret the estimation results for a sample of 1,076 respondents. I estimate CV and MXL models for three different groups of the final sample. First, I estimate all the final data from both DCEs, which include all the respondents and 59,616 total observations. Then, I estimate respondents' preferences based only on the first DCE, which consists of all respondents but only 22,320 observations. Finally, I use data only from the second DCE, which includes 37,296 observations from 1,036 respondents who answered both experiments (40 respondents are excluded, who already own PVs and consider the capacity of their PV systems adequate to charge an EV and thus did not receive the second DCE). The results of CL and MXL are illustrated in Table 6.4 and Table 6.5, respectively. The results show that MXL has lower AIC and BIC measures, allowing us to conclude that MXL is a better model than CL for estimating consumers' preferences for EVs. Finally, Table 6.6 presents the WTP for 1 extra unit of a specific attribute as calculated by the estimates of the MXL model. A positive sign in WTP means that consumers would pay more for a car to enjoy the increase of 1 unit related to an attribute, while a negative sign means they would pay less for a car if they had to experience an increase of 1 unit related to an attribute.

Table 6.4: Estimation results of the CL model.

	All data	DCE 1	DCE 2
	Estimates (s.e.)	Estimates (s.e.)	Estimates (s.e.)
Car Purchase Price (1,000 €)	-0.025***	-0.025***	-0.025***
	(0.003)	(0.004)	(0.004)
Conventional	2.209***	2.202***	2.247***
	(0.182)	(0.210)	(0.217)
Hybrid	1.663***	1.661***	1.691***
	(0.186)	(0.214)	(0.217)
Plug-in Hybrid	1.556***	1.608***	1.522***
	(0.200)	(0.237)	(0.241)
Battery Electric	1.685***	1.911***	1.535***
	(0.184)	(0.227)	(0.206)
Battery Electric + PVs	1.624***		1.524***
	(0.204)		(0.223)
Range – CV (100 km)	0.025**	0.046***	0.007
	(0.012)	(0.017)	(0.017)
Range - electric (PHEV) (100 km)	-0.079	-0.168	0.001
	(0.085)	(0.129)	(0.116)
Range - electric (BEV) (100 km)	0.014	0.018	0.013
	(0.016)	(0.026)	(0.018)
Normal Charging time (h)	0.001	0.006	-0.002
	(0.008)	(0.015)	(0.009)
Fast Charging time (min)	0.000	-0.002	0.001
	(0.001)	(0.002)	(0.001)
Wallbox subsidy	0.174***	0.180***	0.167***
	(0.033)	(0.053)	(0.040)
Free Parking	0.049**	0.053	0.050
	(0.028)	(0.044)	(0.036)
PVs capacity (kWp)	-0.025		-0.023
	(0.018)		(0.018)

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PV price (1,000 €)	-0.001 (0.010)		-0.001 (0.010)
Operating costs (€/100 km)	-0.009*** (0.002)	-0.011*** (0.004)	-0.008*** (0.002)
Model Diagnostics			
LL start	-17,365.248	-6,709.4169	-10,638.217
LL at convergence	-17,279.091	-6,674.434	-10,593.739
Wald chi2(n)	340.22	293.13	262.50
Prob > chi2	0.000	0.000	0.000
Pseudo R^2	0.0569	0.0710	0.0488
AIC/n	34,590.18	13,374.87	21,219.48
BIC/n	34,734.11	13,479.04	21,355.91
Observations	59,616	22,320	37,296
Respondents	1,076	1,076	1,036
Parameters	16	13	16

Note: *, **, and *** represent coefficients significantly different from zero at the 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. DCE 1 includes only data from the first DCE with no PV installation available, while DCE 2 includes only data from the second DCE, where a fifth alternative with PV installation is added. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute.

All ASC estimates for all data groups have the expected positive sign and are statistically significant at a 1% significance level. In the CL model, CV is the prevalent alternative, while BEV, HEV, and the BEV combined with PVs follow with only minor differences among them.[11] On the other hand, in the MXL model, BEV combined with PV installation and PHEV are the prevalent alternatives, while BEV and CV follow with slight differences. The results show that the least preferred option is HEV. The two BEV alternatives combined (with and without PVs) show that BEV technology is the most preferred. Respondents are willing to pay about €64,000 for a PHEV, €62,000 for purchasing a BEV along with PVs, €60,000 for a BEV alone, €57,000 for a CV, and only €48,000 for an HEV, to enjoy the same level of utility. It is also interesting to observe the results for the two DCEs separately. When a fifth alternative of BEV and PVs is added, the WTP for BEV alone and CV is decreased by almost €10,000. In the case of the second DCE, respondents are willing to pay even about €65,000 for a combination of BEVs with PVs. To obtain the same level of utility, they are willing to pay almost 8.5, 12.5, 17.5, and 21 thousand euros less for a BEV, CV, PHEV and HEV, respectively.

[11] See Appendix Table D for results from Wald test testing the statistical equality of the ASC estimates of CL.

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In addition, price and operating costs have the expected negative sign, and they are statistically significant in all models and for all groups of data estimated. The latter agrees with the available literature, arguing that economic reasons are significant for respondents when deciding about their next car purchase. Thus, the likelihood of choosing a vehicle decreases when the purchase price or operating costs increase. The coefficient of the car price is estimated to be equal to -0.025 for the CL model and varies between -0.040 and -0.043 for the MXL model.

The operating costs have a coefficient between -0.008 and -0.011 for the CL model and between -0.017 and -0.021 for the MXL model. The latter can be translated into WTP, as presented in Table 6.6. Consumers are willing to pay about €420 to €500 less to purchase a vehicle if there is an increase in the operating costs of €1 per 100 km. Consumers seem to assign more importance to operating costs if a hypothetical alternative offering a BEV and PVs is available since they could charge their vehicle at home, reducing the related operating costs. WTP for the operating costs is not much higher than the WTP Danielis (2020) found (€300.40) for Italian consumers for a €1 per 100 km reduction in operating costs.

Table 6.5: Estimation results of the MXL model.

	All data		DCE 1		DCE 2	
	Mean (s.e.)	Std. dev. (s.e.)	Mean (s.e.)	Std. dev. (s.e.)	Mean (s.e.)	Std. dev. (s.e.)
Car Purchase Price (1,000 €)	-0.041*** (0.003)		-0.040*** (0.005)		-0.043*** (0.004)	
Conventional	2.314*** (0.192)	3.102*** (0.105)	2.541*** (0.303)	3.093*** (0.184)	2.248*** (0.290)	3.818*** (0.175)
Hybrid	1.946*** (0.187)	2.404*** (0.094)	1.792*** (0.305)	2.436*** (0.170)	1.878*** (0.277)	2.714*** (0.181)
Plug-in Hybrid	2.625*** (0.202)	0.741*** (0.090)	2.124*** (0.356)	1.939*** (0.185)	2.034*** (0.303)	1.483*** (0.159)
Battery Electric	2.439*** (0.156)	1.279*** (0.090)	2.659*** (0.344)	1.815*** (0.218)	2.423*** (0.211)	1.635*** (0.121)
Battery Electric + PVs	2.520*** (0.197)	-1.113*** (0.099)			2.788*** (0.238)	-0.047 (0.150)
Range – CV (100 km)	-0.013 (0.019)	0.240*** (0.010)	0.037 (0.029)	0.128*** (0.022)	-0.026 (0.028)	0.248*** (0.016)
Range - electric (PHEV) (100 km)	-0.202 (0.134)	-0.866*** (0.105)	-0.115 (0.219)	-0.598*** (0.201)	0.296* (0.178)	-0.076 (0.273)
Range - electric (BEV) (100 km)	-0.043** (0.019)	0.241*** (0.016)	-0.013 (0.040)	-0.002 (0.039)	-0.083*** (0.029)	0.294*** (0.030)
Normal Charging time (h)	-0.036*** (0.012)	0.183*** (0.012)	-0.089*** (0.032)	-0.291*** (0.039)	-0.061*** (0.017)	0.218*** (0.018)
Fast Charging time (min)	0.000 (0.002)	0.010*** (0.002)	-0.004 (0.004)	-0.011*** (0.003)	0.001 (0.002)	-0.003 (0.002)
Wallbox subsidy	0.202*** (0.041)	0.235*** (0.066)	0.201** (0.085)	-0.293 (0.325)	0.203*** (0.053)	-0.278*** (0.093)
Free Parking	0.049 (0.038)	0.043 (0.061)	-0.0430 (0.077)	-0.697*** (0.136)	0.044 (0.053)	-0.350*** (0.090)
PVs capacity (kWp)	-0.012 (0.023)	-0.015 (0.013)			-0.029 (0.028)	-0.113*** (0.024)
PV price (1,000 €)	-0.012	0.013			-0.020	0.051***

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	(0.013)	(0.012)			(0.015)	(0.018)
Operating costs (€/100 km)	-0.019***	0.008***	-0.017***	0.024	-0.021***	-0.005
	(0.003)	(0.003)	(0.006)	(0.015)	(0.004)	(0.006)
Model Diagnostics						
LL start	14,988.13		-6,046.70		-9,464.81	
LL at convergence	-11,796.71		-5,166.20		-7,492.57	
LR chi2(15)	10,964.75		3,016.46		6,202.34	
Prob > chi2	0.000		0.000		0.000	
AIC/n	23,655.43		10,382.41		15,047.13	
BIC/n	23,934.29		10,582.74		15,311.46	
Observations	59,616		22,320		37.296	
Respondents	1,076		1,076		1,036	
Parameters	31		31		31	

Note: *, **, and *** represent coefficients significantly different from zero at the 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in parentheses. DCE 1 includes only data from the first DCE with no PV installation available, while DCE 2 includes only data from the second DCE, where a fifth alternative with PV installation is added. All factors are random except for the car purchase price. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute.

The results about driving range vary among the different models and groups of data. In the CL model, only the estimates for the CV range are statistically significant. On the other hand, in the MXL model, the estimates for the CV range are not statistically significant. However, the CV range is characterised by high heterogeneity, which I further explore below in the next section of this chapter. The estimates of electric driving range for PHEVs are statistically significant at a 10% significance level with a positive sign only when estimating the data from the second DCE. The latter shows that the higher the electric driving range of a PHEV, the more likely consumers are to choose a PHEV. More specifically, consumers are willing to pay almost €7,000 more to purchase a PHEV for an increase of 100 km in the electric driving range.

Surprisingly, the estimates for electric driving range for BEVs are statistically significant for all the data and the data from the second DCE but have a negative sign. The latter means that the higher the driving range of a BEV, the less likely it is for consumers to choose a BEV. Consumers are willing to pay between €1,000 and €2,000 less for a 100 km increased electric driving range for BEV. That is in contrast with the findings presented in the literature review, which mostly agree that the driving range for BEVs positively impacts BEV adoption (Aravena & Denny, 2021; Danielis, 2020; Liao et al., 2019; Qian et al., 2019; Rotaris et al., 2021; Ščasný et al., 2018; Wang et al., 2017). A possible explanation for these results may be that the electric driving range has already been increased, and technological progress is promising further increase in the next few years (Davies, 2023b). Therefore, consumers experience less range anxiety related to BEVs. Another reason could be that most Greek consumers do not drive

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more than 5,000 km yearly. Hence, consumers may not consider the driving range as important as other car attributes. Nevertheless, the electric driving range shows indications of preference heterogeneity, and thus, it may be important for at least some consumers.

Moreover, the findings from this study regarding the charging time for EVs differ from the literature (Bansal et al.,2021; Danielis, 2020; Li et al., 2020; Qian et al., 2019; Ščasný et al., 2018). Normal charging time is important for Greek consumers, while coefficients for fast charging time are not statistically significant. An explanation for this may be that the uptake of EV cars in Greece is still in the initial stage, and the infrastructure still needs to be developed enough to cover the needs for normal charging for EV drivers. Results from the MXL model show that the estimates for normal charging time are statistically significant and with the expected negative sign, indicating that an increase of 1 hour for charging will decrease the odds of choosing a BEV or a PHEV. Consumers would pay about €900 to €2,300 less for purchasing a BEV or a PHEV if there is a 1-hour increase in the normal charging time. Note that the difference between the two groups of data (DCE 1 and DCE 2) is almost €1,000 lower for those who have the choice to purchase BEV and install PVs.

Table 6.6: WTP estimates are based on the Mixed Logit estimates presented in Table 6.5. Note: WTP is given in euros.

As a ratio of the car price	ALL DATA	DCE1	DCE2
Conventional	**56,753.33**	**64,059.13**	**52,504.81**
Hybrid	**47,713.26**	**45,164.67**	**43,868.47**
Plug-in Hybrid	**64,376.43**	**53,541.87**	**47,505.37**
Battery Electric	**59,795.70**	**67,022.29**	**56,581.91**
Battery Electric + PVs	**61,784.01**		**65,118.31**
Range – CV (100 km)	-312.36	931.58	-610.74
Range - electric (PHEV) (100 km)	-4,952.05	-2,888.03	**6,924.03**
Range - electric (BEV) (100 km)	**-1,048.97**	-323.47	**-1,937.25**
Normal Charging time (h)	**-892.92**	**-2,253.11**	**-1,413.16**
Fast Charging time (min)	-4.35	-108.74	16.43
Wallbox subsidy	**4,955.45**	**5,076.94**	**4,737.40**
Free Parking	1,198.25	-1,074.39	1,025.50
PVs capacity (kWp)	-285.99		-668.16
PV price (thousand EUR)	-282.16		-457.83
Operating costs (EUR/ 100 km)	**-455.22**	**-421.28**	**-497.95**
As a ratio of the PV price			
PVs capacity (kWp)	1,013.59		1,459.41

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The ones in bold are statistically significant. WTP in this table is always the ratio of the coefficient of a specific attribute over the coefficient of the car purchase price or PV price multiplied by 1,000. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute.

Considering the two policies for EV adoption, the wallbox subsidy is of great importance to consumers. The estimates for the wallbox subsidy are always positive and statistically significant, indicating that offering a €500 subsidy to those purchasing a BEV or a PHEV to install a wallbox (home charger) increases the likelihood of these two vehicles being chosen. In the CL model, estimates for wallbox policy vary between 0.167 and 0.180, while in the MXL model, the same estimates vary between 0.201 and 0.203. More specifically, if consumers can get this subsidy, the WTP for a BEV or a PHEV is between €4,700 and €5,000. On the other hand, estimates for free parking appear statistically significant, only based on the CL model for all the available data. MXL model shows the estimates for the policy of free parking to be statistically insignificant but with potential preference heterogeneity.

Finally, the PV-related attributes, capacity and price, do not affect respondents' decisions regarding car purchases. Estimates for both PV capacity and PV price are always statistically insignificant. That indicates that an increase or decrease in the values of these attributes does not impact consumers' willingness to purchase a BEV. Nevertheless, the choices of respondents and the ASCs show that the combination of BEV with PVs is indeed very attractive to consumers. In addition, the data for the second DCE indicates potential preference heterogeneity for PV-related attributes.

6.3. Observed Preference Heterogeneity

In Table 6.5, standard deviations from the MXL model are presented. Several attributes have statistically significant standard deviations, indicating preference heterogeneity. All the ASCs, the car purchase price, petrol-related driving range, and normal charging time show substantial preference heterogeneity for all data groups. The rest of the attributes have statistically significant standard deviations, at least for one of the data groups.

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As described in the Literature Review section, several consumers' characteristics affect EV- and PV-related decisions. Gender, age, education, income, whether they live in an urban area or own a garage, and mileage are some of the most frequently studied consumer characteristics. To better understand where this heterogeneity comes from and how consumers with different characteristics make decisions, we further explore the results by estimating MXL and adding interactions between the alternative-specific attributes and some consumer-specific characteristics. Table 6.7 below illustrates the results by estimating MXL for all available data, including interactions between all alternative specific attributes and the following demographic characteristics: gender, age, education, size of town, and income. The results are informative about the sensitivity of different groups of consumers to specific attributes.

More specifically, I find that men are more sensitive to the CV range and fast charging time than women. Surprisingly, young consumers (<35 years old) do not differ statistically from those between 35 and 49, except for the weight they assign to wallbox subsidy. Results show that young people are less sensitive to the wallbox subsidy. The latter may not be because of a lack of interest in wallbox technology, but this choice may not be suitable for young people if they have no private parking space to install it. On the other hand, older people (>=50 years old) appear less sensitive to car price and PV capacity than those between 35 and 49 years old.

The results regarding education are interesting since they indicate that the level of education explains a part of consumer heterogeneity associated mostly with technical characteristics. Specifically, higher-educated respondents are more sensitive to the driving range of all technologies and PV capacity, while they are much less sensitive to the PV price and operating costs. Surprisingly, the household income is not associated with the car price. On the contrary, one standard deviation difference in income is related to higher sensitivity to CV and BEV driving range, fast charging time, and PV capacity, but with lower sensitivity to PV price.

The results regarding the size of the town are also surprising. Although it was expected for households in urban areas (with >50 thousand residents) to be more sensitive to some attributes, such as fast charging time and free parking, results indicate that those living in urban areas are more sensitive only to the electric range for PHEVs. A closer look at the region of living (Appendix Table E) reveals that respondents who live in Athens are considerably more sensitive to the CV range than those living in Central Greece. On the other hand, I observe that people living in North Greece, compared to those living in Central Greece, have lower

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sensitivity to price but higher sensitivity to the electric driving range for PHEVs and PV capacity.

Table 6.7: Estimation results of the MXL model with interactions between alternative-specific attributes and socio-demographic respondents' characteristics (gender, age, education, size of town, income).

	Main Effects		Interactions					
	Mean (s.e.)	Std. dev. (s.e.)	Male (vs. female)	Young (vs. middle age)	Old (vs. middle age)	High education (vs. basic)	Urban (vs. Rural)	HH income (avg. per year, normalised)
Car Purchase Price (1,000 €)	-0.049*** (0.007)		-0.002 (0.005)	0.006 (0.007)	-0.014** (0.006)	-0.001 (0.005)	0.010 (0.006)	0.000 (0.002)
Conventional	2.589*** (0.194)	-3.039*** (0.105)						
Hybrid	2.197*** (0.205)	2.367*** (0.104)						
Plug-in Hybrid	2.591*** (0.211)	1.373*** (0.091)						
Battery Electric	2.779*** (0.158)	-0.900*** (0.104)						
Battery Electric + PVs	2.779*** (0.158)	-1.276*** (0.108)						
Range – CV (100 km)	2.766** (0.204)	0.229*** (0.012)	0.081*** (0.026)	-0.016 (0.032)	-0.033 (0.032)	0.096*** (0.028)	0.008 (0.029)	0.066*** (0.013)
Range - electric (PHEV) (100 km)	-0.071** (0.037)	0.280*** (0.079)	-0.107 (0.149)	0.112 (0.183)	0.169 (0.175)	0.418*** (0.155)	0.407** (0.174)	0.013 (0.075)
Range - electric (BEV) (100 km)	-0.127*** (0.048)	0.237*** (0.019)	0.005 (0.033)	0.029 (0.041)	0.060 (0.040)	0.059* (0.035)	0.018 (0.037)	0.047*** (0.016)
Normal Charging time (h)	-0.025 (0.032)	0.201*** (0.013)	-0.019 (0.024)	-0.036 (0.029)	-0.003 (0.028)	-0.002 (0.024)	-0.016 (0.026)	0.014 (0.012)
Fast Charging time (min)	-0.006 (0.004)	0.003 (0.002)	0.006** (0.003)	0.003 (0.003)	0.004 (0.003)	0.001 (0.003)	0.001 (0.003)	0.003* (0.002)
Wallbox subsidy	0.289** (0.114)	-0.330*** (0.063)	-0.092 (0.082)	-0.198** (0.098)	0.087 (0.097)	0.090 (0.085)	-0.032 (0.096)	-0.007 (0.042)
Free Parking	0.145 (0.109)	0.169*** (0.059)	-0.017 (0.078)	-0.075 (0.094)	-0.030 (0.094)	0.068 (0.081)	-0.087 (0.093)	0.021 (0.040)
PVs capacity (kWp)	-0.044 (0.051)	0.003 (0.015)	0.033 (0.035)	-0.053 (0.042)	-0.075* (0.042)	0.130*** (0.036)	0.004 (0.042)	0.043** (0.018)
PV price (1,000 €)	0.005 (0.036)	0.018 (0.013)	-0.035 (0.026)	0,041 (0.032)	0.033 (0.033)	-0.081*** (0.029)	0.008 (0.031)	-0.024* (0.014)
Operating costs (€/100 km)	-0.013 (0.008)	0.017*** (0.004)	-0.006 (0.006)	0.009 (0.007)	0.005 (0.007)	-0.017*** (0.006)	-0.004 (0.007)	0.002 (0.003)
Model Diagnostics								
LL at convergence	-11,683.20							
LR chi2(15)	10825.74							
Prob > chi2	0.000							
AIC/n	23,560.43							
BIC/n	24,433.02							
Observations	59,616							
Respondents	1,076							
Parameters	97							

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. All data from both DCEs are used. All factors are random except for the car purchase price. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute.

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Appendix Tables E-M illustrate the findings from estimations with interactions for more consumer characteristics. To begin with, I investigate whether the preferred car size and car condition (used or new car) have some impact on their preferences. As expected, respondents who want a small car are less sensitive to the car price than those who want a medium car. On the contrary, those who want a large car have higher sensitivity both to car price and operating costs but lower sensitivity to CV and BEV driving range and wallbox subsidy. In addition, those considering buying a new versus a used car are more sensitive to car price, CV range and fast charging time.

I further explore heterogeneity based on current car ownership. I find that those considering replacing their old vehicle with a new one are less sensitive to the electric driving range for PHEVs. In addition, they prefer a BEV or a PHEV over a CV or a HEV, and free parking is an important attribute to them. Regarding the family's fleet size and always comparing it with those with three or more cars, the findings show that those with no cars have less sensitivity in car price, CV range, and normal charging time but higher and substantial sensitivity on free parking policy. Those who currently own only one car are substantially less sensitive to the electric driving range of PHEVs and more sensitive to the free parking policy than those with a large fleet size. The latter group also have less sensitivity to operating costs. Interestingly, those who own two cars seem to be less sensitive to all the monetary-related attributes such as car price, wallbox subsidy, price of PVs and operating costs compared to those who own three or more cars.

In addition, mileage has been found to play a role in consumers' preferences (Danielis, 2020; Jia. & Chen, 2021; Tchetchik et al., 2020). I separated mileage into four groups based on the average yearly km respondents expect to drive up as low, medium, high and very high mileage, corresponding to up to 5,000 km, 5,000-10,000 km, 10,000-20,000 km and over 20,000 km, respectively. I present the results for the first three groups, always compared to those that expect to drive over 20 thousand km per year. The results show that those with low mileage are more sensitive to normal charging time and CV range but less sensitive to the car price. Those with a medium mileage also have lower sensitivity to the car price and larger sensitivity to the CV range, both normal and fast charging time, and wallbox subsidy. Finally, those with high mileage are more sensitive to the CV range, normal charging time and wallbox subsidy.

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In addition, I investigate if there are any differences between the respondents who received the second DCE and those who did not. Findings show that those who replied to both experiments tend to be more sensitive to the electric driving range of PHEVs but less sensitive to the operating costs. In addition, I created a dummy that takes the value 1 if those who do not already own PVs intend to install some in the future and 0 otherwise. According to the results, the intention for future PV installation is related to higher sensitivity to the car price, fast charging time and free parking policy.

Moreover, I check whether owning a garage or being able to install a charger has some impact on consumers' choices, assuming that these conditions would affect whether they can charge at home and thus their decisions regarding EVs and PVs. First, I add interactions with a dummy that takes the value 1 if the respondents park their cars in a garage at home and the value 0 otherwise. Surprisingly, whether consumers park in a garage at home affects only their sensitivity to the car price and driving range for all types of cars. Specifically, those who own a parking lot assign more weight to all the attributes except for the electric driving range of PHEVs, to which they appear to be less sensitive. Interestingly, operating costs in this case are not statistically significant. Also, there are no large differences among the ASCs of all alternatives, although PHEV and BEV (with and without PVs) have the largest coefficients.

Also, respondents were asked if they would install a wallbox at home if it were fully subsidised. I compare those who would install one and those who would not do it for technical issues, such as lack of a parking lot, with those who replied that they would not install one for other reasons. Indeed, the results indicate higher sensitivity for all kinds of driving ranges, modes of charging, and wallbox subsidy but less sensitivity to the operating costs for respondents who are positive about installing a charger if it is fully subsidised. However, those who cannot install a wallbox for technical reasons are less sensitive to the car price. Overall, the inability to park at home nor install a charger explained some of the heterogeneity related to PV attributes.

On the other hand, the accommodation type is one of the most impactful household characteristics for PV-related attributes. Findings show that those living in a family house, compared to an apartment building, are more sensitive to the price of both cars and PVs, while they are less sensitive to the electric range of PHEVs and the PV capacity. For the main effects, the price of PVs is statistically significant, with the expected negative sign indicating that a higher price of PVs decreases the likelihood of consumers choosing a combination of BEV and

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PVs. Finally, compared to renting, whether a household member owns the house or apartment the respondent lives in is associated with lower sensitivity to PV price.

Moreover, I explore the impact of family size on consumer preferences. A respondent living alone is more sensitive to the CV and BEV driving range and the wallbox subsidy than a big family with five or more members. Similarly, a family consisting only of two people is more sensitive to the operating costs and wallbox subsidy. A family of three members is more sensitive to the car price and operating costs. Finally, a family of four members is more sensitive only to the wallbox subsidy than a larger family of five or more members.

Finally, the number of kids in the family explains some of the heterogeneity related to PV capacity. Compared to families with three or more kids, families with no kids are more sensitive to the CV and BEV driving range and operating costs. Families with only one kid are more sensitive to the CV range. Finally, families with two kids are also more sensitive to the CV range, as well as the fast charging time and PV capacity.

6.4. Extensions-Further Analysis

I present the results from estimations using MXL, allowing this time for correlation among the attributes. Table 6.8 and Table 6.9 illustrate the estimates of the models and the estimated WTP, respectively. The findings mostly agree with the main effects of MXL without correlated factors presented before regarding the significance of price and operating costs (Table 6.5). It is estimated that consumers' WTP for every €1 per 100 km increase is between €370 and €412 (Table 6.9). On the other hand, estimates for all types of driving ranges and the wallbox subsidy are not statistically significant for any data group. Finally, estimates for both modes of charging are statistically significant for the data from the first DCE but not the data from the second DCE.

Interestingly, the estimates for PV capacity appear to be statistically significant with a negative sign, indicating that the higher capacity of the PV system is associated with lower odds of a consumer choosing a BEV. The latter may be due to the higher PV price associated with higher PV capacity, the lack of space for a large PV system or the lack of need for such a large PV

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capacity by a household. The data from the second DCE shows that consumers are willing to pay about €2,500 less for a 1 kWp increase in PV system capacity.

Table 6.8: Estimation results of the MXL with correlated factors.

	All Data	DCE 1	DCE 2
	Mean (s.e.)	Mean (s.e.)	Mean (s.e.)
Car Purchase Price (1,000 €)	-0.057***	-0.054***	-0.058***
	(0.003)	(0.006)	(0.004)
Conventional	4.764***	4.674***	5.298***
	(0.279)	(0.411)	(0.368)
Hybrid	4.723***	4.130***	4.633***
	(0.282)	(0.423)	(0.365)
Plug-in Hybrid	4.751***	3.930***	4.359***
	(0.309)	(0.522)	(0.443)
Battery Electric	4.824***	4.834***	4.346***
	(0.296)	(0.502)	(0.360)
Battery Electric + PVs	4.813***		5.030***
	(0.360)		(0.400)
Range – CV (100 km)	0.172	0.033	-0.011
	(0.021)	(0.031)	(0.033)
Range - electric (PHEV) (100 km)	-0.085	0.064	0.151
	(0.194)	(0.372)	(0.305)
Range - electric (BEV) (100 km)	0.007	-0.023	-0.016
	(0.027)	(0.062)	(0.033)
Normal Charging time (h)	-0.029*	-0.066**	-0.006
	(0.016)	(0.038)	(0.021)
Fast Charging time (min)	-0.002	-0.011**	0.000
	(0.002)	(0.006)	(0.003)
Wallbox subsidy	0.087	0.202	0.074
	(0.060)	(0.139)	(0.084)
Free Parking	-0.004	-0.007	-0.107
	(0.058)	(0.114)	(0.084)
PVs capacity (kWp)	-0.079*		-0.145***
	(0.460)		(0.047)
PV price (1,000 €)	0.016		0.031
	(0.026)		(0.027)
Operating costs (€/100 km)	-0.023***	-0.020***	-0.023***
	(0.004)	(0.006)	(0.005)
Model Diagnostics			
LL at convergence	-10,999.77	-4,973.17	-7,066.69
LR chi2()	12,558.64	3,402.52	7,054.10
Prob > chi2	0.000	0.000	0.000
Observations	59,616	22,320	37,296
Respondents	1,076	1,076	1,036
Parameters	136	91	136

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Estimation results of the MXL model. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Standard errors are not provided. Blank spaces are shown when there are no estimates for the corresponding attribute.

Table 6.9: WTP estimates are based on the estimates of MXL with correlated factors presented in Table 6.8. Note: WTP is given in euros.

As a ratio of the car price	ALL DATA	DCE1	DCE2
Conventional	**83,766.76**	**86,657.87**	**91,015.52**
Hybrid	**83,047.63**	**76,562.85**	**79,604.23**

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Plug-in Hybrid	**83,536.70**	**72,853.02**	**74,889.74**
Battery Electric	**84,831.55**	**89,618.16**	**74,669.94**
Battery Electric + PVs	**84,618.65**		**86,424.46**
Range – CV (100 km)	301.96	619.43	-192.97
Range - electric (PHEV) (100 km)	-1,487.00	1,177.37	2,587.04
Range - electric (BEV) (100 km)	129.97	-428.65	-283.46
Normal Charging time (h)	**-509.50**	**-1,226.154**	-97.93
Fast Charging time (min)	-38.15	**-198.69**	-0.51
Wallbox subsidy	1,521.04	3,749.476	1,267.45
Free Parking	-74.63	-124.97	-1,842.83
PVs capacity (kWp)	**-1,384.65**		**-2,488.75**
PV price (thousand EUR)	275.05		526.71
Operating costs (EUR/ 100 km)	**-412.79**	**-368.83**	**-389.23**
As a ratio of the PV price			
PVs capacity (kWp)	5,034.20		4,725.09

The ones in bold are statistically significant. WTP in this table is always the ratio of the coefficient of a specific attribute over the coefficient of the car purchase price or PV price multiplied by 1,000. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute.

In addition, I explore whether a model with tech-specific prices would be more efficient and informative. First, by estimating CL (Appendix Table N), I observe that the coefficients for the car prices of different alternatives do not substantially differ. Thus, I test whether the differences are statistically significant by a Wald test with the null hypothesis that the estimated coefficients are equal (Appendix Table O). The results fail to reject the hypothesis for equality among coefficients.

Next, I estimate an MXL model with no correlated factors (Table 6.5) by adding tech-specific prices and assuming that the estimates of prices of BEV cars for both alternatives with and without PVs are equal. The previous Wald test results can support the latter assumption. The results for MXL are illustrated in Table 6.10. Tech-specific prices do not largely reduce the log-likelihood (LL at convergence) or affect the results compared to the main effects from the MXL model presented before (Table 6.5). The ASCs remain statistically significant for all groups of data. Alternatives with BEV are the prevalent choice of respondents, while HEV remains the least preferred alternative. The most impactful attributes on consumers' decisions are operating costs, wallbox subsidy and normal charging time. Under this specification, normal charging time has larger coefficients, and it is not statistically significant for the case where only data from the first DCE are estimated.

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By observing the coefficients for tech-specific prices, I conclude that based on all the available data, BEV price has the lowest impact on consumers' preferences. Whereas, for data only based on the first DCE, the price for BEVs is the most impactful. That might occur because more attributes related to this technology are available for consumers to consider when PV installation is added to the design. Thus, consumers may assign more importance to other BEV-related attributes than the price alone. Overall, based on the results from CL and MXL, I cannot confidently conclude that the effect of price is significantly different among the various technologies.

Table 6.10: Estimation results of the MXL model with tech-specific prices.

	All data		DCE 1		DCE 2	
	Mean (s.e.)	Std. dev. (s.e.)	Mean (s.e.)	Std. dev. (s.e.)	Mean (s.e.)	Std. dev. (s.e.)
Conventional Car Price (1,000 €)	-0.044*** (0.007)		-0.041*** (0.011)		-0.055*** (0.011)	
Hybrid Car Price (1,000 €)	-0.049*** (0.007)		-0.038*** (0.008)		-0.032*** (0.008)	
Plug-in Hybrid Car Price (1,000 €)	-0.043*** (0.005)		-0.041*** (0.007)		-0.048*** (0.006)	
Battery Electric Car Price (1,000 €)	-0.039*** (0.004)		-0.054*** (0.008)		-0.040*** (0.005)	
Conventional	2.049*** (0.244)	2.904*** (0.102)	2.725*** (0.393)	3.161*** (0.190)	2.664*** (0.388)	3.839*** (0.210)
Hybrid	1.563*** (0.248)	2.463*** (0.101)	2.105*** (0.339)	2.197*** (0.149)	1.752*** (0.320)	2.359*** (0.197)
Plug-in Hybrid	1.853*** (0.245)	1.982*** (0.100)	2.344*** (0.378)	1.720*** (0.222)	2.197*** (0.329)	1.624*** (0.151)
Battery Electric	2.359*** (0.167)	1.345*** (0.077)	2.727*** (0.336)	2.074*** (0.183)	2.392*** (0.222)	1.780*** (0.113)
Battery Electric + PVs	2.728*** (0.205)	0.484*** (0.152)			2.723*** (0.240)	0.182 (0.162)
Range – CV (100 km)	0.021 (0.020)	0.137*** (0.017)	0.027 (0.030)	0.223*** (0.019)	-0.025 (0.028)	0.256*** (0.017)
Range - electric (PHEV) (100 km)	0.051 (0.129)	-0.323*** (0.124)	-0.152 (0.219)	-0.653*** (0.219)	0.273 (0.184)	-0.458** (0.192)
Range - electric (BEV) (100 km)	-0.027 (0.023)	-0.193*** (0.030)	0.021 (0.042)	-0.078** (0.034)	-0.086*** (0.029)	0.304*** (0.028)
Normal Charging time (h)	-0.083*** (0.014)	-0.222*** (0.016)	-0.037 (0.027)	0.204*** (0.042)	-0.078*** (0.020)	0.232*** (0.020)
Fast Charging time (min)	-0.001 (0.002)	-0.012*** (0.002)	-0.006 (0.004)	-0.020*** (0.006)	0.001 (0.002)	-0.004* (0.003)
Wallbox subsidy	0.199*** (0.041)	-0.240*** (0.079)	0.214** (0.084)	0.102 (0.186)	0.201*** (0.053)	-0.159 (0.104)
Free Parking	0.059 (0.038)	0.088 (0.091)	-0.012 (0.084)	-0.813*** (0.131)	0.036 (0.053)	-0.398*** (0.089)
PVs capacity (kWp)	-0.027	0.064***			-0.011	-0.048

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	(0.023)	(0.022)			(0.025)	(0.040)
PV price (1,000 €)	-0.012	-0.028*			-0.013	-0.003
	(0.013)	(0.017)			(0.013)	(0.024)
Operating costs (€/100 km)	-0.020***	0.005	-0.018***	0.008	-0.020***	0.014
	(0.003)	(0.004)	(0.080)	(0.007)	(0.004)	(0.009)
Model Diagnostics						
LL at convergence	-11,802.94		-5,165.54		-7,492.40	
Observations	59,616		22,320		37.296	
Respondents	1,076		1,076		1,036	
Parameters	34		28		34	

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. DCE 1 includes only data from the first DCE with no PV installation available, while DCE 2 includes only data from the second DCE where a 5th alternative with PV installation is added. All factors are random except for the tech-specific purchase prices. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute.

Finally, as a preliminary attempt to further explore the impact of incentives such as tax fees and subsidies on consumers' preferences, I estimate the CL model by separating the initial car price from these incentives. All the results are provided in Appendix Table P. First, I separate the initial price by the incentive applied to it. Second, I separate the incentives into malus and bonus, representing tax fees and subsidies, respectively. Finally, malus and bonus are separated based on the technology. Similarly, I separate the initial price of PVs and the subsidy applied to it.

The results show that when I treat the initial price and the incentives related to price as two different attributes, the impact of incentives is stronger than that of the initial price. The results improve when I separate the incentives into malus and bonus. Malus represents the tax fees applied to the initial purchase price of a car (CV, HEV or PHEV). The coefficient is statistically significant and has the expected negative sign, indicating that increased tax fees will decrease the odds of the specific car being chosen. On the other hand, a bonus represents the subsidy offered to purchase a vehicle (PHEV or BEV). The coefficient for bonus is statistically significant with the expected positive sign and almost twice as large as that of malus. That means that the subsidy may increase the odds of a car being chosen, and it is a stronger policy than tax fees. The initial price of the car, operating costs, CV range, and subsidy for wallbox have the expected signs and are statistically significant, at least at a 10% significance level.

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By further separating the incentives based on the technology they are applied to, only tax fees for CVs (hardly at a 10% significance level) and subsidies for BEVs and PHEVs are statistically significant. Results indicate that tax fees have a similar effect on all the technologies. However, the subsidy for PHEV and BEV may impact the demand for the two technologies differently. It is worth noting that the coefficient for the subsidy for PHEVs is at least twice as large as that of the subsidy for BEVs. PV-related attributes show similar results. Only the subsidy for PVs, not the initial price, is statistically significant, showing that subsidisation is important for consumers and can affect their purchase decisions regardless of the initial price.

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7 Discussion

7.1. Implications for policy

Although ICE vehicles remain currently a prevalent choice among potential car buyers, the results from this study indicate that Greek consumers have a positive attitude towards both BEVs and PHEVs. I find that if a BEV is subsidised, consumers will shift their purchase decisions towards more alternative vehicle technologies. Their shift away from CV technology is even stronger when consumers make their choice on a bundle of two green technologies- a BEV and PVs- that both receive a subsidy. Increasing the wedge between the operating costs of the two alternative vehicle technologies, CVs and BEVs, would make this shift further stronger.

In the current study, the alternative of BEV plus PV is not described as a market bundle product offered by a company at a single price. Respondents are provided with the hypothetical alternative of simultaneously purchasing these two technologies under specific hypothetical conditions, represented by the available attributes and levels, showing the purchase price and the subsidy separately for both green technologies on the choice cards. Therefore, the choice of BEV plus PVs represents the decision of a household to adopt both technologies at the same time (not necessarily from the same supplier). The results are in line with previous studies that argue that a combination of BEV and PV technology adds value to BEVs for consumers (Delmas et al., 2017; Stauch, 2021).

It seems that respondents are not sensitive to changes in the purchase price of a PV system or its capacity. However, I note that a PV always appears in the fifth alternative (labelled as BEV+PV), and hence, utility from a PV may be captured by the ASC, which is indeed larger than the ASC for the BEV alternative. Monetary attributes such as the car price and the operating costs are the most important factors for consumers. Additionally, the subsidy for the installation of wallbox makes the purchase of BEVs and PHEVs much more attractive. By breaking down the final price of car and PV prices into the initial price and a subsidy, I conclude that subsidies are of great importance for Greek consumers, and financial support can indeed motivate Greek consumers to deploy low-carbon vehicle technologies faster and broader. Therefore, subsidies for EVs are an instrumental policy in the promotion of the technology when the uptake of it is still in the initial stage, as it happens in Greece. Finally, the importance of monetary attributes for consumers is clear not only from the results from the DCEs but also from their answers when we asked them about the main barriers and factors of their purchase choices.

In addition, it would be very useful for consumers to be offered a bundle product of BEV and PV technologies directly on the market. Directly purchasing the two technologies from one seller will be more convenient for consumers. Indeed, many car companies already provide the opportunity for BEV consumers to purchase a PV system (Weisbrod, 2022). As a more direct indication of the impact of the total final price for a bundle product of BEV and PVs, it would be interesting to explore consumers' response to the final price they would have to pay for each alternative in the DCEs (Appendix Table P). The government could also provide support (e.g by offering subsidies) to the PV and BEV makers and suppliers in order for them to provide attractive bundled products to consumers and thus indirectly assist the deployment of energy-efficient technologies.

Additional government support with a combined subsidy that requires the purchase of EVs, PVs, and a home charger, even by different suppliers, may add value to these technologies and increase their acceptance. In this case, the subsidy should adequately cover the combined purchase's financial burden for the households, as well as be available for those who actually need it. As I mentioned before, investing in EV and PV technologies can significantly burden many families financially. Considering the Greek economy and the difficulties Greek consumers have experienced in the last decades, it is well understood that purchasing a new vehicle or installing PVs may only be possible for some households. Therefore, the available subsidies may assist only those who are already able to buy these technologies, further exaggerating injustice and inequality (Caulfield et al., 2022; Gomez Vilchez et al., 2019; Sovacool et al., 2019).

Although PV installation can benefit households in multiple ways and increase the attractiveness of BEVs, it is still impossible for many households due to technical or practical reasons, such as lack of space or sunlight, or the disagreement of all the residents in the apartment buildings. In addition, PV installation can practically assist BEV charging only if

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the households install a wallbox (home charger). Similarly, the installation of a wallbox can be technically or practically difficult or impossible for many Greek households. Accommodating the process for households living in multiple residents' buildings or solving technical difficulties such as the lack of parking space might slightly increase the adoption of the two technologies. Indeed, over the last 30 years, many new buildings have been equipped with parking lots that would allow for home-charging facilities (Mpoi et al., 2023).

In addition, companies and workplaces could facilitate the charging of EVs by providing free parking spaces for their employees with wallbox for charging. Currently, only 23% of respondents stated that they can park at a garage at work. I recommend that workplaces, similar to households, take advantage of the available subsidies for BEVs and wallbox installation in their parking lots to enhance BEV deployment. Further studies could explore the WTP of the companies if they could also install PVs and wallboxes on their buildings in order to benefit from the produced electricity available not only to cover the company's needs but also to charge the employees' vehicles. Finally, the government could provide subsidies for the installation of multiple wallboxes to companies and other workplaces even without the purchase of a BEV to facilitate charging at work for employees and, consequently, mass BEV adoption.

Moreover, directing attention to the findings regarding trust and knowledge about EV and PV technologies is important. As presented in the descriptive statistics, about 26% of respondents who already own PVs are not aware of the subsidy "PVs on the roof". Of those who do not already own PVs and are considering installing, 51% are not aware of the subsidy, and 16% are unsure about it. In addition, it is remarkable that many of them were impressed, grateful, or surprised by the information provided during the survey regarding both EVs and PVs, such as the available policies and incentives. The comments provided in the debriefing, along with the information gathered via the survey, indicate a substantial lack of adequate information and knowledge regarding the technologies and the incentives provided. Therefore, the information campaigns are an instrumental step towards EV and PV development in the country. The latter is supported by the available literature that highlights the importance of knowledge, trust and experience regarding EV technology (Anastasiadou & Gavanas, 2022; Hardman et al., 2017; Hesselink & Chappin, 2019; Jia & Chen, 2021; Li et al., 2020; Li et al., 2022; Noel et al., 2019).

Furthermore, the findings prove high heterogeneity in Greek consumer preferences regarding EV adoption. This means that policymakers need to consider this heterogeneity when making

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decisions so they can introduce efficient incentives and information campaigns targeting specific consumer groups to enhance faster EV deployment in the country. Gender, age, and region were not found to impact the preferences of consumers to a great extent. On the other hand, higher education and income, compared to other consumers' characteristics, are closely associated with the sensitivity consumers have to some attributes, especially technical attributes and PV-related attributes. In addition, consumers living in family houses, residents who own and do not rent, face fewer technical difficulties and, therefore, are more likely to install PVs. By targeting these groups of consumers and providing them with adequate subsidisation and other incentives, BEV and PV deployment may increase at a significantly higher pace. The latter will be beneficial for all consumers since the increase in demand for these technologies will lower the prices and facilitate their adoption by more consumers.

Finally, in line with Hardman et al. (2017), I recommend the following measures to increase the adoption of EVs, especially of BEVs and PHEVs, in Greece. First, incentives should be applied when someone is buying a BEV or a PEHV, and not afterwards. That agrees with the findings that monetary characteristics are the most significant car attributes and that subsidies are a more powerful policy than tax fees. Second, incentives should promote BEVs or PHEVs with high electric ranges, but not luxury ones that can be bought by consumers who already have the financial resources to purchase these vehicles (Caulfield et al., 2022; Gomez Vilchez et al., 2019; Sovacool et al., 2019). Third, the premature removal of incentives could negatively affect the adoption of EV technologies. Therefore, incentives should be designed with longevity in mind. Moreover, the Greek government currently does not provide a subsidy for the purchase of a PHEV. However, the results show a strong preference for PHEVs, which can still enhance the transition to a greener transportation sector. Therefore, it would be helpful for subsidies to be provided for the purchase of PHEVs, which can also use electricity and be charged by RES at home or green public charging facilities.

7.2. Limitations and Future Research

The limitations and drawbacks of this study should also be considered. First, although Greece is a small country with a current population of about 10.3 million (EAFO, 2024), the sample would have to be much larger than a sample of 1,076 respondents to make robust conclusions, especially considering the high heterogeneity related to consumers' preferences. In addition,

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the Greek islands were excluded from the sampling. The survey and hence the results of this study do not cover a significant part of the Greek population, of about 1 million people (HSA, 2023), whose preferences might significantly differ from people living on the mainland.

Furthermore, this survey excludes some important consumer characteristics that could explain heterogeneous preferences. These characteristics refer to attitudinal, behavioural, and psychological characteristics whose importance is described in the Literature Review. For example, more information regarding consumers' lifestyles, travelling habits, beliefs about environmental issues, or knowledge and opinion about EVs and PVs would be useful to explain part of consumers' preferences. In addition, this information would provide some context for the cultural differences between Greece and other countries. Findings differ from those from similar studies using DCEs for different car technologies in other countries. Consumers' preferences may vary among different countries based on each country's culture, lifestyle, knowledge, available incentives, and available infrastructure.

Indeed, the available infrastructure for EVs may affect consumers' preferences in different countries. Considering the lack of parking spaces in Greece for many households and the results of this thesis, adequate charging stations for EVs might be an essential motive for EV adoption. However, in this study, the focus is on charging at home since charging infrastructure is currently under development in Greece, and I am interested in PV installations from households. Moreover, many attributes were already included in the DCE design; thus, an additional attribute referring to the number of charging points or their density was not included. As EV adoption and charging infrastructure are developing, it would be interesting to explore consumers' preferences regarding charging stations so that efficient charging infrastructure will be available to facilitate the charging of EVs for all drivers. As the results show, for Greek consumers, normal and not fast charging time is more important, indicating either a preference for the convenience of charging at home or the lack of adequate basic charging infrastructure.

Furthermore, I note avenues of analysis for future research based on the available data from the survey I conducted. First, since the results for electric driving range for BEVs did not have the expected sign, I could test if there are decreasing marginal range patterns, such as that the utility consumers get from the additional range decreases while the base range increases, as identified by Noel et al. (2019) and Bansal P. et al. (2021). In addition, it would be interesting to explore the effect of tech-specific operating costs and the impact of the hypothetical scenario for zero operating costs for BEVs.

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Last but not least, the large number of attributes, alternatives and choice sets included in the DCEs may be an important drawback of this study. Although increasing the number of attributes is not widely considered to affect response efficiency negatively, increased information respondents need to process to make their choices may impact it (Mariel et al., 2021). Also, several studies suggest that a large number of choice sets may cause respondents to feel fatigued and affect their answers. However, there has yet to be a general agreement on the ideal maximum number of choice sets. On the other hand, the literature suggests that a large number of alternatives negatively affects response efficiency due to increased complexity. Although many choices might help consumers find a choice that matches their preferences, the complexity might lead them to choose the opt-out option more often or to make options based on only one attribute, usually that of price (Mariel et al., 2021). Even though the results presented show that the opt-out was chosen infrequently, a large share of respondents made choices based only on one attribute. That is, most likely, the purchase's final price. Thus, a smaller number of choice sets with fewer alternatives and fewer attributes for respondents to evaluate but available to a larger sample may provide better results.

EV technology is developing, and the deployment of BEVs has been decided and supported. Therefore, both the adoption and knowledge of EVs will keep increasing. Thus, future DCEs could focus on merely BEVs or PHEVs and closely explore consumers' preferences for these technologies, providing alternatives with the most significant car-related attributes and new potential incentives. Nevertheless, based on the currently low uptake of EVs in Greece, the available knowledge, infrastructure, and incentives, this study provides an adequate group of choice sets that is as informative and realistic as possible to elicit Greek consumers' preferences. To our knowledge, the current study provides the most informative study with SP available for Greek consumers' preferences regarding EVs and PVs.

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8 Conclusion

To sum up, electromobility is a prevalent policy globally aiming to decrease GHG emissions, air and noise pollution and increase energy savings. However, the impact of EVs is highly dependent on the electricity generation mix. Therefore, it is argued that EVs need to be powered by electricity from RES. Specifically, the literature suggests that the increasing combined adoption of energy-efficient technologies or promoting complementary products, such as EVs and PVs, is considered instrumental to mitigating GHG emissions and achieving sustainability since the combination adds value to both products and increases their adoption.

Following the directives of the European Green Deal, each European member state aims to reduce its footprint by introducing effective incentives to complete national targets for decreased GHG emissions and increased EV deployment, related infrastructure, and RES share in electricity production. Greece introduced incentives, such as registration fees, subsidization for the purchase of BEVs, free parking, and subsidization for the installation of a wallbox (home charger) to support the deployment of EVs, especially of BEVs, for the first time in 2020. Nevertheless, the adoption of EVs in the country is still in the initial phase, with the shares of registered BEVs and PHEVs representing 0.20% and 0.31% of the total number of passenger cars, respectively.

Additionally, Greece aims to increase the share of RES in the generation mix of energy and electricity. Instrumental policy for this is the increase of solar power in the generation mix by increasing the installation of small PV systems by households. Thus, since 2010, the government has been offering the subsidy “PVs on the roof”, for households which want to install PVs on their roofs or other auxiliary areas.

I assume that if Greek households have the opportunity to install PVs to produce electricity and they are able to install a wallbox to use part of this electricity for charging a PHEV or BEV, their willingness to adopt one of them will increase. To test the latter hypothesis, I used DCEs and both CL and MXL models to investigate the preferences of Greek households for all types of EVs and the impact of a combination of BEVs and PVs on EV adoption. I elicited consumers' preferences through an original survey in Greece that included a wide range of questions

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regarding households' energy and electricity consumption, current car ownership, future car preferences, as well as demographic and socioeconomic characteristics of respondents. The data were collected by a pilot survey and the main wave. The pilot study targeted to assist with an efficient survey and DCE design.

Two DCEs were created for this thesis, but the respondents received only one or both of them based on whether they had already installed PVs with an adequate capacity for EV charging. The first DCE consisted of four alternative types of cars, CV, HEV, PHEV and BEV, and seven attributes that describe these alternatives, purchase price, operating costs, driving range, normal charging time, fast charging time, €500 subsidy for the purchase of a wallbox (home charger, and free parking policy. The second DCE consisted of five alternatives, CV, HEV, PHEV, and a combination of BEV and PVs. The attributes describing these alternatives are the same as for the first DCE, with the addition of two more attributes that describe PVs; those are the purchase price and capacity of the hypothetical PV system. The final sample used for the estimation of the main effects of the models excluded speeders, pilot data, and respondents who plan to buy a luxury car with a price higher than €50,000. It consisted of 1,076 respondents and 59,616 observations. Only 40 respondents had an adequate capacity of PVs to charge a BEV or a PHEV and, thus, did not receive the second DCE.

The results indicated that Greek consumers are positive towards EVs and that the installation of PVs can enhance the adoption of BEVs, with some consumers moving their preferences towards alternative modes of transport when this choice is available. However, car- and not PV-related attributes impact their decisions. Specifically, the findings showed that for Greek consumers, car purchase price, operating costs, normal charging time, and wallbox subsidy are the most influential factors when making decisions about a future car purchase. Especially, higher car purchase price, operating costs and normal charging time can prevent consumers from choosing an EV.

I also estimated consumers' WTP for the available attributes. Specifically, consumers are willing to pay between €420 and €500 less for a vehicle if the related operating costs increase by €1 per 100 km. In addition, they are willing to pay between €890 and €2,250 less for a PHEV or BEV for every additional hour in the normal charging time. On the other hand, they are willing to pay between €4,730 and €5,080 more for the purchase of PHEV or BEV if they can receive a €500 subsidy for the installation of a wallbox in their houses. Surprising are the results of the electric driving range of BEVs since Greek consumers are affected negatively by

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the additional driving range of BEVs. The latter is in contrast with the literature findings. However, the electric driving range, both for BEVs and PHEVs, as well as the CV range, is characterized by consumers' preferences heterogeneity, and it is important, at least for some respondents.

Indeed, the findings of this study agree with related literature that proves high consumer preference heterogeneity for cars and especially EVs. A thorough exploration of the impact of different consumers' characteristics on their preferences shows that many of them affect consumers' sensitivity to specific attributes. Specifically, education, income, the size of the car, whether the car will be new or used, the mileage, intention to install PVs, current fleet size, and family size significantly affect consumers' sensitivity to car-related attributes and, therefore, drive the trade-off among those when they choose their preferred alternative vehicle. In addition, whether respondents live in a family house or apartment building and whether they own or rent their houses affects their sensitivity not only to car-related attributes but also to PV-related attributes.

Moreover, extensions of the models showed that consumers' sensitivity to price does not significantly depend on the related technology and that the surcharges or discounts are those that drive their sensitivity to car price. The latter indicates the importance of incentives for the promotion of EVs and PVs. More specifically, the results showed that subsidization might have a stronger effect on consumers' decisions compared to tax fees. Finally, I paid attention to the overall importance of information and knowledge regarding energy-efficient technologies and the available incentives for their faster deployment.

Despite the attractiveness of EVs for Greek consumers, the lack of incentives till recently, the lack of adequate charging infrastructure, as well as economic and technical barriers for households to adopt both EVs and PVs result in the low uptake of EVs in the country. Policymakers need to take into consideration the existing preference heterogeneity to introduce efficient incentives and policies that could facilitate the faster diffusion of EV technologies while reducing the related GHG emissions with the increasing contribution of RES in their charging and assuring a socially fair and equal low carbon transition.

This study contributes to the available literature regarding consumers' preferences and willingness to pay for cars, focusing on the attributes and policies that enhance or prevent EV adoption. In addition, it is the first informative study about Greek consumers' preferences for both EVs and PVs that also evaluates their response to the available incentives and policies for

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energy-efficient technologies. Moreover, it adds knowledge about consumer preference heterogeneity. Most importantly, this study investigates the impact PV installation has on the adoption of alternative-fueled cars and whether the combination of two complementary energy-efficient technologies can indeed affect consumers' adoption decisions.

Nevertheless, there are limitations that are further described in the Discussion, such as the exclusion of Greek islands, the available charging infrastructure and behavioural consumer characteristics, as well as the large number of alternatives and attributes in the DCEs. Similarly, there are many avenues of studies to further explore both with the available data collected for this study and with future research. For example, based on the available data, it is possible to investigate consumers' response to the total final price of the BEV plus PVs, the decreasing marginal BEV-range patterns and the impact of tech-specific or zero operating costs. Finally, future research could test the validity of the results of this thesis with RP when adequate data is available, explore the impact of PVs on charging in public infrastructure or workplaces, or the impact of different bundle products of energy-efficient technologies on their adoption by households.

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Appendix

Appendix Table A: The quota set to represent the Greek population for car owners increased by 10% to include potential car buyers who do not currently own a car, e.g. younger people.

Demographic Characteristics	Categories	Percentage
Gender	Male	50.10%
	Female	49.90%
Age	18-34	29.50%
	35-49	34.60%
	50-65	35.90%
Region		
Attica	EL3-Attiki (Attica)	43.50%
Central Macedonia East Makedonia/ Thraki Epirus West Macedonia	EL5-Voreia Ellada (North Greece)	30.30%
Thessalia West Greece Peloponnese Central Greece	EL6-Kentriki Ellada (Central Greece)	26.30%
Education		
No basic education. Primary school diploma Secondary School Diploma. Vocational Specialty Degree or training (Level 3 CEK or Level 1 IEK) High school diploma (General). Vocational High School Leaving Certificate (EPAL) Vocational Specialty Diploma Level 4 IEK/ Higher School Degree	Basic Education (Up to Secondary)	65.00%
University/ TEI/ Higher Education Degree Master's Degree Ph.D	Higher education	35.00%

Appendix Table B: Estimation results from CL and MXL exploring the effect of pilot data and luxury cars on the car estimates of purchase car price.

	CL with interaction for pilot data	MXL with interaction for pilot data		CL with interaction for luxury cars	MXL with interaction for luxury cars	
	Estimates (s.e.)	Mean (s.e.)	Std. dev (s.e.)	Estimates (s.e.)	Mean (s.e.)	Std. dev (s.e.)

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Purchase car price (1,000 €)	-0.019*** (0.003)	-0.032*** (0.002)		-0.027*** (0.003)	-0.045*** (0.003)	
Conventional	2.016*** (0.160)	1.914*** (0.198)	3.094*** (0.114)	2.192*** (0.167)	2.373*** (0.185)	2.956*** (0.126)
Hybrid	1.519*** (0.163)	1.626*** (0.174)	2.278*** (0.097)	1.696*** (0.169)	1.937*** (0.174)	2.149*** (0.094)
Plug-in Hybrid	1.387*** (0.175)	1.763*** (0.199)	1.543*** (0.113)	1.558*** (0.181)	2.116*** (0.193)	1.644*** (0.121)
Battery Electric	1.626*** (0.161)	2.276*** (0.136)	1.425*** (0.070)	1.789*** (0.165)	2.603*** (0.140)	1.440*** (0.070)
Battery Electric + PVs	1.534*** (0.180)	2.483*** (0.166)	-0.842*** (0.107)	1.689*** (0.183)	2.788*** (0.171)	-1.054*** (0.092)
Range – CV (100 km)	0.035*** (0.011)	0.010 (0.018)	0.189*** (0.013)	0.029** (0.011)	0.000 (0.018)	0.201*** (0.011)
Range - electric (PHEV) (100 km)	-0.041 (0.079)	0.166 (0.112)	0.000 (0.086)	-0.033 (0.079)	0.189* (0.113)	0.135** (0.068)
Range - electric (BEV) (100 km)	0.024* (0.015)	0.016 (0.016)	0.107*** (0.019)	0.024* (0.014)	0.012 (0.016)	-0.099*** (0.018)
Normal charg. time (h)	-0.005 (0.007)	-0.101*** (0.013)	0.271*** (0.013)	-0.005 (0.007)	-0.104*** (0.013)	0.280*** (0.012)
Fast charg. time (min)	0.000 (0.001)	0.001 (0.001)	-0.001 (0.002)	0.000 (0.001)	0.000 (0.001)	-0.006*** (0.002)
Wallbox subsidy	0.155*** (0.029)	0.182*** (0.035)	0.270*** (0.054)	0.151*** (0.029)	0.158*** (0.036)	0.264*** (0.056)
Free Parking	0.034 (0.025)	0.035 (0.034)	-0.007 (0.057)	0.035 (0.025)	0.033 (0.034)	0.046 (0.062)
PVs capacity (kWp)	0.001 (0.016)	-0.012 (0.021)	-0.077*** (0.016)	0.006 (0.017)	-0.001 (0.021)	-0.084*** (0.014)
PV price (1,000 €)	-0.015 (0.009)	-0.014 (0.011)	-0.019** (0.010)	-0.015* (0.009)	-0.019* (0.011)	0.011 (0.009)
Operating costs (€/100 km)	-0.008*** (0.002)	-0.017***	-0.006* (0.004)	-0.009*** (0.002)	-0.018*** (0.003)	-0.003 (0.004)
Car price X luxury cars				0.014*** (0.005)	0.031*** (0.003)	
Car price X pilot	-0.004 (0.005)	0.008** (0.003)				
Range CV X pilot	-0.048*** (0.016)	-0.050*** (0.019)				
PV price X pilot	0.019 (0.016)	0.010 (0.017)				
Model Diagnostics						
LL at convergence	-21098,46	-14720,99		-21074,63	-14640,70	
Wald chi2(n)	386.91			384.85		
LR chi2(n)		12,748.02			12,867.85	
Prob > chi2	0.000	0.000		0.000	0.000	
Observations	72,504	72,504		72,504	72,504	
Respondents	1311	1,076		1311	1311	
Parameters	17	32		17	32	

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the car purchase price and the interactions.

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Appendix Table C: One-sided t-test for equal means to test the statistical equality of the final sample and the quota set for the target population (see Appendix table A for Quota).

T-test						
Null Hypothesis: H0	Alternative Hypothesis: H1	Degrees of Freedom	Mean	Std. dev.	Pr (T<t)	Result
Male=50.10	Male≠50.10	61,495	0.486	0.500	0.000	Reject H0
Young =29.50	Young ≠29.50	61,495	0.301	0.459	0.000	Reject H0
Old = 35.90	Old ≠ 35.90	61,495	0.370	0.483	0.000	Reject H0
Attica = 43.50	Attica ≠ 43.50	61,495	0.458	0.498	0.000	Reject H0
North GR = 30.30	North GR ≠ 30.30	61,495	0.311	0.463	0.000	Reject H0
Higher education= 35.00	Higher education≠ 35.00	61,495	0.311	0.470	0.000	Reject H0 Reject H0

Appendix Table D: Results from Wald test for ASC estimates' equality from Appendix Table .

Wald test				
Null Hypothesis: H0	Alternative Hypothesis: H1	chi2(1)	Prob<chi2(1)	Result
ascBEV=ascBEVPV	ascBEV≠ascBEVPV	0.380	0.540	Do not reject H0
ascBEV=ascCV	ascBEV≠ascCV	10.730	0.001	Reject H0
ascBEV=ascPHEV	ascBEV≠ascPHEV	0.580	0.448	Do not reject H0
ascBEV=ascHEV	ascBEV≠ascHEV	0.020	0.888	Do not reject H0
ascCV=ascHEV	ascCV≠ascHEV	58.910	0.002	Reject H0
ascCV=ascPHEV	ascCV≠ascPHEV	38.080	0.000	Reject H0
ascHEV=ascPHEV	ascHEV≠ascPHEV	1.010	0.316	Do not reject H0
ascHEV=ascBEVPV	ascHEV≠ascBEVPV	0.040	0.837	Do not reject H0
asPHEV=ascBEVPV	asPHEV≠ascBEVPV	0.120	0.727	Do not reject H0
ascCV=ascBEVPV	ascCV≠ascBEVPV	9.910	0.002	Reject H0

Appendix Table E: Estimation results of the MXL model, including interactions between the attributes and different consumer and household-related characteristics as observed through the answers in the survey (received second DCE or not and residence).

	Main Effects		Interactions	Main Effects		Interactions	
	Mean (s.e.)	Std. dev. (s.e.)	replied both DCEs (vs. replied only 1st DCE)	Mean (s.e.)	Std. dev. (s.e.)	Athens (vs. Central Greece)	North Greece (vs. Central Greece)
Car Price (1,000 €)	-0.038*** (0.004)		-0.004 (0.005)	-0.036*** (0.005)		-0.004 (0.006)	-0.015** (0.007)
Conventional	2.321*** (0.195)	3.128*** (0.106)		2,370*** (0.194)	3.038*** (0.109)		
Hybrid	1.965*** (0.189)	2.410*** (0.093)		1.992*** (0.189)	2.361*** (0.096)		
Plug-in Hybrid	2.673*** (0.202)	0.731*** (0.090)		2.631*** (0.208)	0.973*** (0.116)		
Battery Electric	2.425*** (0.158)	1.273*** (0.091)		2.492*** (0.156)	1.286*** (0.093)		
Battery Electric + PVs	2.458*** (0.197)	-1.082*** (0.100)		2.574*** (0.199)	-1.194*** (0.095)		

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Range – CV (100 km)	-0.001 (0.023)	0.244*** (0.010)	-0.035 (0.023)	-0.058** (0.028)	0.228*** (0.010)	0.094*** (0.031)	0.034 (0.033)
Range - electric (PHEV) (100 km)	-0.362** (0.153)	-0.875*** (0.104)	0.248** (0.121)	-0.471** (0.195)	-0.920*** (0.097)	0.187 (0.189)	0.540*** (0.207)
Range - electric (BEV) (100 km)	-0.041 (0.032)	0.241*** (0.015)	-0.002 (0.034)	-0.042 (0.033)	0.233*** (0.014)	-0.008 (0.040)	-0.005 (0.043)
Normal charg. time (h)	-0.021 (0.020)	0.184*** (0.012)	-0.022 (0.022)	-0.042* (0.023)	0.182*** (0.012)	0.019 (0.027)	-0.015 (0.030)
Fast charg. time (min)	-0.002 (0.003)	0.010*** (0.002)	0.002 (0.003)	0.000 (0.003)	0.010*** (0.002)	0.001 (0.004)	-0.001 (0.004)
Wallbox subsidy	0.229*** (0.067)	0.227*** (0.067)	-0.051 (0.080)	0.254*** (0.082)	0.119 (0.080)	0.026 (0.099)	-0.140 (0.107)
Free Parking	0.043 (0.062)	0.048 (0.062)	0.007 (0.077)	0.008 (0.079)	0.039 (0.064)	0.080 (0.096)	0.015 (0.104)
PVs capacity (kWp)	-0.006 (0.023)	-0.015 (0.013)		-0.075* (0.041)	-0.014 (0.014)	0.071 (0.044)	0.085* (0.048)
PV price (1,000 €)	-0.014 (0.013)	0.013 (0.012)		0.022 (0.028)	0.007 (0.012)	-0.035 (0.033)	-0.047 (0.036)
Operating costs (€/100 km)	-0.012** (0.005)	0.009** (0.004)	-0.010* (0.006)	-0.012** (0.006)	0.0.10 (0.004)	-0.006 (0.007)	-0.012 (0.008)
Model Diagnostics							
LL at convergence	-11,776.77			-11771.28			
LR chi2(15)	10,986.52			10,929.94			
Prob > chi2	0.000			0.000			
Observations	59,616			59,616			
Respondents	1,076			1,076			
Parameters	40			53			

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the car purchase price and the interactions.

Appendix Table F: Estimation results of the MXL model, including interactions between the attributes and different consumer and household-related characteristics as observed through the answers in the survey (size of the new car and whether it will be new or used).

	Main Effects		Interactions		
	Mean (s.e.)	Std. dev. (s.e.)	small car (vs. medium car)	large car (vs. medium car)	new car (vs. used car)
Car Price (1,000 €)	-0.052*** (0.005)		-0.038*** (0.006)	0.023*** (0.006)	0.014*** (0.005)
Conventional	2.712*** (0.206)	3.178*** (0.113)			
Hybrid	2.328*** (0.193)	2.418*** (0.089)			
Plug-in Hybrid	3.065*** (0.209)	0.738*** (0.133)			
Battery Electric	2.920*** (0.163)	1.285*** (0.099)			
Battery Electric + PVs	2.993*** (0.205)	-0.983*** (0.124)			
Range – CV (100 km)	-0.011 (0.026)	0.242*** (0.010)	-0.020 (0.028)	-0.112*** (0.041)	0.054** (0.027)
Range - electric (PHEV) (100 km)	-0.275 (0.172)	-0.844*** (0.112)	0.189 (0.170)	0.244 (0.252)	-0.073 (0.166)

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Range - electric (BEV) (100 km)	-0.069**	0.264***	0.012	-0.093*	0.041
	(0.032)	(0.018)	(0.037)	(0.050)	(0.034)
Normal charg. time (h)	-0.052**	0.185***	0.002	0.045	0.018
	(0.021)	(0.013)	(0.023)	(0.040)	(0.023)
Fast charg. time (min)	-0.002	0.009***	-0.003	0.002	0.008***
	(0.003)	(0.002)	(0.003)	(0.006)	(0.003)
Wallbox subsidy	0.286***	0.178**	-0.051	-0.385***	-0.042
	(0.071)	(0.073)	(0.082)	(0.150)	(0.081)
Free Parking	-0.036	0.054	0.075	0.090	0.105
	(0.067)	(0.061)	(0.079)	(0.147)	(0.077)
PVs capacity (kWp)	0.010	-0.004	-0.001	-0.013	-0.032
	(0.035)	(0.014)	(0.035)	(0.066)	(0.035)
PV price (1,000 €)	-0.026	0.023*	0.007	0.030	0.014
	(0.023)	(0.013)	(0.027)	(0.049)	(0.026)
Operating costs (€/100 km)	-0.020***	0.005	-0.001	0.019*	-0.003
	(0.005)	(0.004)	(0.006)	(0.011)	(0.006)
Model Diagnostics					
LL at convergence	-11,696.39				
LR chi2(15)	10,933.57				
Prob > chi2	0.000				
Observations	59,616				
Respondents	1,076				
Parameters	64				

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the car purchase price and the interactions.

Appendix Table G: Estimation results of the MXL model, including interactions between the attributes and different consumer and household-related characteristics as observed through the answers in the survey (garage at home and intention to install PVs).

	Main Effects		Interactions	Main Effects		Interactions
	Mean (s.e.)	Std. dev. (s.e.)	Home garage (vs. no home garage)	Mean (s.e.)	Std. dev. (s.e.)	Intend to install PVs (vs. they do not)
Car Price (1,000 €)	0.049***		0.015***	-0.047***		0.022***
	(0.004)		(0.004)	(0.003)		(0.005)
Conventional	2.389***	3.080***		2.339***	3.154***	
	(0.195)	(0.113)		(0.194)	(0.109)	
Hybrid	2.013***	2.419***		1.991***	2.406***	
	(0.191)	(0.096)		(0.188)	(0.092)	
Plug-in Hybrid	2.629***	0.838***		2.660***	0.703***	
	(0.205)	(0.110)		(0.202)	(0.091)	
Battery Electric	2.497***	1.241***		2.466***	1.295***	
	(0.157)	(0.094)		(0.156)	(0.096)	
Battery Electric + PVs	2.554***	-1.143***		2.556***	-1.145***	
	(0.198)	(0.096)		(0.199)	(0.100)	
Range petrol (per km)	-0.164***	0.238***	0.165***	-0.019	0.239***	0.026
	(0.042)	(0.010)	(0.041)	(0.020)	(0.010)	(0.028)
Range – CV (100 km)	0.442	-0.822***	-0.667***	-0.211	-0.835***	0.101
	(0.272)	(0.103)	(0.255)	(0.140)	(0.106)	(0.162)

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Range - electric (PHEV) (100 km)	-0.183*** (0.050)	0.244*** (0.016)	0.148*** (0.048)	-0.041* (0.022)	0.245*** (0.016)	-0.005 (0.037)
Range - electric (BEV) (100 km)	-0.034** (0.015)	0.182*** (0.012)	-0.004 (0.019)	-0.031** (0.015)	0.179*** (0.012)	-0.021 (0.024)
Fast charg. time (min)	0.001 (0.002)	0.010*** (0.002)	-0.002 (0.003)	-0.003 (0.002)	0.009*** (0.001)	-0.009*** (0.003)
Wallbox subsidy	0.195*** (0.054)	0.212*** (0.074)	0.028 (0.076)	0.185*** (0.048)	0.236*** (0.065)	0.055 (0.086)
Free Parking	0.078 (0.051)	0.054 (0.061)	-0.055 (0.073)	-0.010 (0.045)	0.061 (0.063)	0.203** (0.083)
PVs capacity (kWp)	-0.006 (0.028)	-0.016 (0.014)	-0.013 (0.033)	-0.002 (0.026)	-0.011 (0.014)	-0.039 (0.038)
PV price (1,000 €)	-0.015 (0.017)	0.008 (0.012)	0.007 (0.025)	-0.023 (0.015)	0.020* (0.011)	0.037 (0.028)
Operating costs (€/100 km)	-0.004 (0.011)	0.009*** (0.004)	-0.016 (0.011)	-0.018*** (0.004)	0.006* (0.004)	-0.002 (0.007)
Model Diagnostics						
LL at convergence	-11,777.120			-11,767.971		
LR chi2(15)	10,954.930			10,885.680		
Prob > chi2	0.000			0.000		
Observations	59,616			59,616		
Respondents	1,076			1,076		
Parameters	42			42		

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the car purchase price and the interactions.

Appendix Table H:. Estimation results of the MXL model, including interactions between the attributes and different consumer and household-related characteristics as observed through the answers in the survey (installation of home charger if it is fully subsidized by the government).

	Main Effects		Interactions	
	Mean (s.e.)	Std. dev. (s.e.)	Would install charger (vs. would not for other reasons)	Would not install charger due to technical issues (vc. would not for other reasons)
Car Price (1,000 €)	-0.043*** (0.005)		0.001 (0.006)	-0.029** (0.012)
Conventional	2.452*** (0.196)	2.857*** (0.119)		
Hybrid	1.329*** (0.196)	-2.649*** (0.110)		
Plug-in Hybrid	2.190*** (0.206)	-1.558*** (0.088)		
Battery Electric	2.727*** (0.164)	1.072*** (0.109)		
Battery Electric + PVs	2.564*** (0.214)	1.586*** (0.126)		
Range – CV (100 km)	-0.059** (0.029)	-0.123*** (0.019)	0.111*** (0.028)	0.062 (0.051)
Range - electric (PHEV) (100 km)	-0.562*** (0.196)	0.885*** (0.142)	0.557*** (0.190)	0.432 (0.331)
Range - electric (BEV) (100 km)	-0.119*** (0.038)	0.219*** (0.027)	0.122*** (0.039)	0.063 (0.077)

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Normal charg. time (h)	-0.162*** (0.028)	0.190*** (0.017)	0.151*** (0.028)	0.082 (0.055)
Fast charg. time (min)	-0.011*** (0.003)	0.007*** (0.002)	0.014*** (0.004)	0.000 (0.007)
Wallbox subsidy	-0.101 (0.088)	-0.179*** (0.067)	0.443*** (0.099)	0.021 (0.196)
Free Parking	-0.039 (0.086)	0.254*** (0.073)	0.137 (0.097)	-0.099 (0.186)
PVs capacity (kWp)	-0.017 (0.040)	0.016 (0.015)	-0.005 (0.042)	0.079 (0.074)
PV price (1,000 €)	-0.023 (0.028)	0.031** (0.016)	0.013 (0.032)	-0.031 (0.059)
Operating costs (€/100 km)	-0.011** (0.005)	0.000 (0.009)	-0.015*** (0.006)	0.008 (0.012)
Model Diagnostics				
LL at convergence	-11,619.536			
LR chi2(15)	10,182.300			
Prob > chi2	0.000			
Observations	59,616			
Respondents	1,076			
Parameters	53			

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the car purchase price and the interactions.

Appendix Table I: Estimation results of the MXL model, including interactions between the attributes and different consumer and household-related characteristics as observed through the answers in the survey (intention to replace the old car with the new one and family fleet size).

	Main Effects		Interactions	Main Effects		Interactions		
	Mean (s.e.)	Std. dev. (s.e.)	Replace old car with new (vs. use both)	Mean (s.e.)	Std. dev. (s.e.)	Have no cars (vs. own 3 or more cars)	Have 1 car (vs. own 3 or more cars)	Have 2 cars (vs. own 3 or more cars)
Car Price (1,000 €)	-0.046*** (0.004)		0.007 (0.005)	-0.025** (0.013)		-0.034** (0.017)	-0.010 (0.013)	-0.024* (0.013)
Conventional	2.344*** (0.193)	3.117*** (0.109)		2.584 (0.192)	2.903c (0.108)			
Hybrid	1.994*** (0.189)	2.381*** (0.094)		1.913 (0.196)	2.142*** (0.094)			
Plug-in Hybrid	2.676*** (0.204)	0.773*** (0.103)		2.196 (0.211)	1.723*** (0.101)			
Battery Electric	2.474*** (0.157)	1.297*** (0.090)		2.777 (0.168)	-0.768*** (0.206)			
Battery Electric + PVs	2.575*** (0.198)	-1.132*** (0.096)		2.740 (0.203)	-1.189*** (0.157)			
Range – CV (100 km)	-0.026 (0.023)	0.242*** (0.010)	0.027 (0.025)	0.058 (0.058)	0.180*** (0.012)	-0.169** (0.073)	-0.045 (0.059)	-0.061 (0.060)
Range - electric (PHEV) (100 km)	-0.008 (0.155)	-0.869*** (0.107)	-0.363** (0.151)	0.469 (0.342)	0.347*** (0.122)	-0.090 (0.430)	-0.650* (0.343)	-0.180 (0.348)
Range - electric (BEV) (100 km)	-0.052* (0.027)	0.240*** (0.015)	0.011 (0.033)	-0.077 (0.075)	0.236*** (0.015)	0.001 (0.098)	0.022 (0.077)	0.042 (0.079)
Normal charg. time (h)	-0.035** (0.017)	0.182*** (0.011)	-0.002 (0.022)	-0.069 (0.057)	0.220*** (0.012)	-0.065 (0.074)	0.004 (0.058)	0.024 (0.059)

Fast charg. time	-0.002	0.010***	0.004	0.005	0.014***	-0.017*	-0.006	-0.007
(min)	(0.002)	(0.001)	(0.003)	(0.007)	(0.002)	(0.009)	(0.007)	(0.008)
Wallbox	0.138**	0.221***	0.122	0.564	-0.286***	-0.385	-0.328	-0.429**
subsidy	(0.058)	(0.074)	(0.078)	(0.200)	(0.078)	(0.254)	(0.205)	(0.210)
Free Parking	0.098*	0.028	-0.091	-0.281	0.166***	0.410*	0.377**	0.284
	(0.054)	(0.062)	(0.075)	(0.176)	(0.078)	(0.227)	(0.183)	(0.153)
PVs capacity	-0.025	-0.012	0.024	-0.095	-0.072***	-0.010	0.018	0.153
(kWp)	(0.029)	(0.013)	(0.034)	(0.105)	(0.018)	(0.123)	(0.107)	(0.107)
PV price (1,000	0.001	0.015	-0.027	0.087	-0.001	-0.019	-0.081	-0.133**
€)	(0.018)	(0.012)	(0.025)	(0.063)	(0.012)	(0.081)	(0.066)	(0.066)
Operating costs	-0.020***	0.009**	0.002	0.011	0.023***	-0.011	-0.033**	-0.035***
(€/100 km)	(0.004)	(0.003)	(0.006)	(0.013)	(0.004)	(0.013)	(0.013)	(0.014)
Model Diagnostics								
LL at convergence	-11,785.93			-11,777.330				
LR chi2(15)	10,963.54			10,876.58				
Prob > chi2	0.000			0.000				
Observations	59,616			59,616				
Respondents	1,076			1,076				
Parameters	42			64				

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the car purchase price and the interactions.

Appendix Table J: Estimation results of the MXL model, including interactions between the attributes and different consumer and household-related characteristics as observed through the answers in the survey (type of house and ownership).

	Main Effects		Interactions	Main Effects		Interactions
	Mean (s.e.)	Std. dev. (s.e.)	Family house (vs. apartment building)	Mean (s.e.)	Std. dev. (s.e.)	Owner (vs. renting)
Car Price (1,000 €)	-0.047***		0.015***	-0.040***		-0.004
	(0.004)		(0.005)	(0.005)		(0.005)
Conventional	2.297***	3.101***		2.500***	3.004***	
	(0.192)	(0.107)		(0.191)	(0.108)	
Hybrid	1.933***	2.431***		1.680***	2.585***	
	(0.189)	(0.099)		(0.191)	(0.105)	
Plug-in Hybrid	2.649***	0.703***		2.108***	1.431***	
	(0.204)	(0.096)		(0.203)	(0.074)	
Battery Electric	2.456***	1.268***		2.387***	1.339***	
	(0.156)	(0.088)		(0.164)	(0.087)	
Battery Electric +	2.546***	-1.082***		2.620***	0.887***	
PVs	(0.198)	(0.107)		(0.201)	(0.153)	
Range – CV (100 km)	-0.002	0.241***	-0.020	-0.021	0.167***	0.042
	(0.023)	(0.010)	(0.025)	(0.027)	(0.011)	(0.026)
Range - electric	-0.022	-0.921***	-0.465***	-0.059	-0.088	-0.219
(PHEV) (100 km)	(0.151)	(0.115)	(0.148)	(0.172)	(0.091)	(0.162)
Range - electric	-0.026	0.244***	-0.036	-0.083**	0.253***	0.051
(BEV) (100 km)	(0.026)	(0.016)	(0.032)	(0.036)	(0.021)	(0.038)
Range - electric	-0.041**	0.185***	0.008	-0.080***	0.196***	0.036
(BEV) (100 km)	(0.017)	(0.012)	(0.022)	(0.024)	(0.013)	(0.025)
Fast charg. time (min)	0.001	0.010***	-0.003	-0.001	-0.011	0.002
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)

Wallbox subsidy	0.211***	0.236***	-0.020	0.183**	-0.132*	0.045
	(0.054)	(0.067)	(0.078)	(0.074)	(0.072)	(0.087)
Free Parking	0.072	0.059	-0.056	0.049	-0.156**	0.005
	(0.052)	(0.061)	(0.075)	(0.072)	(0.072)	(0.084)
PVs capacity (kWp)	0.014	-0.013	-0.058*	-0.049	0.020	-0.055
	(0.028)	(0.013)	(0.034)	(0.036)	(0.017)	(0.037)
PV price (1,000 €)	-0.033*	0.014	0.048*	0.030	0.018	-0.056**
	(0.017)	(0.012)	(0.025)	(0.024)	(0.012)	(0.028)
Operating costs	-0.017***	0.008**	-0.004	-0.013**	0.016***	-0.010
(€/100 km)	(0.004)	(0.004)	(0.006)	(0.006)	(0.004)	(0.006)
Model Diagnostics						
LL at convergence	-11,783.99			-11,604.95		
LR chi2(15)	10,966.14			10,715.15		
Prob > chi2	0.000			0.000		
Observations	59,616			59,616		
Respondents	1,076			1,076		
Parameters	42			42		

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the car purchase price and the interactions.

Appendix Table K: Estimation results of the MXL model, including interactions between the attributes and different consumer and household-related characteristics as observed through the answers in the survey (mileage).

	Main Effects		Interactions		
	Mean (s.e.)	Std. dev. (s.e.)	Low mileage (vs. very high mileage)	Medium mileage (vs. very high mileage)	High mileage (vs. very high mileage)
Car Price (1,000 €)	-0.031***		-0.013*	-0.020***	-0.008
	(0.006)		(0.007)	(0.008)	(0.007)
Conventional	2.394***	2.155***			
	(0.196)	(0.116)			
Hybrid	2.082***	2.401***			
	(0.191)	(0.096)			
Plug-in Hybrid	2.691***	0.798***			
	(0.206)	(0.102)			
Battery Electric	2.550***	1.239***			
	(0.158)	(0.100)			
Battery Electric + PVs	2.608***	-1.132***			
	(0.200)	(0.100)			
Range – CV (100 km)	-0.107***	0.231***	0.068**	0.167***	0.139***
	(0.032)	(0.011)	(0.035)	(0.039)	(0.042)
Range - electric (PHEV) (100 km)	-0.442**	-0.837***	0.330	0.194	0.320
	(0.212)	(0.098)	(0.214)	(0.236)	(0.246)
Range - electric (BEV) (100 km)	-0.063	0.244***	-0.002	0.029	0.065
	(0.047)	(0.016)	(0.051)	(0.056)	(0.059)
Normal charg. time (h)	-0.087***	0.171***	0.061*	0.072**	0.063*
	(0.027)	(0.014)	(0.031)	(0.035)	(0.038)
Fast charg. time (min)	-0.007**	0.010***	0.007	0.012***	0.006
	(0.004)	(0.002)	(0.004)	(0.005)	(0.005)
Wallbox subsidy	0.049	0.267***	0.103	0.246**	0.340**
	(0.097)	(0.065)	(0.112)	(0.125)	(0.137)
Free Parking	-0.004	0.030	0.056	0.070	0.109
	(0.092)	(0.063)	(0.108)	(0.120)	(0.130)

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PVs capacity (kWp)	-0.050	-0.012	0.023	0.050	0.089
	(0.044)	(0.014)	(0.048)	(0.054)	(0.058)
PV price (1,000 €)	-0.009	0.015	0.003	0.002	-0.025
	(0.032)	(0.012)	(0.037)	(0.041)	(0.045)
Operating costs (€/100 km)	-0.021***	0.007**	0.003	-0.001	0.007
	(0.007)	(0.004)	(0.008)	(0.009)	(0.010)
Model Diagnostics					
LL at convergence	-11,751.17				
LR chi2(15)	10,892.90				
Prob > chi2	0.000				
Observations	59,616				
Respondents	1,076				
Parameters	64				

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses.. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the car purchase price and the interactions.
Low mileage=<5,000 km/year, Medium mileage=5,000-9,999 km/year, High mileage=10,000-19,999 km/year, Very high mileage=>=20,000 km/year.

Appendix Table L: Estimation results of the MXL model, including interactions between the attributes and different consumer and household-related characteristics as observed through the answers in the survey (size of household).

	Main Effects		Interactions			
	Mean (s.e.)	Std. dev. (s.e.)	1 person alone (vs. >=5 family members)	2 members (vs. >=5 family members)	3 members (vs. >=5 family members)	4 members (vs. >=5 family members)
Car Price (1,000 €)	-0.053***		0.015	0.016	0.023**	0.000
	(0.008)		(0.013)	(0.009)	(0.009)	(0.009)
Conventional	2.388***	3.117***				
	(0.198)	(0.112)				
Hybrid	1.984***	2.374***				
	(0.190)	(0.090)				
Plug-in Hybrid	2.707***	0.694***				
	(0.205)	(0.100)				
Battery Electric	2.531***	1.275***				
	(0.159)	(0.099)				
Battery Electric + PVs	2.576***	-1.168***				
	(0.202)	(0.097)				
Range – CV (100 km)	0.009	0.247***	-0.121**	-0.062	-0.070	0.069
	(0.039)	(0.010)	(0.057)	(0.044)	(0.044)	(0.043)
Range - electric	-0.211	-0.895***	0.212	-0.235	0.035	0.106
(PHEV) (100 km)	(0.256)	(0.107)	(0.359)	(0.272)	(0.269)	(0.270)
Range - electric (BEV)	-0.033	0.233***	-0.135*	-0.036	-0.023	0.058
(100 km)	(0.046)	(0.018)	(0.076)	(0.055)	(0.054)	(0.054)
Normal charg. time (h)	-0.005	0.200***	-0.031	-0.058	-0.032	-0.036
	(0.033)	(0.019)	(0.055)	(0.040)	(0.038)	(0.039)
Fast charg. time (min)	0.002	0.010***	-0.009	-0.005	-0.003	0.000
	(0.004)	(0.002)	(0.007)	(0.005)	(0.005)	(0.005)
Wallbox subsidy	-0.041	0.248***	0.327*	0.290**	0.285	0.233*
	(0.117)	(0.065)	(0.196)	(0.138)	(0.138)	(0.137)
Free Parking	0.019	0.056	-0.060	0.098	-0.062	0.094
	(0.108)	(0.069)	(0.185)	(0.131)	(0.128)	(0.128)

PVs capacity (kWp)	0.000 (0.049)	-0.017 (0.013)	-0.115 (0.088)	-0.038 (0.057)	-0.071 (0.058)	0.072 (0.055)
PV price (1,000 €)	-0.013 (0.0034)	0.0015 (0.011)	0.065 (0.063)	0.025 (0.043)	0.014 (0.043)	-0.036 (0.041)
Operating costs (€/100 km)	-0.035 (0.008)	0.009** (0.004)	0.021 (0.014)	0.028*** (0.010)	0.021** (0.010)	0.009 (0.010)
Model Diagnostics						
LL at convergence	-11,750.07					
LR chi2(15)	10,943.98					
Prob > chi2	0.000					
Observations	59,616					
Respondents	1,076					
Parameters	75					

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the car purchase price and the interactions.

Appendix Table M: Estimation results of the MXL model, including interactions between the attributes and different consumer and household-related characteristics as observed through the answers in the survey (number of kids living in the household).

	Main Effects		Interactions		
	Mean (s.e.)	Std. dev. (s.e.)	No kids (vs. with >=3 kids)	1 kid (vs. with >=3 kids)	2 kids (vs. with >=3 kids)
Car Price (1,000 €)	-0.040*** (0.007)		-0.008 (0.008)	-0.001 (0.009)	-0.007 (0.009)
Conventional	2.666*** (0.198)	3.094*** (0.102)			
Hybrid	1.842*** (0.194)	2.543*** (0.103)			
Plug-in Hybrid	2.485*** (0.204)	1.283*** (0.101)			
Battery Electric	2.563*** (0.161)	-1.333*** (0.072)			
Battery Electric + PVs	2.786*** (0.199)	-0.651*** (0.139)			
Range – CV (100 km)	-0.165*** (0.038)	-0.213*** (0.011)	0.125*** (0.038)	0.219*** (0.042)	0.195*** (0.045)
Range - electric (PHEV) (100 km)	0.299 (0.258)	-0.504*** (0.104)	-0.095 (0.253)	-0.425 (0.275)	-0.205 (0.302)
Range - electric (BEV) (100 km)	-0.062 (0.047)	0.086*** (0.019)	0.085* (0.051)	0.084 (0.054)	0.085 (0.059)
Normal charg. time (h)	-0.053 (0.037)	0.259*** (0.012)	-0.043 (0.039)	-0.001 (0.042)	-0.053 (0.046)
Fast charg. time (min)	-0.006 (0.004)	-0.002 (0.002)	0.007 (0.005)	0.007 (0.005)	0.011** (0.005)
Wallbox subsidy	0.092 (0.124)	-0.351*** (0.057)	0.128 (0.135)	0.116 (0.146)	0.086 (0.157)
Free Parking	-0.052 (0.115)	0.022 (0.073)	0.091 (0.126)	0.207 (0.137)	0.092 (0.148)
PVs capacity (kWp)	-0.099* (0.055)	0.022* (0.012)	0.060 (0.057)	0.101 (0.062)	0.169*** (0.064)
PV price (1,000 €)	-0.032 (0.042)	0.087*** (0.015)	0.016 (0.045)	-0.003 (0.048)	-0.024 (0.051)

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Operating costs (€/100 km)	-0.026*** (0.008)	0.011** (0.005)	0.016* (0.009)	0.002 (0.010)	-0.005 (0.011)
Model Diagnostics					
LL at convergence	-11,753.403				
LR chi2(15)	10,933.540				
Prob > chi2	0.000				
Observations	59,616				
Respondents	1.076				
Parameters	64				

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the car purchase price and the interactions.

Appendix Table N: Estimation results from CL model with alternative-specific prices.

	CL
	Estimates (s.e.)
Conventional Car Price (1,000 €)	-0.028*** (0.005)
Hybrid Car Price (1,000 €)	-0.022*** (0.005)
Plug-in Hybrid Car Price (1,000 €)	-0.023*** (0.005)
Battery Electric Car Price-only BEV (1,000 €)	-0.028*** (0.004)
Battery Electric Car Price- BEV + PVs (1,000 €)	-0.025*** (0.006)
Conventional	2.290*** (0.206)
Hybrid	1.598*** (0.211)
Plug-in Hybrid	1.514*** (0.213)
Battery Electric	1.735*** (0.191)
Battery Electric + PVs	1.603*** (0.224)
Range – CV (100 km)	0.023* (0.012)
Range - electric (PHEV) (100 km)	-0.077 (0.085)
Range - electric (BEV) (100 km)	0.016 (0.016)
Normal charg. time (h)	0.002 (0.008)
Fast charg. time (min)	0.000 (0.001)
Wallbox subsidy	0.173*** (0.033)
Free Parking	0.051* (0.028)
PVs capacity (kWp)	-0.025 (0.018)
PV price (1,000 €)	-0.001

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	(0.010)
Operating costs (€/100 km)	-0.009***
	(0.002)
Model Diagnostics	
LL at convergence	-17,274.55
Wald chi2(n)	344.55
Prob > chi2	0.000
Observations	59,616
Respondents	1,076
Parameters	20

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV).

Appendix Table O: Results from Wald test for prices' coefficients equality from Appendix Table N.

Wald test				
Null Hypothesis: H0	Alternative Hypothesis: H1	chi2(1)	Prob<chi2(1)	Result
priceCV-priceHEV=0	priceCV-priceHEV≠0	1.150	0.283	Do not reject H0
priceCV-pricePHEV=0	priceCV-pricePHEV≠0	0.770	0.379	Do not reject H0
priceCV-priceEV=0	priceCV-priceEV≠0	**0.000**	0.985	Do not reject H0
priceCV-priceEVPV=0	priceCV-priceEVPV≠0	0.260	0.609	Do not reject H0
priceHEV-pricePHEV=0	priceHEV-pricePHEV≠0	0.040	0.845	Do not reject H0
priceHEV-priceEV=0	priceHEV-priceEV≠0	1.160	0.281	Do not reject H0
priceHEV-priceEVPV=0	priceHEV-priceEVPV≠0	0.180	0.672	Do not reject H0
pricePHEV-priceEV=0	pricePHEV-priceEV≠0	0.940	0.333	Do not reject H0
pricePHEV-priceEVPV=0	pricePHEV-priceEVPV≠0	0.080	0.776	Do not reject H0
priceEV-priceEVPV=0	priceEV-priceEVPV≠0	0.400	0.526	Do not reject H0

Appendix Table P: Estimation results of the CL model: Exploring the effect of tax fees and subsidization policies separately from initial prices for cars or PVs.

	CL 1	CL 2	CL 3	CL 4
	Estimates (s.e.)	Estimates (s.e.)	Estimates (s.e.)	Estimates (s.e.)
Conventional	1.965***	1.900***	1.834***	1.832***
	(0.191)	(0.195)	(0.202)	(0.202)
Hybrid	1.365***	1.321***	1.293***	1.290***
	(0.201)	(0.204)	(0.203)	(0.203)
Plug-in Hybrid	1.184***	1.120***	1.003***	1.001***
	(0.226)	(0.230)	(0.233)	(0.233)
Battery Electric	1.269***	1.222***	1.214***	1.218***
	(0.231)	(0.234)	(0.235)	(0.235)
Battery Electric + PVs	1.217***	1.154***	1.150***	1.127***
	(0.247)	(0.252)	(0.254)	(0.254)
Range – CV (100 km)	0.024*	0.026**	0.026**	0.027***
	(0.012)	(0.012)	(0.013)	(0.013)
Range - electric (PHEV) (100 km)	-0.076	-0.066	-0.076	-0.069**
	(0.085)	(0.085)	(0.085)	(0.085)
Range - electric (BEV) (100 km)	0.003	0.002	0.007	0.008
	(0.016)	(0.016)	(0.016)	(0.016)
Normal charg. time (h)	-0.001	-0.001	-0.001	-0.003
	(0.008)	(0.008)	(0.008)	(0.008)
Fast charg. time (min)	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)

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Wallbox subsidy	0.170***	0.171***	0.166***	0.165***
	(0.033)	(0.033)	(0.033)	(0.033)
Free Parking	0.046	0.047*	0.035	0.030
	(0.028)	(0.028)	(0.029)	(0.029)
PVs capacity (kWp)	-0.026	-0.023	-0.026	-0.071**
	(0.018)	(0.018)	(0.018)	(0.032)
PV price (1,000 €)	-0.001	-0.002	0.000	
	(0.010)	(0.010)	(0.010)	
Initial PV price (1,000 €)				0.024
				(0.016)
Subsidy for PVs (1,000 €)				0.068*
				(0.040)
Operating costs (€/100 km)	-0.009***	-0.009***	-0.009***	-0.009***
	(0.002)	(0.002)	(0.002)	(0.002)
Initial Car Price (1,000 €)	-0.010*	-0.010*	-0.008	-0.008
	(0.006)	(0.006)	(0.006)	(0.006)
Malus or Bonus (1,000 €)	-0.047***			
	(0.007)			
Malus (1,000 €)		-0.029***		
		(0.008)		
Bonus (1,000 €)		0.060***		
		(0.009)		
Malus for CVs (1,000 €)			-0.020*	-0.020*
			(0.012)	(0.012)
Malus for HEVs (1,000 €)			-0.039	-0.038
			(0.020)	(0.025)
Malus for PHEVs (1,000 €)			-0.029	-0.029
			(0.019)	(0.019)
Bonus for PHEVs (1,000 €)			0.115***	0.115***
			(0.019)	(0.019)
Bonus for BEVs (1,000 €)			0.047***	0.047***
			(0.010)	(0.010)
Model Diagnostics				
LL at convergence	-17,252.30	-17,247.48	-17,233.73	-17,232.52
Wald chi2(n)	466,50	410.25	436.27	438.99
Prob > chi2	0.000	0.000	0.000	0.000
Observations	59,616	59,616	59,616	59,616
Respondents	1,076	1,076	1,076	1,076
Parameters	17	18	21	22

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute.

Appendix Table P: Estimation results from CL and MXL using as variable the total price of alternative (that is the final price of the vehicle or the filan price of the vehicle plus the final price of PVs).

	CL	MXL	
	Estimates (s.e.)	Mean (s.e.)	Std. dev (s.e.)
Final Total Price of alternative	-0.024***	-0.041***	
(1,000 €)	(0.003)	(0.003)	
Conventional	2.200***	2.386***	3.127***
	(0.181)	(0.196)	(0.115)
Hybrid	1.652***	1.837***	2.280***
	(0.185)	(0.195)	(0.094)
Plug-in Hybrid	1.538***	2.310***	1.306***
	(0.199)	(0.205)	(0.190)

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Battery Electric	1.668***	2.446***	-0.959***
	(0.183)	(0.162)	(0.081)
Battery Electric + PVs	1.614***	2.556***	1.196***
	(0.203)	(0.202)	(0.095)
Range – CV (100 km)	0.024**	-0.003	0.208***
	(0.012)	(0.019)	(0.012)
Range - electric (PHEV) (100 km)	-0.075	0.058	-0.177
	(0.085)	(0.126)	(0.188)
Range - electric (BEV) (100 km)	0.015	-0.029	0.228***
	(0.016)	(0.023)	(0.030)
Normal charg. time (h)	0.000	-0.053***	0.206***
	(0.008)	(0.013)	(0.016)
Fast charg. time (min)	0.000	-0.002	0.016***
	(0.001)	(0.002)	(0.003)
Wallbox subsidy	0.173***	0.190***	-0.196**
	(0.033)	(0.041)	(0.084)
Free Parking	0.054*	0.057	0.117
	(0.028)	(0.039)	(0.086)
PVs capacity (kWp)	-0.001	-0.001	0.039**
	(0.014)	(0.020)	(0.019)
Operating costs (€/100 km)	-0.009***	-0.020***	0.008*
	(0.002)	(0.003)	(0.004)
Model Diagnostics			
LL at convergence	-17,282.07	-11,828.164	
Wald chi2(15)/	340.25		
LR chi2(14)		10,907.81	
Prob > chi2	0.000	0.000	
Observations	59,616	59,616	
Respondents	1,076	1,076	
Parameters	15	29	

Note: *, **, and *** represent coefficients significantly different from zero at 0.1, 0.05, and 0.01 significance levels, respectively. Standard errors are provided in the parentheses. Range - CV = the driving range for petrol or diesel (CV, HEV, PHEV). Blank spaces are shown when there are no estimates for the corresponding attribute. All factors in the MXL model are random except for the final total price of the alternative.

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