UNIVERSIDADE CATÓLICA PORTUGUESA

Factors influencing Electric Vehicles adoption

Do Gender and Experience matter? A Portuguese overview

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Católica Porto Business School
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Resumo

Atualmente, as empresas estão a trabalhar de forma a promover a sustentabilidade nos seus negócios, devido às tendências atuais e, ao facto de o mercado o exigir. Os consumidores estão se a tornar cada vez mais responsáveis e a praticar ações sustentáveis, aumentando a consciencialização, e a desempenhar um papel crucial na sociedade, de forma a reduzir a pegada de carbono, reduzir gastos desnecessários e evitar prejudicar o ambiente. Os veículos elétricos são vistos como altamente sustentáveis, por não emitirem carbono para a atmosfera. No entanto, a sua produção é pouco sustentável, como é o caso das baterias. Assim sendo, o objetivo deste estudo é explorar quais as razões por detrás da intenção de compra dos consumidores em relação a veículos elétricos. Devido ao seu crescimento nos últimos anos, este é um tema que tem estado a ser bastante explorado. Portanto, o tópico ganha importância na perspetiva de perceber quais são os fatores de Incentivo ou as Barreiras que os consumidores consideram determinantes na sua decisão de compra e se os mesmos diferem de acordo com o Género ou Experiência.

A metodologia utilizada foi quantitativa e foi recolhida informação através de um inquérito online a pessoas residentes em Portugal. Os resultados revelam que a característica mais relevante que influencia a intenção de compra é o facto destes veículos serem amigos do ambiente. Por outro lado, preço de compra elevado revelou ser a principal barreira à aquisição destes veículos. Além disso, alguns inquiridos mencionaram o facto de os veículos elétricos não serem tão verdes como são retratados. No que toca ao Género e à Experiência, apenas os fatores de Incentivo à compra estabeleceram relação com estas variáveis.

Palavras-chave: Veículos Elétricos, Comportamento Sustentável do Consumidor, Experiência, Género, Fatores de Incentivo, Barreiras.

Abstract

Nowadays, enterprises are working towards promoting sustainability in their businesses, due to the on-going trends, and the fact that the market is demanding it. Meanwhile, consumers are becoming more responsible and practicing sustainable actions, increasing consciousness, and having a crucial role in the society, in order to reduce the carbon footprint, reduce unnecessary wastes and avoid harming the environment. Electric vehicles are seen as highly sustainable, due to the non-emissions of carbon to the atmosphere. Though, their production is unsustainable, as it is the case of the batteries. Therefore, the aim of this study is to explore the reasons behind consumers intention to purchase electric vehicles. Due to its growth over the past years, this is a topic that has been widely explored. As so, it gains importance of which are the determinant factors that are perceived by consumers in their decision-making and if it differs from Gender or Experience.

The methodology used was quantitative and information was gathered through an online questionnaire to people that live in Portugal. The results revealed that the characteristic that was considered the most relevant to influence the intention to purchase was the fact that these vehicles are environmentally friendly. Yet, higher purchase price was found as being the prime Barrier to this acquaintance. Moreover, some respondents mentioned the fact that electric vehicles are not as green as they are portrayed. Regarding Gender and Experience, just the Incentive factors to the purchase had relations with these variables.

Keywords: Electric Vehicles, Sustainable Consumer Behaviour, Experience, Gender, Incentive Factors, Barriers.

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EV- Electric Vehicle

EVs- Electric Vehicles

GHG- Greenhouse Gas

H- Hypothesis

RQ- Research Question

SCB- Sustainable Consumer Behaviour

Introduction

Over the last years, sustainability has gain massive attention around the world, especially in businesses and by influencing consumers to behave in a conscious way to protect the environment. Therefore, consumers and enterprises are changing their focus towards promoting sustainability and being more sustainable in their decisions, their strategies, and objectives.

Nevertheless, the automobile industry is not an exception, and, in the last decades, Electric Vehicles (EVs) became more sustainable alternative to conventional transports. Despite the fact that these vehicles are considered environmentally friendly, its production, on the other hand, is highly unsustainable. Moreover, when deciding to acquire a new vehicle, there are different reasons why some individuals choose one vehicle over the other. Are there personal preferences? Are consumers concerned about the environment? Is it more affordable? Is the autonomy a barrier? How about the number of charging stations? Are there enough features to convince a consumer to purchase an Electric Vehicle (EV)?

Several studies have been conducted in Portugal about EVs, purchasing intention and how consumers behave. Neto (2021) studied the motivations and constraints of EV users, by making an analysis on the perception of usability. Dinis (2021) aimed at exploring which attributes EVs have and the users' satisfaction, considering the driving experience. Nogueira (2016) aimed to understand what are the motivations and barriers to the purchase of an EV. Both studies assume a past experience in the buying intentions (or having experience in driving EVs).

Gomes (2021) studied the hydrogen automobile related to sustainability, considering consumers' perceptions, aiming to understand how consumers act towards hydrogen vehicles in comparison to other mobility options. Vrösch (2018) explores the level of acceptance of consumers towards EVs in Lisbon. The author measure which are the main factors to buy an EV and the main barriers, aiming to

ascertain the level of awareness, customers' perception, and preferences around EVs, the infrastructure and the policy incentives (Vrösch, 2018).

Therefore, despite the research mentioned, there is a *gap* to explore: understanding if Portuguese consumers practise sustainable actions and which are the factors that influence the decision to purchase an EV, considering the Gender of the consumer and Experience with EV ownership.

The research was conducted through a qualitative and quantitative approach, being, in its majority, quantitative, due to the usage of survey to gather the answers given and the analysis made. Concepts such as *greenwashing*, Sustainability, Sustainable Consumer Behaviour (SCB), Incentives to the purchase and Barriers to acquire EVs are some of the concepts that are explored in this analysis.

Therefore, the study starts with Chapter 2- Literature Review, both on Sustainability and EV studies. The methodology is presented in Chapter 3, Further on, it is explored and presented the results on Chapter 4. A deeper discussion is presented in Chapter 5 and this work ends with the main conclusions and further research directions.

Chapter 1- Literature Review

1.1. Sustainability

Back in 1987, the United Nation Brundtland Commission defined sustainability as "the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations Brundtland Commission, 1987).

The Circular Economy concept involves the three pillars of sustainability: environmental, social, and economic (Agrawal & Singh, 2019). Regarding the environmental aspect, it secures environmental capitals for the humanity; the social pilar refers to helping in the training and progress by enhancing the jobs of employees in conjunction with their health and society welfare; lastly, the economic aspect helps in creating constantly returns by ensuring that there is enough money (Agrawal & Singh, 2019). Even though sustainability involves these three core concepts, the focus of this work will mainly be around the environmental aspect.

Sustainability and green consumption are related concepts. The importance of sustainability gains strength due to the lack of resources available and the fact that there is over population (Kotob, 2011). Green consumption is categorised as the consumption that is compatible with preservation of the environment of current and future generations. Green consumers are those whose actions are done to improve both social and environmental results whilst increasing the well-being of consumers (Haba et al., 2023). Align with this, arises the definition of a green good, which, according to Montoya-Villalobos (2023), is "a product (tangible or intangible) that minimizes its environmental impact (direct and indirect) during its whole life-cycle, subject to the present technological and scientific status".

The concept of sustainability has risen as one of the most significant topics of the modern era, with plenty of discussions around how sustainable consumption can help

to moderate the negative environmental effects along with understanding what influences consumers to shift towards green consumption (Haba et al., 2023).

1.2. Role of Sustainability in Businesses

Business Sustainability can be defined as how firms are able to respond to their financial needs in the short-term without having to compromise theirs, or others', capability to meet their future needs (Bansal & DesJardine, 2014).

According to Oláh et al. (2020), in today's businesses, no matter which sector, industries or activities are being done, enterprises are highly concerned about the future prospectus and do not want to have surprises afterwards. As so, firms started to strongly take into consideration and acknowledging that, to remain competitive, both social and environmental concerns should be incorporated in their main business strategies (Hermundsdottir & Aspelund, 2022).

Though, challenges towards sustainability are multifaced and there is still little knowledge on which sort of sustainable innovation firms are financially motivated to implement- weather environmental or social (Hermundsdottir & Aspelund, 2022). In line with this thought, Schlüter et al. (2023) argues that sustainable business models are receiving plenty of attention and are seen as a mean to create revenue whilst reducing the environmental impact of the business and, at the same time, increase its social benefits.

1.3. Consumer and sustainable consumption

Consumers are conscient about green issues, such as the limited natural resources available, the global warming and pollution emissions and, therefore, ponder them when making green purchasing decisions (Shao & Ünal, 2019). However, despite caring and promoting an eco-friendly behavior, consumers who have unsustainable purchasing behaviours account 30% to 40% of the degradation of the environment, leveraging the waste and pollution levels, according to Ghaffar et al. (2023). How

consumers act and behave appears to be a determining factor regarding the development of green and more environmentally friendly production systems (Feil et al., 2020). Individuals who are more open-minded hold a positive view on information and are more curious about alternatives to fight environmental problems (Irfan & Ahmad, 2021). Moreover, people whose level of consciousness is higher, tend to be more goal-oriented and are constantly participating in decision-making (Irfan & Ahmad, 2021).

Daily consumption is strongly motivated by convenience, routine, value for money, concerns related to personal health, hedonism and how people answer to norms such as social and institutional (Wang et al., 2014).

When buying products, consumers do not require just information regarding the environmental impact but also the information of the social impact it brings (Shao & Ünal, 2019).

Such actions come from various factors that influence decisions: from governments modifying their policies and regulations, to companies working towards social responsibility programs and engaging and teaching people to change their consumer behavior and its patterns (Kotob, 2011). Promoting a conscious consumption to damage the least the environment is something that both governments and enterprises are seeking (Tan et al., 2022). Choosing sustainable options and behaviours are preferred decisions as they appear to be better for the environment than other alternative options (Puntiroli et al., 2022). Though, the consumption of such products is seen as causing few impacts within the environment quality than a common good, (Montoya-Villalobos, 2023).

1.3.1. Consumers skepticism towards sustainable consumption

Consumers doubts regarding the usage of such products is seen as a preponderant barrier to green consumption (Montoya-Villalobos, 2023), as well as lack of information regarding the effects of both conventional and green good products have towards the environment, leading too lack of confidence. As an example, despite consumer's awareness and environmentally more informed than in past generations, their consumer behaviour appears to be contradictory- although 65% of individuals aims to purchase sustainable products, in fact, only 26% do it (Farooq & Wicaksono, 2021). As so, an important aspect to be understood is whether the behaviour consumers have towards these sustainable actions currently will strive other sustainable behaviours in the future (Puntiroli et al., 2022). This is, according to Montoya-Villalobos (2023), in some industries, consumers bought the idea that their products are environmentally friendly, yet they are not. Their skepticism has a negative influence on their intention to purchase (Farooq & Wicaksono, 2021). Research made by Farooq and Wicaksono (2021), results showed that consumer's skepticism is due to having experienced episodes of *greenwashing* and, therefore, have more doubts towards large companies and have a preference for silently sustainable companies. *Greenwashing*, according to Delmas & Burbano (2011, p. 65), is "the intersection of two firm behaviors: poor environmental performance and positive communication about environmental performance.".

1.3.2. Factors influencing SCB

Sustainability has been studied in multiple industries. Regarding the factors that may influence sustainable consumption, according to Biswas and Roy (2015) are:

- Consumers' perception of eco-friendly products;
- Price and quality;
- Consumers desire to seeking knowledge;
- Their image concern;
- Peer opinion;

- Advertisement of activities and subsidies;
- The desire to demonstrate that they are concerned about environmental protection.

This may have a strong impact on their behaviour towards sustainable consumption (Biswas and Roy, 2015).

However, according to Saari et al. (2021), many individuals still take into consideration the economy as being primarily related with the manufacture and consumption of physical products, though scholars have proved that people are buying products and using services faster than the renewal, process or recycle of the ecosystem.

Factors such as knowledge and awareness of environmental concerns have been emphasized as having a crucial effect on pro-environmental behaviour[1], according to Saari et al. (2021). Nevertheless, environmental knowledge considerably has an influence on how consumer's perceive environmental risk as well as the level of the concerns around the environment (Saari et al., 2021).

Salazar et al. (2012) concluded that, in the social aspect, information given by social groups positively influences the likelihood of choosing social and environmentally friendly products. Furthermore, in their study results, woman tend to pay more attention or be more sensitive towards social information whilst man considered the economic existing resources (Salazar et al., 2012).

All in all, sustainable consumption englobes the three factors, social, environmental, and economic and, therefore, the purchasing attitude of such products is inspired by the knowledge of the impact that a certain product has on the environment, what are the conditions of the employers involved have in the manufacturing process and the willingness to use financial resources to acquire it (Vergura et al., 2023).

[1] this concept is repeatedly linked to sustainable consumption behaviour, being a characteristic of how people behave by helping to decrease the negative impact of the environment (Saari et al.,2021).

1.4. Electric Vehicles

Considering the automobile industry, EVs will become the mainstream trend to be developed in the future (Tu & Yang, 2019). This is due to the growing concerns regarding the impact of the environment of the actual transport system that have enhanced the adoption of clean, energy-efficient, and environmentally friendly alternatives to decrease the carbon footprint (Lashari et al., 2021). For detailed history on EVs, see Appendix 1.

Considering the perspective of energy, more abundant sources of energy will improve reliability and balance the consume of energy (Tu & Yang, 2019). Therefore, as the world is changing towards low-carbon and sustainable actions are already being taken, the strategy to adopt electric mobility aims to accelerate this shift to vehicles with low, and zero, emissions (Nogueira et al., 2022).

As any product or service, it has its advantages and disadvantages, and can be understood differently according to each consumers perception.

1.4.1. The Market of EVs

Figure 1 presents the foreseen unit sales of both battery EVs and plug-in hybrid vehicles in a period of 12 years. It is clear, as presented on the chart, that EVs are going to have a massive sale worldwide, becoming a main trend in the automobile industry, as mentioned above by Tu and Yang (2019).

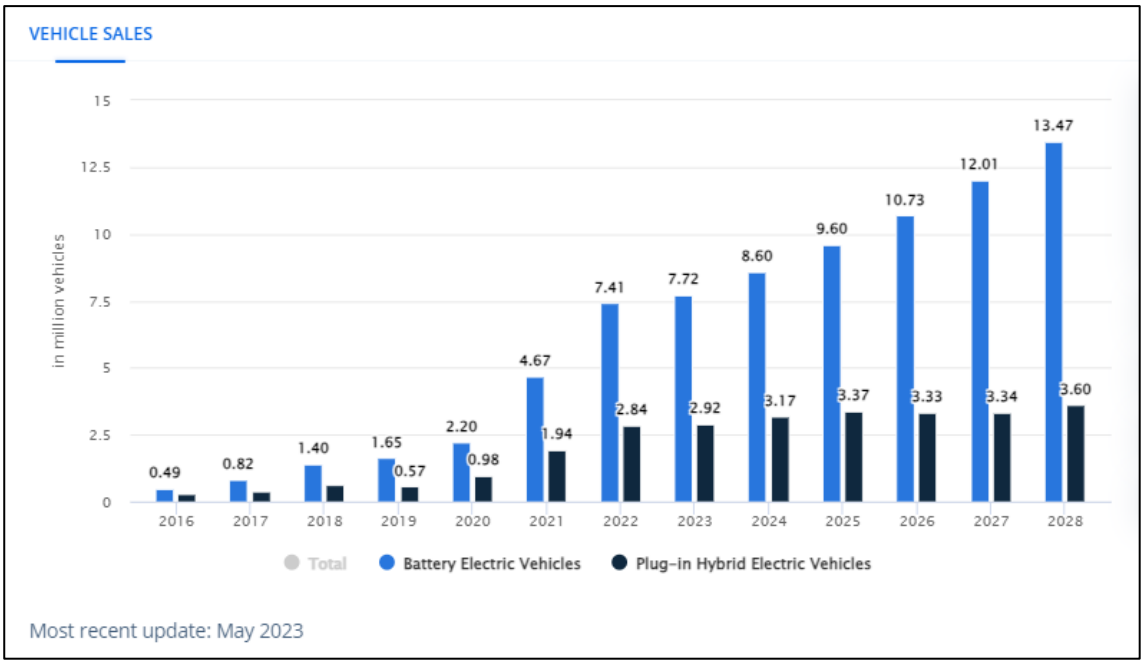

Figure 1- Unit sales of EVs worldwide

Source: Statista (2023)

1.4.2. Market Sale of EVs in Portugal

Portugal, as it is possible to be demonstrated in Figure 2, was the 9th country worldwide with the highest percentage of EV sale worldwide. This indicates that the trend in Portugal is becoming highly followed by a wide number of consumers. In Portugal, by 2026, it is forecasted that the number of EVs registered is 28,030 (Source: ReportLinker, 2023)

It is also clear that Scandinavian countries (Norway, Iceland, Sweden, Denmark, and Finland) had the highest number of EV sales all over the world. For instance, Norway has made it clear, in their agenda, the sale of cars and vans sold, by 2025, should be zero-emissions (Sanguesa et al., 2021). The same is applied to Germany and the United Kingdom, being 2040 the goal (Sanguesa et al., 2021).

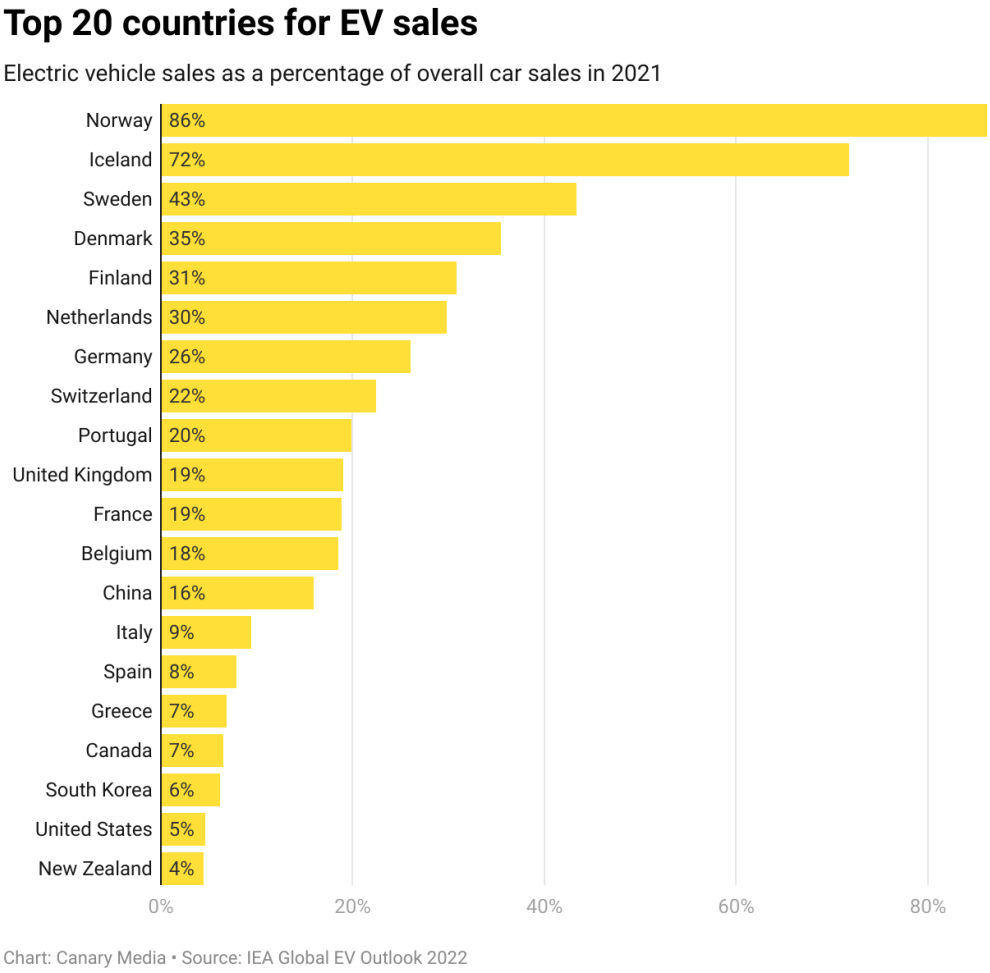

Figure 2- 20 countries with higher percentage of EVs sold worldwide in 2021

Source: Olano (2022)

1.4.3 EVs and the Environment

Greenhouse Gas (GHG) emissions are perceived as being the main reason for global warming and environmental destruction (Corradi et al., 2023). The transport industry, though, accounts over 20% of the carbon dioxide emissions around the world (Ye et al., 2021). In Europe, GHG emissions coming from transports rose 19,4% between the years of 1990 and 2013, accounting for close to one quarter of the GHG emissions emitted in the whole European Union, according to Barbarossa et al. (2017). This brings the urge to shift to vehicle electrification (Ye et al., 2021). Therefore, EVs, specifically

for road passengers, are seen as the most likely alternative, in terms of social-technical solutions to seek sustainability in the transport sector, especially when the production of electricity is generated from clean and renewable sources of energy (Corradi et al., 2023). As an example, the usage of EVs saves energy due to the electricity that is produced in grid systems that use modern power station (Larminie & Lowry, 2012). As so, the transport sector significantly influences the advance and growth of the society and the economy (Barbarossa et al. (2017). According to Wellbrock et al. (2020), the automobile industry is going through the greatest disruption in its history and big trends such as emission reduction, automated driving, mobile services, less heavier constructions are and have been changing the landscape towards something more positive.

Nonetheless, EVs, in regard to environmental concerns, had some advantages in comparison to combustion engine cars. The fact that they do not release any emissions for the environment and, moreover, they are silent, becoming ideal for places and environments such as warehouses, the interior of buildings and, for example, golf courses where there is no tolerance for pollution and noise (Larminie & Lowry, 2012).

Another reason why EVs are being adopted is the fact that oil is a limited resource, which is becoming gradually expensive to produce, since its extraction is close to exhaustion and, therefore, more expensive to exploit (Larminie & Lowry, 2012). As an alternative, oil might need to be produced from other fossil fuels like coal, and this, for sure, will affect the costs of petrol and diesel, leading to a more range of production and spread of EVs to be used in the society, based on Larminie and Lowry (2012).

EVs are deemed to be carbon-free, helping to reduce climate changes, improve the community health and decrease the ecological damage (Shu et al., 2021). However, as EVs only source of power are batteries, the explosion worldwide in the EV industry implies that a massive number of Lithium-ion batteries, in the upcoming future, will be manufactured, used, and disposed (Shu et al., 2021). Furthermore, despite these vehicles not releasing any tailpipe emissions whilst being driven, it shall be contemplated that the employed electric energy of the EVs might have been generated

with the usage of fossil duels, consequentially causing carbon emissions and air pollution (Pipitone et al., 2021).

Moreover, the production of electric energy is not entirely made of renewable resources, it is collected through a wide variety of resources that might have carbon footprint such as coal, natural gas and oil, or even might create different and dangerous waste, coming from nuclear energy (Pipitone et al., 2021).

1.4.4. Consumers and EVs

The acceptance of consumers is determinant in the seeking of success of a transport sector that is sustainable (Egbue & Long, 2012). Despite other crucial factors such as technology development and cost entrance on the EVs market, there are, on the other hand, individual reasons that may influence consumer behaviour, like personal reasons, social reasons, as well as socio-demographic and psychological aspects (Corradi et al., 2023). Following Ye et al. (2021), customers generally affirm that they care for the environment and expect green products, yet they might abandon the idea of acquiring an EV due to the price. Though, consumers are often skeptical about the actual benefits environmentally friendly products bring to the environment (Ye et al., 2021). Advertisement regarding the benefits of EVs to the environment develop and grow customers' cognition about EVs (Ye et al., 2021).

As an example, according to Secinaro et al. (2022), the more customers have control of such factors like comprehension of technology, price, availability, or information of how to use an EV or a hybrid vehicle, the more likely their behavioural intention will evolve. In line with this idea, Tu and Yang (2019) concluded that the opinions given by those who are around consumers plays great influence on their intention to buy an EV. In addition, how consumers act towards EVs may be due to socio-demographic characteristics (Secinaro et al., 2022). Moreover, based on Secinaro et al. (2022), despite considering environmental aspects when buying an EV or hybrid vehicle, economic aspects can be more important for potential EV consumers. The rise of technologies is considered naturally attractive to those consumers who buy EVs, in fact, these

segments of buyers often have a more positive attitude towards innovations and are keener to new technologies (Secinaro et al., 2022). Therefore, in agreement, having environmental awareness and accepting technological products are characteristics that have an impact on their behavioural intention (Tu & Yang, 2019).

There are several reasons that motivate consumers to choose an EV. Factors such as attitude and perception, along with personal characteristics and the performance of the vehicle, can have a strong influence in the intention of acquiring and purchasing an EV (Lashari et al., 2021). How its use is perceived, the ease of use and compatibility are highly considered as positive impacts on consumers attitudes behaviours (Tu & Yang, 2019).

On the other hand, consumers generally have conservative attitudes when it comes to accepting innovative products, because of the lack of considerable understanding of the source itself, which would mean they would not buy these products until these doubts are cleared (Tu & Yang, 2019).

Lashari et al. (2021) concluded that consumers acknowledge the importance of purchase funding and the benefits of the environment. The perception of economic advantages of using an EV has a very strong influence in the intention of buying an EV (Lashari et al., 2021). Moreover, according to Lashari et at. (2021), how consumers perceive incentives given by governments that reduce the operating costs of EVs are considerably important in their decision to acquire an EV.

Consumers consider that there is no clear difference between how an EV operates and a conventional vehicle (Tu & Yang, 2019). Though, as it is a new product that uses green technology, EVs possess an optimized driving operation in comparison to conventional vehicles and are brought up with innovative technological functions as, for example, the use of voice speaker, automatic parking systems, amongst other features (Tu & Yang, 2019).

In Poland, Bienias et al. (2020) studied what do people think about EVs, demonstrating that 26% of the respondents buy an EV due to subsidies for purchasing, 19% on both free use of parking zones for those who have EV and tax reliefs

(possibility), concluding that the sustainability criteria, is not a crucial aspect when choosing an EV- represents only 4% on the motivational factors.

According to Kim and Kang (2022), a public questionnaire concluded that low fuel costs and governance subsidies have been acknowledge as the main reasons to consider buying an EV in Korea. Moreover, recently, the interest in the protection of the environment has risen as a prime motivation (Kim & Kang, 2022). The main factors identified when buying an EV were, sequentially, maximum mileage, performance, the cost of the vehicle, design and the govern subsidies (Kim & Kang, 2022).

Ling et al. (2021) concluded, on their research, amongst a list of ten factors, that the three major EVs promotion policies motives that are preferred by consumers are: purchase subsidies, the number of charging stations and free battery charging. Moreover, these authors concluded that having had the experience of drive or ride an EV via demonstration programmes had, statistically, a positive impact in the intention of purchasing an EV (Ling et al., 2021).

1.5. Characteristics of EVs

1.5.1. Positive characteristics

EVs are energy-efficient and innovative transports allowing a shift to sustainable low carbon emissions in the transport systems (Irfan & Ahmad, 2021). EVs may create a potential alternative to ensure social benefits by decreasing the consumption of petroleum and GHG emissions and this may be appealing to some individuals (Egbue & Long, 2012). Furthermore, both media and social networks generally tend to influence values that affect the decisions taken by consumers (Egbue & Long, 2012).

It seems to have advantages in comparison to combustion engine vehicles, as they are more economic to drive, and are friends of the environment (Irfan & Ahmad, 2021). A study made by Pradeep et al. (2021) aimed at understanding the willingness consumers should accept EVs in India concluded that knowledge of the environment, perception of technology, economic benefits, psychological needs, and attributes such as performance are the key indicators that consumers consider when buying an EV.

It is very common to be used as a mean for mobility devices for people who are physically handicapped and elderly- as a matter of fact, it is one of the most common varieties of EVs in both Europe and the United States, according to Larminie and Lowry (2012). Moreover, it can be used on pavements, shops and in various buildings (Larminie & Lowry, 2012).

1.5.2. Negative characteristics

According to Hidrue et al. (2011), based on an economic analysis to date on EVs, there are a set of reasons against EVs, mainly the higher costs of battery, the limited driving range, the time spent on charging and the lack of recharging stations. Barriers like the cost and performance heavily influence the purchasing intention rather than sustainability and environment benefits of electric vehicles (Egbue & Long, 2012). Moreover, according to Nogueira et al. (2022), not every individual has the financial possibility to buy an EV, because of aspects such as the initial price, the degradation of the battery or insufficient charging stations. In line with this, several academics revealed that, one of the highest barriers is the high selling price (Alganad et al., 2023). In addition, individuals are skeptical about the quality of the electric vehicles (Alganad et al., 2023).

It has been presented that some of the most frequent barriers to the acceptance of any new technology involves lack of knowledge, the initial high costs and low risk of tolerance (Egbue & Long, 2012). Customers still appear to be resistant to new technology that haven't been proved or remains unfamiliar (Egbue & Long, 2012).

The initial price to be paid for an EV is considerably higher than to the cost of a gasoline combustion engine vehicle (Egbue & Long, 2012). Moreover, according to Egbue & Long (2012), this cost will rise in line with the size of the battery or the range of the car. Regarding financial benefits, individuals are keener to opt for options that will enhance the most its utility based on their preferences, information about other alternatives and budget (Egbue & Long, 2012). Regarding non-financial motives, specifically the ones related to environment and energy, may affect customers' decisions to buy an EV (Egbue & Long, 2012).

Chapter 2 - Methodology

2.1. Purpose of the study

The aim of this study is to analyse which factors do consumers consider as being the most important ones when deciding to purchase, or not, an EV. Moreover, the research will be analysing if these factors may differ according to Gender and Experience. Bloodhart and Swim (2020) explored social influences regarding gender differences through different perspectives and highlight the need of future policies and attitudes of sustainable consumption, whereas Odrowaz-Coates (2021) conducted a research perspective of the definition of sustainability, considering gender like a seed for sustainable innovation.

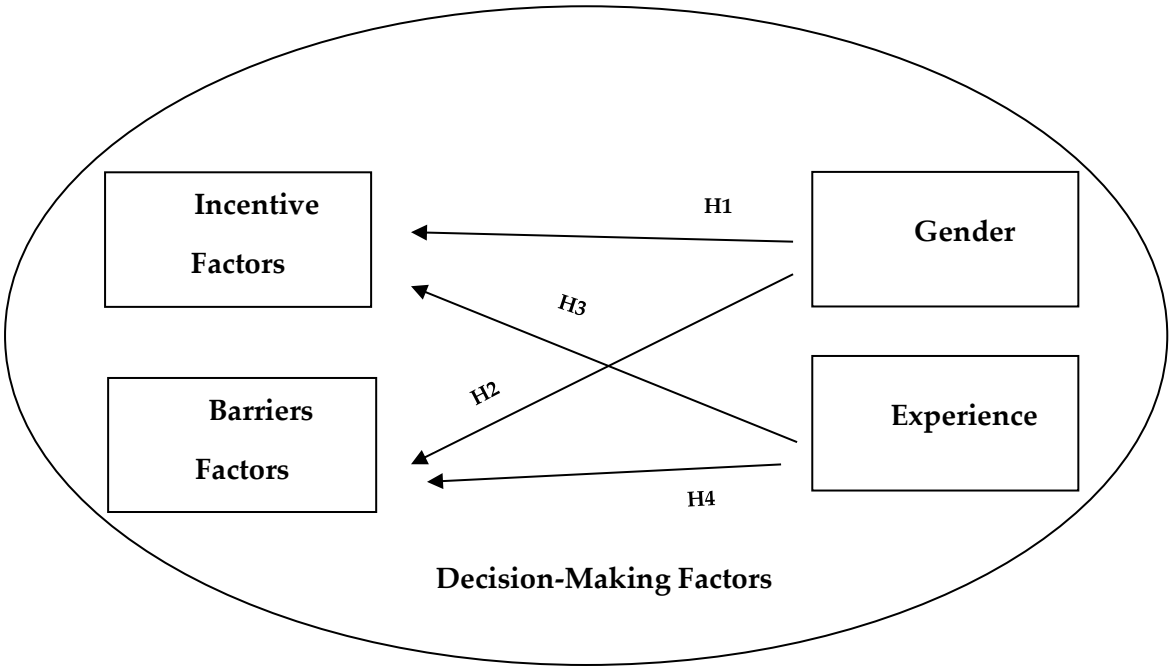

Table 1- Proposed Framework of the study

RQ: Which factors do consumers take into consideration when planning to buy, or not, an EV?

Sub question 1: Do these factors differ according to Gender?

Sub question 2: Do these factors differ according to Experience?

Sub question 3: What are the Incentive factors in the purchase intention and the Barriers to purchase?

Hypothesis:

H1. Incentive factors differ according to Gender

H2. Barriers differ according to Gender

H3. Incentive factors differ according to Experience

H4. Barriers differ according to Experience

The proposed framework helps explaining the purpose of the study and the concepts to be analysed. The goal is to analyse which are the decision-making factors that influence the purchase, or not, of an EV. Yet, this study aims at ascertaining, as well, whether the Incentive Factors and Barriers differ according to Gender or Experience, as part of the decision-making factors.

This study will contribute by helping to understand how consumers perceive the adoption of EVs taking into consideration the Incentive factors and the main Barriers found to the non-purchase. Moreover, by considering the Gender of the consumer, it can help comprehend which of the presented factors are more valued by male and female and if these factors listed differ according to previous Experience with EVs or not. Overall, this research will help understanding the reasons behind the intention to adopt an EV.

2.2. Method and Data

The current study uses a quantitative approach, as data was collected through survey. According to Lowhorn (2007), quantitative research sets accurate and significant statistics conclusions, of population by exploring a representative sample of the population. Besides, quantitative research, imperatively, is presented as an approach that can be scientific in nature, as so, the use of this particular methodology to collect and analyse data will allow generalisation to be possible (Daniel, 2016). Following Marshall (2005), surveys can generate data to be used with great quality, achieve a fair number of answers, and provide anonymity, especially this latest aspect that pushes for more transparent and frank responses if compared to interviews, might helping diminish bias.

Egbue and Long (2012) explored the barriers to the widespread of EVs, conducting a survey to comprehend consumers' perceptions and attitudes. On the other hand, Bienias et al. (2020) studied the opinion of consumers who have bought an EV through the same mean- survey.

Therefore, the usage of a questionnaire is perceived as being more accurate, ensure more responses and goes straight to the point of the questions proposed, avoiding misperceptions.

The study focuses specifically in Portugal, with only portuguese habitants being allowed to participate.

2.3. Survey Design

To address the proposed RQ, a questionnaire was conducted in order to better understand the respondents' perceptions towards the factors influencing the possible purchase of an EV.

The survey was design on the online platform *Google Forms*. It was, afterwards, shared on different social media platforms, such as *Facebook*, *Instagram* and *Linkedin*. The questionnaire was available online for a month, between June and July.

The survey itself is of anonymous answer, divided into three different sections, as seen on Appendix 2:

- **Section 1** (general questions)- gender, age, gross annual income, scholar level, region of the country, number of cars owned, and which type of car own.
- **Section 2** (consumer behaviour towards sustainable consumption)- aiming to understand how it can be perceived the behave of consumers towards sustainability and sustainable consumption.
- **Section 3** (EVs)- this section was designed, initially, to understand if consumers were thinking of purchasing, in the near future, an EV. According to the answer given- if **yes,** then what are the reasons behind wanting to purchase one or, if **not**, the barriers to not wanting to buy one.

Considering the number of answers given, there are 208 answers, being N=208 the number of valid answers.

Chapter 3- Results

3.1. Sample

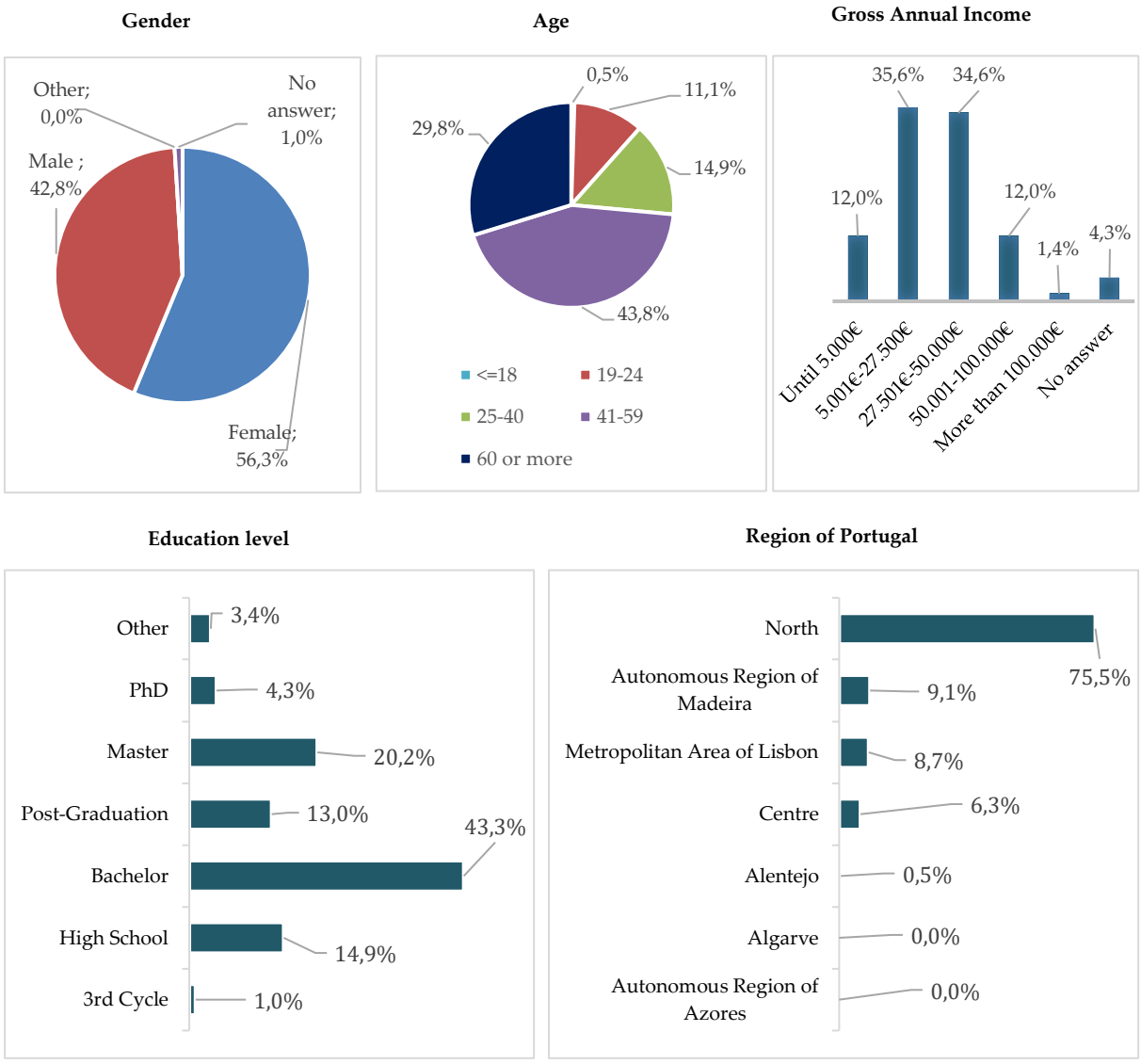

Figure 3- Characterisation per gender, age, annual income, education level and region of the Portugal

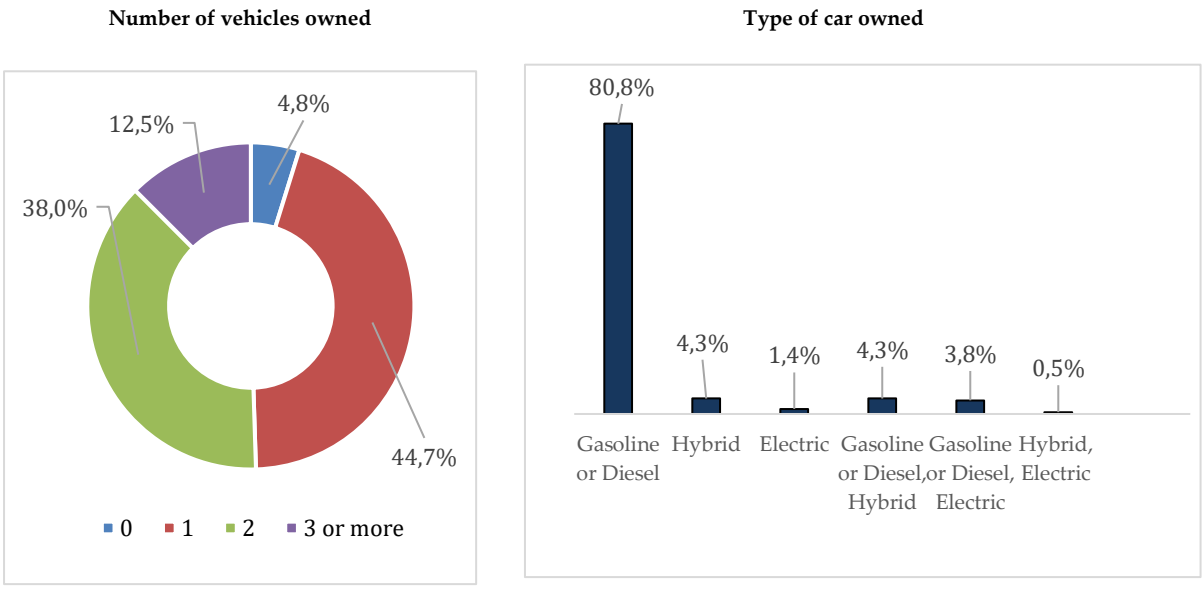

Figure 4- Number of vehicles and type of car owned

The socio-demographic perspective demonstrates that respondents are balanced in gender, having slightly more answers of females, from the north of Portugal and have a gasoline or diesel car. Other information can be concluded, such as 43,8%, the highest percentage, is gathered in the ages between 41-59 years old, there is a balance in the answers of gross annual income, with people saying they earn between 5,001€-27,500€ (35,6%) and 27,501€-50,000€ (34,6%), as well as a considerable number of individuals have selected Bachelor (43,3%) as their education level. Regarding the number of vehicles, the respondents have one or two vehicles.

The sample was divided into two groups: Experience and no Experience with EVs. The vast majority of the respondents seems to not have any experience with EVs, representing 89,4% of the sample, whereas just 11,6% claims to have had experienced EVs.

3.2. Sustainable Consumer Behaviour

This section aims at understanding how consumers act towards sustainable consumption and behaviour, giving insights to comprehend and explore their consciousness about sustainability and their attitudes towards it.

The questions were taken from a questionnaire made by Bearden et al. (2011), using a Likert scale from 1 to 7. Table 2 shows the percentage of answers on each scale and the mean and standard deviation of the answers.

Question:	1	2	3	4	5	6	7	N.O.	$\bar{x}$	s
1."It is important to me that the products I use do not harm the environment"	1,9%	2,4%	5,8%	1,9%	17,3%	28,8%	41,3%	0,5%	5,84	1,429
2. "I consider the potential environmental impact of my actions when making many of my decisions"	1,9%	3,4%	3,8%	8,2%	22,1%	34,1%	26%	0,5%	5,53	1,403
3. "My purchase habits are affected by my concern for our environment"	2,4%	5,3%	4,3%	11,1%	22,1%	32,7%	21,2%	1%	5,30	1,503
4. "I am concerned about wasting the resources of our planet"	1,4%	1,4%	5,3%	1,4%	11,1%	22,6%	46,2%	10,6%	6,04	1,381
5. "I would describe myself as environmental responsible"	1,4%	3,8%	4,8%	6,3%	26,4%	31,7%	23,1%	2,4%	5,46	1,387

Table 2- SCB analysis

Note: 1- Strongly disagree; 2- Disagree; 3- Somewhat disagree; 4- Neutral; 5- Somewhat agree; 6- Agree; 7- Strongly agree; N.O.- No Opinion; $\bar{x}$- mean; s- standard deviation.

To measure the validity and reliability of the variables used to comprehend consumer behaviour and the reasons behind intention to purchase an EV, the Cronbach alpha coefficient was calculated to measure the variable SCB, by analysing its precision and accuracy. In regard to Table 2, cronbach's alpha is 0,953, revealing a very high level of confidence.

Question	Female ($\bar{x}$)	Male ($\bar{x}$)
1."It is important to me that the products I use do not harm the environment"	5,70	6,00
2. "I consider the potential environmental impact of my actions when making many of my decisions"	5,46	5,61
3. "My purchase habits are affected by my concern for our environment"	5,18	5,44
4. "I am concerned about wasting the resources of our planet"	5,96	6,14
5. "I would describe myself as environmental responsible"	5,40	5,53

Table 3- SCB per Gender

To measure the differences by Gender and their attitude towards SCB, T-test was conducted to ascertain if there are any differences between male and female. Because both groups had more than 30 people each, it was conducted an independent sample T-test, as it is show on Table 3. Overall, it seems that male tend to be slightly more sustainable in their actions in comparison to female.

3.3. Intention to buy an EV

Question	Experience	No Experience
Yes, and I don't have	-	41,3%
Yes, and I have	9,1%	-
No, and I don't have	-	48,1%
No, and I have	1,4%	-

Table 4- Intention to buy an EV in the near future (divided by having or not Experience)

In order to perceive if the respondents were willing to acquire an EV, in the near future, a question was asked to measure their intention. Table 4 shows the percentage of each option given, distributed in two groups: having, or not, Experience of EVs.

To explore the reasons behind intending to purchase an EV, questions were made based on past surveys who explored similar areas of interest. This section aims at finding which are the five most determinant factors that influence EVs purchase intention. As so, Table 5 presents the questions made and the respective source.

Characteristics	Author
"Electric vehicles are less costly to buy than gasoline-fueled vehicles."	(Irfan & Ahmad, 2021)
"Electric vehicles are less costly to run than gasoline-fueled vehicles."	(Irfan & Ahmad, 2021)
"EVs are safe and silent"	(Corradi et al., 2023)
"Good Acceleration"	(Corradi et al., 2023)
"New Technologies"	(Kim & Kang, 2022)
"EVs are more stylish and have an elegant designed"	(Ghasri et al., 2019)
"Financial Incentives"	(Ling et al., 2021)
"EVs are more durable"	(Ghasri et al., 2019)
"EVs have higher energy efficiency"	(Ghasri et al., 2019)
"EVs are more environment friendly"	(Ghasri et al., 2019)
"EVs reduce the risk of car to car accidents"	(Ghasri et al., 2019)
"EVs are more reliable for daily trips"	(Ghasri et al., 2019)
"Electric vehicles are convenient and give a better driving experience".	(Irfan & Ahmad, 2021)
"Charging time"	(Kim & Kang, 2022)
Other Option[2]	

Table 5- Incentive factors to the purchase of EVs

[2] The answers given can be found on appendix 3.

Figure 5 displays the percentage of the answers each characteristic received. Furthermore, it is presented an open answer, as well in this section, so respondents could also add a feature different than the ones presented.

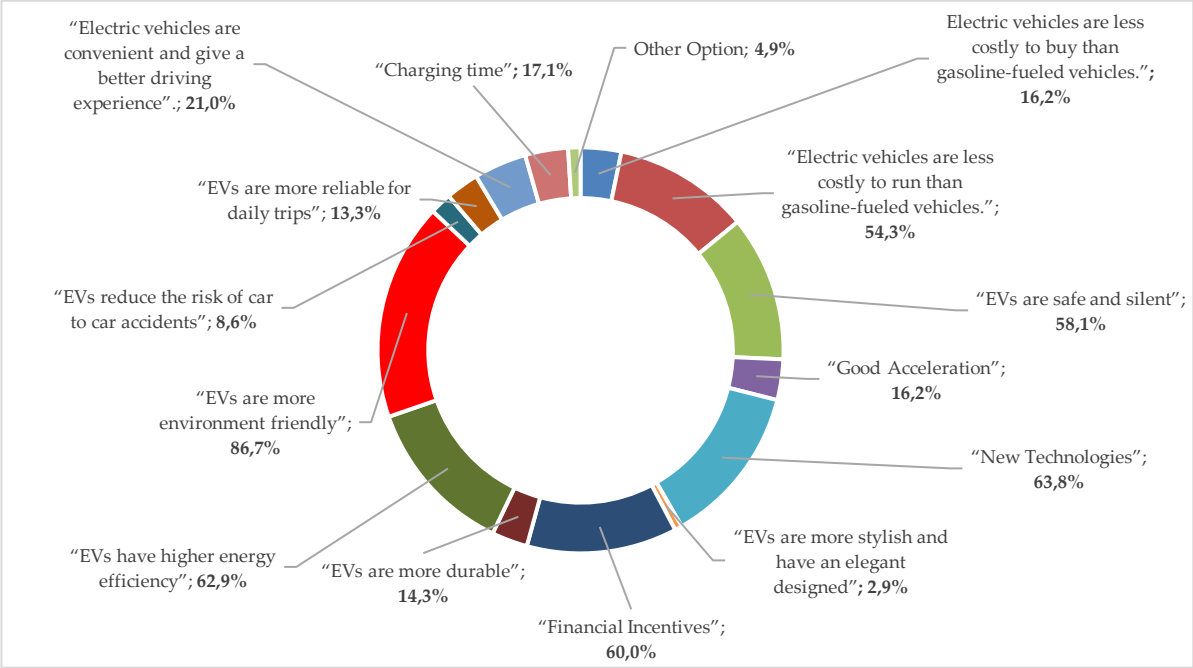

Figure 5- Incentives to purchase an EV

For respondents who answered **yes** in the intention to buy question, a section with 18 questions was taken from different surveys (Dutta & Hwang, 2021; Buhmann & Criado, 2023; Irfan & Ahmad, 2021), using a Likert scale from 1 to 5, the same scale used by the authors mentioned above. This section aims to find the reasons behind the intention to purchase an EV. Table 6 presents the percentage per scale level, the mean and standard deviation.

Question	1	2	3	4	5	N.O.	$\bar{x}$	s
"Electric vehicle can decrease the use of petroleum".	1%	0,5%	3,8%	16,3%	28,5%	0,5%	4,41	0,832
"I think electric vehicle would be beneficial to the environment in the long term".	2.,4%	2,4%	4,3%	13%	22,1%	6,3%	4,13	1,141
"I would feel satisfied about myself if I buy an environmental-friendly electric vehicle".	1%	1%	2,9%	13,5%	26,4%	5,8%	4,42	0,876
"I am concerned about environmental problems".	0,5%	0,5%	1,9%	13,5%	31,3%	2,9%	4,57	0,717
"I like the idea to own an environmentally-friendly electric vehicle".	0,5%	1%	1,9%	13%	28,8%	5,3%	4,52	0,772
"I compare the purchasing price of electric vehicle and internal combustion engine vehicle to make sure that I get the best value for the money I spend".	1,4%	2,4%	12%	13,5%	17,8%	3,4%	3,93	1,058
"I would buy an electric vehicle if the quality is lower than a conventional vehicle".	4,8%	5,3%	12%	14,9%	10,6%	5,7%	3,44	1,239
"I believe that government's financial incentive policy of buying electric vehicle increases my intention".	3,8%	5,3%	7,7%	15,4%	16,3%	1,9%	3,72	1,258
"I believe that government's incentive policy such as direct grants to consumers on buying electric vehicle increases my intention".	3,8%	3,8%	8,7%	15,4%	16,3%	2,4%	3,76	1,232
"The mass media suggest that I should use electric vehicle".	2,4%	1%	10,1%	17,3%	14,9%	4,8%	3,91	1,053
"The mass media urge me to use an electric vehicle".	5,8%	1,4%	11,1%	15,4%	12%	4,8%	4,13	1,141
"The maintenance and repair of an electric vehicle is important to me when I decide to adopt it".	1%	1,9%	5,3%	14,4%	21,6%	6,3%	4,22	0,970
"Driving an electric vehicle would improve my image and social status".	10,1%	9,6%	17,8%	7,2%	-	2,4%	2,49	1,017
"Using an emissions-free vehicle seems exciting".	1%	1%	10,1%	17,8%	19,7%	1%	4,10	0,92
"An electric vehicle fits my personal necessities.".	1,4%	1,4%	10,1%	19,7%	15,4%	2,4%	3,96	0,963
"I have the intention to drive an electric vehicle in the near future".	1%	1,4%	6,3%	15,9%	21,2%	4,8%	4,20	0,941
"I will recommend the use of the electric vehicle to other people".	3,4%	2,4%	14,9%	13%	13,5%	3,4%	3,65	1,159
"The purchasing price of an electric vehicle is higher than conventional internal combustion engine vehicle".	1%	1,4%	8,2%	12%	21,2%	6,7%	4,16	0,992

Table 6- Measuring the reasons behind interest in purchasing an EV

Note: 1- Strongly disagree; 2- Disagree; 3- Neutral; 4- Agree; 5- Strongly agree; N.O.- No Opinion; $\bar{x}$- mean; s- standard deviation.

Considering the respondents who have shown intention to purchase an EV in the future, the statement "I am concerned about environmental problems" has the higher average of responses, representing a level of agreement of 4,57, followed by "I like the idea to own an environmentally-friendly electric vehicle", (4,52). On the other hand, "driving an electric vehicle would improve my image and social status", is the lowest one (2,49), indicating that, apparently, image and social status is the least reason for respondents, in this analysis, to acquire an EV, representing, in fact, a level of disagreement.

3.4. Barriers to purchase an EV

This section presents the characteristics that were considered as barriers to the adoption and purchase of an EV. As before, respondents were asked to select the five most important ones, and an open answer, as another option, was added so respondents could write down a different characteristic other than those presented. Questions were taken from past survey by Adhikari et al. (2020) and can be seen in Table 7.

Characteristics
"Absence of an annual tax exemption"
"Battery replacement cost"
"Fewer EV models"
"Higher purchase price"
"Lack of charging stations"
"Lack of environmental awareness regarding EVs"
"Lack of evidence on reliability and performance"
"Lack of knowledge on EVs"
"Lack of long-term planning and goals on the government's part"
"Lack of repair and maintenance workshops"
"Limited battery life"
"Limited range (one-time travel distance at full charge)"
Other Options[3]

Table 7- Barriers to the Purchase of EV

Figure 6 shows the answers seen as a Barrier to the purchase of an EV, and other motives.

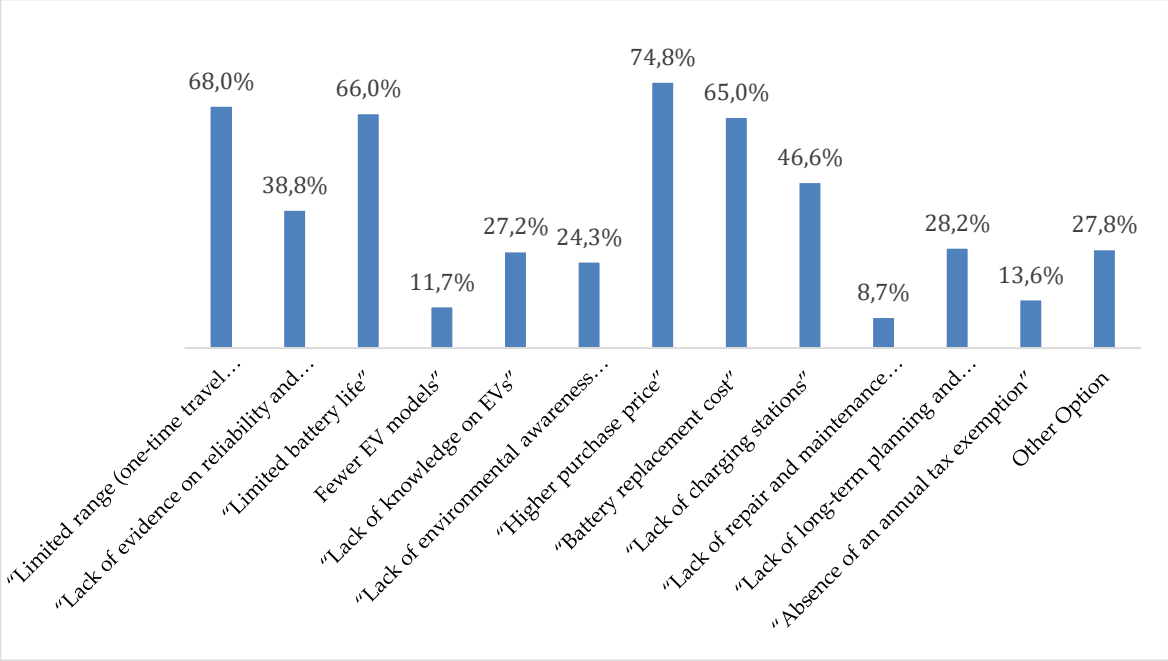

Figure 6- Barriers to purchase an EV

3 The answers given can be found on appendix 3.

3.5. Experience and Gender

In order to measure if there are any relation between variables Experience vs Incentives; Experience vs Barriers; Gender vs Incentives and Gender vs Barriers, it was conducted a crosstab, with chi square, due to the variables in study being qualitative.

3.5.1. Experience and Incentives to purchase EVs

Characteristics	Experience (No | Yes)[4]	Level of Significance (p<0,05)
"Electric vehicles are less costly to buy than gasoline-fueled vehicles."	17,4% | 10,5%	0,459
"Electric vehicles are less costly to run than gasoline-fueled vehicles."	53,5% | 57,9%	0,727
"EVs are safe and silent"	55,8% | 68,4%	0,313
"Good Acceleration"	16,3% | 15,8%	0,958
"New Technologies"	**68,8% | 42,1%**	**0,030**
"EVs are more stylish and have an elegant designed"	3,5% | 0%	0,409
"Financial Incentives"	60,5% | 57,9%	0,836
"EVs are more durable"	12,8% | 21,1%	0,352
"EVs have higher energy efficiency"	61,6% | 68,4%	0,579
"EVs are more environment friendly"	89,7% | 73,7%	0,062
"EVs reduce the risk of car to car accidents"	6,9% | 15,8%	0,208
"EVs are more reliable for daily trips"	14,9% | 5,3%	0,259
"Electric vehicles are convenient and give a better driving experience".	20,7% | 21,1%	0,972
"Charging time"	14,9% | 26,3%	0,232

Table 8- Experience vs Incentives to purchase EVs

To see if there is any association between Experience and Incentives that lead to the purchase of an EV. The results of Table 8 demonstrate that, for p-value<0,05, there is just one significant statistic association: "new technologies" (0,030). This indicates that does with no experience value more "new technologies" as an incentive to purchase than those that already have experienced EVs.

4 The percentage demonstrates those who said "No" or "yes" considering experience and the percentage (%) is of the amount that says it determines their decision-making of positive attributes to buy an EV.

3.5.2. Experience and Barriers of EVs

Characteristics	Experience (No| Yes)[5]	Level of Significance (p<0,05)
"Limited range (one-time travel distance at full charge)"	66,7% | 100%	0,161
"Lack of evidence on reliability and performance"	38,4% | 50%	0,640
"Limited battery life"	65,7% | 75%	0,699
"Fewer EV models"	21,2% | 0%	0,302
"Lack of knowledge on EVs"	18,2% | 25%	0,730
"Lack of environmental awareness regarding EVs"	25,3% | 0%	0,248
"Higher purchase price"	74,7% | 75%	0,991
"Battery replacement cost"	63,6% | 25%	0,118
"Lack of charging stations"	46,5% | 50%	0,889
"Lack of repair and maintenance workshops"	14,1% | 25%	0,546
"Lack of long-term planning and goals on the government's part"	21,2% |0%	0,302
"Absence of an annual tax exemption"	13,1% | 0%	0,438

Table 9- Experience vs Barriers to purchase EVs

Considering Experience vs Barriers, there is no significant statistic association between the variables studied (p-value>0,05), as perceivable on Table 9. Hence, there is no relation between the Barriers and Experience.

[5] "No" refers to not having experience but said "yes" as considering that factor determinant when making a decision. "Yes "refers to those who have experience and consider the factor as being determinant in their decision-making.

3.5.3. Gender and Incentives to purchase EVs

Characteristics	Gender (Female | Male)	Level of Significance (p<0,05)
"Electric vehicles are less costly to buy than gasoline-fueled vehicles."	20,6% | 9,5%	0,130
"Electric vehicles are less costly to run than gasoline-fueled vehicles."	**42,9% | 71,4%**	**0,004**
"EVs are safe and silent"	60,3% | 54,8%	0,572
"Good Acceleration"	**9,5% | 26,2%**	**0,023**
"New Technologies"	65,1% | 61,9%	0,740
"EVs are more stylish and have an elegant designed"	3,2% | 2,4%	0,811
"Financial Incentives"	60,3% | 59,5%	0,935
"EVs are more durable"	14,3% | 14,3%	1,000
"EVs have higher energy efficiency"	58,7% | 69%	0,284
"EVs are more environment friendly"	88,9% | 83,3%	0,412
"EVs reduce the risk of car to car accidents"	11,1% | 4,8%	0,255
"EVs are more reliable for daily trips"	11,1% | 16,7%	0,412
"Electric vehicles are convenient and give a better driving experience".	25,4% | 11,9%	0,090
"Charging time"	**23,8% | 7,1%**	**0,026**

Table 10- Gender vs Incentives to purchase EVs

Considering Gender and the Incentives to buy EVs, three characteristics are statistically significant (p-value<0,05) which are, according to Table 10: 1) "EVs are less costly to run than gasoline-fueled vehicles" (0,004); 2) "good acceleration" (0,023); and lastly 3) "charging time" (0,026). This means that female value less acceleration and run costs than male. Moreover, male value less the charging time.

3.5.4. Gender and Barriers of EVs

Characteristics	Gender (Female I Male)	Level of Significance (p<0,05)
"Limited range (one-time travel distance at full charge)"	63% I 74,5%	0,215
"Lack of evidence on reliability and performance"	32,5% I 42,6%	0,448
"Limited battery life"	68,5% I 61,7%	0,473
"Fewer EV models"	25,9% I 14,9%	0,173
"Lack of knowledge on EVs"	22,2% I 12,8%	0,215
"Lack of environmental awareness regarding EVs"	24,1% I 23,4%	0,937
"Higher purchase price"	77,8% I 72,3%	0,528
"Battery replacement cost"	61,1% I 63,8%	0,778
"Lack of charging stations"	44,4% I 51,1%	0,506
"Lack of repair and maintenance workshops"	16,7% I 12,8%	0,582
"Lack of long-term planning and goals on the government's part"	20,4% I 19,1%	0,878
"Absence of an annual tax exemption"	14,8% I 10,6%	0,532

Table 11- Gender vs Barriers to purchase EVs

In regard to the Gender vs Barriers to purchase an EV, Table 11 reveals that there are no significant statistic associations. Therefore, there is no relation between the Gender and the Barriers of the study.

Chapter 4 - Discussion

The proposed RQ aims at understanding what are the factors that influence, or not, the decision to acquire an EV. Therefore, conclusions can be taken.

Considering SCB, respondents favor sustainable actions ($\bar{x} > 5$ in the likert scale), with the highest score answer being "I am concerned about environmental problems" (Table 3, question 4).

Therefore, to understand what are the factors that determine the decision to acquire an EV, tests were made to measure if there are any associations between the variables (Gender and Experience).

Thus, after analysing the intention to have an EV, it is possible to conclude that the 5 main Incentive factors are:

1) "electric vehicles are environmentally friendly";

2) "new technologies";

3) "electric vehicles have higher energy efficiency";

4) "financial incentives";

5) "electric vehicles are safe and silent".

Though, on the other hand, those who claim not to have intention to purchase an EV, stated that the 5 main Barriers are:

1) "higher purchase price";

2) "limited range (one-time travel distance at full charge)";

3) "battery replacement cost";

4) "limited battery life";

5) "lack of charging stations".

Moreover, given the possibility to add more options, a considerable number of respondents mentioned the negative impact on the environment of batteries manufacturing, especially the material used and where they come from, considering as being more harmful to the environment than the conventional vehicles production.

It is noticeable to highlight the different perspective that respondents that intend to buy have from respondents that do not intend to buy when it comes to the environmentally friendly argument.

Regarding the associations made between the variables Gender, Experience, Incentives to purchase an EV and the Barriers to not purchase, it can be concluded that, for Incentive factors, there are statistically significant associations between Incentives and both Gender and Experience whereas for Barriers, there is no significant statistically association to Gender or Experience.

As so, the following results justify the hypothesis of the study:

H1: Incentive Factors differ according to Gender

H1 is accepted in three factors- "electric vehicles are less costly to run than gasoline-fueled vehicles" (0,004), in "good acceleration" (0,023) and "charging time" (0,026), as p-value< 0,05. This reveals that, in this situation, Incentives and Gender have a statistically significant association. According to a study made by Sovacool et al. (2019), the authors concluded that woman consider aspects such as operating costs, as being significant. Regarding man, as an example, speed and acceleration are key relevant features (Sovacool at al., 2019). These conclusions are in agreement with my results as male value acceleration more than female. Though, it differs as my results revealed that female consider less running costs.

H2: Barriers differ according to Gender

H2 is rejected as all Barriers and Gender relation present p-value> 0,05, demonstrating that there is no statistically significant association between these variables.

H3: Incentive Factors differ according to Experience

H3 is accepted in the Incentive factor "new technologies" (0,030), resulting in a statistically significant association between this variable and Experience, as p-value <0,05. Following Secinaro et al., (2022), consumers who acquire EVs are attracted by the growth of new technologies which make them have a positive attitude. Therefore, these are in agreement with my results as the respondents who do not have experience EVs value new technologies when it comes to purchase it. Moreover, this results differ from my conclusions as those who have experienced it, do not value this factor as much.

H4: Barriers differ according to Experience

H4 is rejected as there is no statistically significant association between all the Barriers of study and Experience, since p-values>0,05.

Hence, results of which factors influence the intention to purchase, or not, an EV, are consistent with the conclusion taken by Secinaro et al. (2022), with technology being determinant and attractive to these consumers who are keen to try these new features. Pradeep et al. (2021) concluded that, in India, for example, technology perception is a crucial factor in the willingness to purchase an EV. Though, Tu and Yang (2019) mentioned that consumers are often more conservative regarding new innovative products, which differs from my results. The incentives that the government provides to buy these vehicles are appealing, being on the five most preferred Incentives. Economic advantages (benefits it brings, and incentives) can be strongly determined in the purchase intention (Pradeep et al., 2021; Secinaro et al., 2022; Lashari et al., 2021). Moreover, in agreement, the fact that these vehicles are considered environmentally friendly, as Irfan and Ahmad (2021) mentioned, comes in first as the reasons to purchase one. The outcomes of my analysis add that the fact that EVs are safe and silent are determinant in their willingness to acquire an EV, corroborated by Sovacool at al. (2019), since woman, in their study, found safety as being a determinant factor.

As for the Barriers, these results are in line with Hidrue et al. (2011), as, in an economic analysis, the author concluded that the higher costs of batteries, the limited driving range and the fact that there is a low number of charging infrastructures, being these three motives part of the top five characteristics that are Barriers to purchase an EV. Moreover, these results differ from the conclusions made by Ling et al. (2021), where the increasing number of charging stations comes on top three of the preferred reasons to acquire an EV. Following Nogueira et al. (2022) results, the initial price, the battery degradation, and lacking charging stations are barriers, confirming my results. Additionally, the prime reason, of my results, to not acquire an EV is the "higher purchase price", agreeing with Alganad et al. (2023), as it is one of the highest barriers found by researchers.

Furthermore, my results add that a considerable number of individuals point out that EVs' manufacturing is highly prejudicial to the environment and are still not very clear about this "green image", some even claimed that EVs are not environmentally friendly. The fact that some buildings do not have the capability to charge an EV, and the fact that it takes time to charge are seen as some additional Barriers to purchase these vehicles.

Conclusion

The goal of this study was to comprehend how do consumers behave towards sustainable consumption, and which are the factors they take into consideration when intending to purchase an EV. Moreover, exploring Gender and Experience would help comprehending the different perceptions both male and female have on EVs characteristics as well as considering Experience with EVs usability.

Therefore, the results demonstrate that the five main reasons to acquire one were "electric vehicles are environmentally friendly", "new technologies", "electric vehicles have higher energy efficiency", "financial incentives" and "electric vehicles are safe and silent" whereas the five main barriers were the "higher purchase price", "limited range (one-time travel distance at full charge)", "battery replacement cost", "limited battery life" and "lack of charging stations".

Moreover, associations were made in order to see if these factors could differ from Gender or Experience. Hypothesis were tested to confirm if there were associations between the variables. Only H1 and H3 were accepted, rejecting H2 and H4. Thus, the results revealed that, for Incentives to purchase an EV, there is a statistically significant association with Experience (H3)- "new technologies". Regarding the relation with Gender, it demonstrates a statistically significant association with three factors (H1)- "electric vehicles are less costly to run than gasoline-fueled vehicles", "good acceleration" and "charging time". On the other hand, regarding the Barriers, there is no statistically significant association between these variables and Experience (H4) or Gender (H2).

EVs are perceived differently by individuals. It is possible to conclude that, only for the Incentive factors, there were significantly statistic associations with Gender or Experience.

Furthermore, the difference of the characteristics between male and female regarding Incentive factors are not of environmental concerns, but characteristics of performance of the vehicle.

Nonetheless, some limitations are the fact that sample is not representative of Portugal, plus the vast majority of the respondents is from the north, does not allow to make overall conclusions of the country itself. Furthermore, the survey was only available for a month, so eventually, if it was available for more time and more engagement to request more answers, eventually the sample could have been bigger.

Regarding academic contribution, this work will help completing past research that has been done around EVs and how consumers behave towards these vehicles. From a practice contribution, differences were found between Gender and Experience. Despite punctual, these differences could help organisations target their audience through constructing strategies and marketing campaigns more differently. This can help enterprises to consider communication and sustainable attitudes when communicating the products, as EVs manufacturing issues and its damage to the environment, were mentioned by a considerable number of people, were seen as crucial factors for not buying an EV.

Considering future research, I would propose explore in-depth how knowledge of EVs Experience influences the purchasing. Another suggestion could be comprehending the impact Experience has on other perspectives (on those who have driven, for example). Regarding Gender, could be interesting to explore if the sustainable impact of these vehicles influences decisions to not acquire an EV, as there were a considerable number of individuals who mentioned environmental issues. The methodology chosen was a survey, so, if interview was conducted, eventually different reasons could have been found in consumers decisions to acquire an EV.

Though EVs do not release carbon emissions to the environment whilst being in movement, this *greenwashing* that is made towards consumers, to promote sustainability has to be align with facts and be as much transparent as possible. Nevertheless, consumers are informed, and some considered that these vehicles are not as green as they portray, as mentioned before on the literature review and open answers given by the respondents of this sample.

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Appendices

Appendix 1:

History of Electric Vehicles

Over time, there have been changes in the automobile industry, from the variety of vehicles that were introduced in the market, to the type of engine they use and especially technology has been growing and becoming a crucial aspect these days, amongst other things (Iulia & Szabo, 2022). As for the electric vehicles, its story started a few centuries ago, back to 1830 where the first electric vehicles were built, right after the development of the primary electrical machines (Iulia & Szabo, 2022). As time passed by, electric cars started to gain strength, especially in the early 1900s, where dozens of new and more comfortable electric car models were produced lone in the United States (1,575 electric vehicles in comparison to just 936 of combustion engine), according to Iulia and Szabo (2022).

Throughout time, electric vehicles have changed, improved, and developed its automobiles until now. Following Iulia and Szabo (2022), *Electrobats* was the name given to the first successful and commercial electric cars available, built firstly in 1894 and it was a very heavy and slow car with steel tires, with rechargeable batteries that would weight above 725kg among the 2 tons gross mass of the car (Iulia & Szabo, 2022). Closer to the end of the nineteen century, there were massive productions of batteries that were rechargeable and, therefore, electric vehicles became broadly in use (Larminie & Lowry, 2012, p.3). In the beginning of the twentieth century, electric vehicles were considered as the future road transport, as a matter of fact, electric cars were favoured in comparison to fuel or steam-powered vehicles, according to Larminie & Lowry (2012). In the 1920s, hundred thousand electric vehicles were produced to be used as cars, vans, delivery vehicles and transports such as buses, yet, regardless of the promise of these primary electric vehicles launch, once oil was more affordable and widely available and the start of the combustion engine vehicles

arrived, it became a more attractive solution for powering vehicles (Larminie & Lowry, 2012).

Appendix 2:

Survey Design

English || Portuguese

Declaration	Declaração
Dear participant, As part of my Master's thesis between Católica Porto Business School and Lancaster University, I intend to explore consumer behaviour in relation to sustainability options when buying an electric car. This questionnaire is simple and anonymous and will take approximately 5 minutes to complete. Thank you in advance for your collaboration, which will be brief and very important! If you have any questions, please don't hesitate to get in touch: s-jbpinheiro@ucp.pt	Estimado participante, No âmbito da minha tese de Mestrado entre a Católica Porto Business School e a Lancaster University, pretendo explorar os comportamentos do consumidor face a opções de sustentabilidade na compra de carro elétrico. O presente questionário é de resposta simples e anónima, levando aproximadamente 5 minutos a ser respondido. Agradeço, desde já, a sua colaboração, que será breve e muito importante! Caso tenha alguma dúvida, não hesite em contactar: s-jbpinheiro@ucp.pt

Section 1 || Secção 1[6]

Gender || Género	
Male || Masculino	○
Female || Feminino	○
Other || Outro	○

Age || Idade*	
≤ 18 years old || ≤18 anos	○
19-24	○
25-40	○
41-59	○
60 or more || 60 ou mais	○

Gross Annual Income || Rendimento Annual Bruto	
Until 5,000€ ||Até 5,000€	○
5,001€- 27,500€	○
27,501€-50,000€	○
50,001€- 100,000€	○
More than 100,000€ || Mais de 100,000€	○

[6] Questions with "*" were compulsory

Region of the Country || Região do País*	
North || Norte	◯
Centre || Centro	◯
Metropolitan Area of Lisbon || Área Metropolitana de Lisboa	◯
Alentejo	◯
Algarve	◯
Autonomous Region of Azores || Região Autónoma dos Açores	◯
Autonomous Region of Madeira || Região Autónoma da Madeira	◯

Number of Vehicles || Quantos carros possui*	
0	◯
1	◯
2	◯
3 or more || 3 ou mais	◯

Education Level || Nível de Escolaridade*	
3rd Grade || 3º Ciclo	◯
High School || Ensino Secundário	◯
Bachelor || Licenciatura	◯
Post- Graduation || Pós- Graduação	◯
Master || Mestrado	◯
PhD || Doutoramento	◯
Other || Outro	◯

Type of car owned || Que tipo de carro tem?	
Diesel or Gasoline || Diesel ou Gasolina	◯
Hybrid || Híbrido	◯
Electric || Elétrico	◯

End of Section 1 \|\| Fim da 1º Secção

Section 2- Customer Profile || Secção 2- Perfil do Consumidor[7]

On a scale of 1 to 7, rate your level of agreement with each of the following statements, where: 1 (Strongly Disagree), 2 (Disagree), 3 (Somewhat Disagree), 4 (Neutral), 5 (Somewhat Agree), 6 (Agree) and 7 (Strongly Agree).	Avalie, numa escala de 1 a 7, qual **o nível de concordância** de cada uma das seguintes afirmações, em que: 1 (Discordo Totalmente), 2 (Discordo), 3 (De certa forma Discordo), 4 (Neutro), 5 (De certa forma Concordo), 6 (Concordo) e 7 (Concordo Totalmente)

Question:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**No Opinion || Sem Opinião**
1."It is important to me that the products I use do not harm the environment" || "É importante para mim que os produtos que eu use não prejudiquem o ambiente"	○	○	○	○	○	○	○	○
2. "I consider the potential environmental impact of my actions when making many of my decisions" || "Eu considero o potencial impacto ambiental das minhas ações quando tomo muitas das minhas decisões "	○	○	○	○	○	○	○	○
3. "My purchase habits are affected by my concern for our environment" || "Os meus hábitos de compra são afetados pela minha preocupação pelo nosso ambiente"	○	○	○	○	○	○	○	○
4. "I am concerned about wasting the resources of our planet"|| "Estou preocupado com o desperdício de recursos do nosso planeta"	○	○	○	○	○	○	○	○
5. "I would describe myself as environmental responsible" || "Eu descrever-me-ia como ambientalmente responsável"	○	○	○	○	○	○	○	○

Section 3- Electric Vehicles || Secção 3- Carros Elétricos[8]

Do you think of acquire, in the near future, an Electric Vehicle? || Pensa em adquirir, num future próximo, um Carro Elétrico?	
Yes, and I have || Sim, e já tenho	○
Yes, and I don't have || Sim, e não tenho	○
No, and I don't have || Não, e não tenho	○
No, and I have || Não, e já tenho	○

[7] Compulsory answer
[8] Here, if respondent answered "Yes, and I have" or "Yes, and I don't have", then it moves forward to section 4. If answered "No, and I don't have" or "No, and I have", then moves to section 6.

Section 4- Acquisition of an Electric Vehicle || Secção 4- Aquisição de um Carro Elétrico

On a scale of 1 to 5, where 1 (strongly disagree) and 5 (strongly agree), please **the level of agreement** with each factor when buying an electric car.	Numa escala de 1 a 5, onde 1 (discordo totalmente) e 5 (concordo totalmente), avalie **o nível de concordância** de cada fator aquando da compra de um carro elétrico

Question	**1**	**2**	**3**	**4**	**5**	**No Opinion || Sem Opinião.**
"Electric vehicle can decrease the use of petroleum". || "Carros elétricos podem reduzir o uso de petróleo".	○	○	○	○	○	○
"I think electric vehicle would be beneficial to the environment in the long term". || "Penso que, a longo prazo, os carros elétricos serão benéficos para o ambiente"	○	○	○	○	○	○
"I would feel satisfied about myself if I buy an environmental-friendly electric vehicle". || "Sentir-me-ia satisfeito comigo próprio se comprasse um veículo elétrico amigo do ambiente".	○	○	○	○	○	○
"I am concerned about environmental problems". || "Estou preocupado com problemas ambientais".	○	○	○	○	○	○
"I like the idea to own an environmentally-friendly electric vehicle". || "Agrada-me a ideia de ter um carro elétrico amigo do ambiente".	○	○	○	○	○	○
"I compare the purchasing price of electric vehicle and internal combustion engine vehicle to make sure that I get the best value for the money I spend". ||" Comparo o preço de compra de um carro elétrico e de um carro com motor de combustão interna de forma a garantir que obtenho o melhor valor pelo dinheiro que gasto".	○	○	○	○	○	○
"I would buy an electric vehicle if the quality is lower than a conventional vehicle". "Eu compraria um carro elétrico se a qualidade fosse inferior à de um carro convencional".	○	○	○	○	○	○
"I believe that government's financial incentive policy of buying electric vehicle increases my intention". || "Considero que a política de incentivos do Governo (como incentivos fiscais) na compra de carros elétricos, aumenta a minha intenção de compra".	○	○	○	○	○	○
"I believe that government's incentive policy such as direct grants to consumers on buying electric vehicle increases my intention". || "Considero que a política de incentivos do Governo (como subsídios diretos) na compra de carros elétricos, aumenta a minha intenção de compra".	○	○	○	○	○	○
"The mass media suggest that I should use electric vehicle". || "Os meios de comunicação social sugerem que deva utilizar um carro elétrico".	○	○	○	○	○	○
"The mass media urge me to use an electric vehicle". || "Os meios de comunicação social incitam-me a utilizar um veículo elétrico".	○	○	○	○	○	○
"The maintenance and repair of an electric vehicle is important to me when I decide to adopt it". || "A manutenção e reparação de um carro elétrico é importante para mim quando decido optar por ele".	○	○	○	○	○	○

Question	1	2	3	4	5	No Opinion || Sem Opinião.
"Driving an electric vehicle would improve my image and social status". || "Conduzir um carro elétrico melhoraria a minha imagem e estatuto social".	○	○	○	○	○	○
"Using an emissions-free vehicle seems exciting". || "Usar um carro sem emissões parece excitante".	○	○	○	○	○	○
"An electric vehicle fits my personal necessities.". || "Um carro elétrico satisfaz as minhas necessidades pessoais"	○	○	○	○	○	○
"I have the intention to drive an electric vehicle in the near future". || "Tenho a intenção de conduzir, num futuro próximo, um carro elétrico ".	○	○	○	○	○	○
"I will recommend the use of the electric vehicle to other people". || "Vou recomendar o uso de carros elétricos a outras pessoas".	○	○	○	○	○	○
"The purchasing price of an electric vehicle is higher than conventional internal combustion engine vehicle". || "O preço de compra de um carro elétrico é mais elevado do que o de um carro convencional com motor de combustão interna".	○	○	○	○	○	○

Section 5- What leads you to purchase an Electric vehicle || Secção 5- O que o leva a comprar um carro elétrico?

Which characteristics lead you to the purchase of an electric vehicle? **Select the five (5) most relevant.**	Quais as características que o levam a comprar um carro elétrico? **Selecione as cinco (5) mais relevantes**

Characteristics	
"Electric vehicles are less costly to buy than gasoline-fueled vehicles." || "A compra de carros elétricos é menos dispendiosa do que carros a gasolina".	○
"Electric vehicles are less costly to run than gasoline-fueled vehicles." ||" A manutenção de carros elétricos é menos dispendiosa do que de carros a gasolina"	○
"EVs are safe and silent". || "Os carros elétricos são seguros e silenciosos".	○
"Good Acceleration" || "Boa Aceleração"	○
"New Technologies" || "Novas Tecnologias"	○
"EVs are more stylish and have an elegant designed" || "Os carros elétricos têm mais estilo e um design elegante"	○
"Financial Incentives" || "Incentivos Fiscais"	○
"EVs are more durable" || "O carro elétrico tem maior durabilidade"	○
"EVs have higher energy efficiency" || "Os carros elétricos tem maior eficiência energética".	○
"EVs are more environment friendly" || "Os carros elétricos são mais amigos do ambiente"	○
"EVs reduce the risk of car to car accidents" || "Os carros elétricos reduzem o risco de acidente entre carros.".	○

Characteristics	
"EVs are more reliable for daily trips" || "Os carros elétricos são mais fiáveis para viagens diárias".	○
"Electric vehicles are convenient and give a better driving experience". ||" Os carros elétricos são confortáveis e proporcionam uma melhor experiência de condução".	○
"Charging time" || "Tempo de Carregamento"	○
Other Option || "Outra Opção"	○

Which one do you consider as being **the most determinant factor**, from the ones selected above? **Select just one (1)**	Qual considera **ser o fator mais determinante**, dos acima selecionados? **Selecione apenas um (1)**

Characteristics	
"Electric vehicles are less costly to buy than gasoline-fueled vehicles." || "A compra de carros elétricos é menos dispendiosa do que carros a gasolina".	○
"Electric vehicles are less costly to run than gasoline-fueled vehicles." ||" A manutenção de carros elétricos é menos dispendiosa do que de carros a gasolina"	○
"EVs are safe and silent". || "Os carros elétricos são seguros e silenciosos".	○
"Good Acceleration" || "Boa Aceleração"	○
"New Technologies" || "Novas Tecnologias"	○
"EVs are more stylish and have an elegant designed" || "Os carros elétricos têm mais estilo e um design elegante"	○
"Financial Incentives" || "Incentivos Fiscais"	○
"EVs are more durable" || "Os carros elétricos tem maior durabilidade"	○
"EVs have higher energy efficiency" || "Os carros elétricos tem maior eficiência energética".	○
"EVs are more environment friendly" || "Os carros elétricos são mais amigos do ambiente"	○
"EVs reduce the risk of car to car accidents" || "Os carros elétricos reduzem o risco de acidente entre carros.".	○
"EVs are more reliable for daily trips" || "Carros elétricos são mais fiáveis para viagens diárias".	○
"Electric vehicles are convenient and give a better driving experience". ||" Os carros elétricos são confortáveis e proporcionam uma melhor experiência de condução".	○
"Charging time" || "Tempo de Carregamento"	○
Other Option || Outra Opção	○

Section 6- Reasons to not acquire an electric vehicle || Secção 6- Razões da não aquisição de um carro elétrico

What lead you to **not purchase** an electric vehicle? **Select the five (5) most relevant**.	O que o leva a **não comprar** um carro elétrico? **Selecione as cinco (5) mais relevantes**

Characteristics	
"Limited range (one-time travel distance at full charge)" || "Autonomia limitada (distância percorrida com um carregamento completo)".	○
"Lack of evidence on reliability and performance" || "Falta de provas de fiabilidade e desempenho".	○
"Limited battery life" || " Duração limitada da bateria"	○
"Fewer EV models" || "Poucos modelos de carros elétricos"	○
"Lack of knowledge on EVs" || "Pouco conhecimento sobre carros elétricos"	○
"Lack of environmental awareness regarding EVs" || "Falta de sensibilização ambiental em relação aos carros elétricos"	○
"Higher purchase price" || "Preço de compra elevado"	○
"Battery replacement cost" || "Custo de substituição da bateria"	○
"Lack of charging stations" || "Falta de postos de carregamento"	○
"Lack of repair and maintenance workshops" || "Falta de oficinas de reparação e manutenção"	○
"Lack of long-term planning and goals on the government's part" || "Falta de planeamento e objetivos, a longo prazo, por parte do governo"	○
"Absence of an annual tax exemption" || "Ausência de isenção fiscal annual"	○
Other Option|| Outra Opção	○

Which one do you consider as being **the most determinant factor**, from the ones selected above? **Select just one (1)**	Qual considera **ser o fator mais determinante**, dos acima selecionados? **Selecione apenas um (1)**

Characteristics	
"Limited range (one-time travel distance at full charge)" || "Autonomia limitada (distância percorrida com um carregamento completo)".	○
"Lack of evidence on reliability and performance" || "Falta de provas de fiabilidade e desempenho".	○
"Limited battery life" || " Duração limitada da bateria "	○
"Fewer EV models" || "Poucos modelos de carros elétricos"	○
"Lack of knowledge on EVs" || "Pouco conhecimento sobre carros elétricos"	○

Characteristics	
"Lack of environmental awareness regarding EVs" || "Falta de sensibilização ambiental em relação aos carros elétricos"	○
"Higher purchase price" || "Preço de compra elevado"	○
"Battery replacement cost" || "Custo de substituição da bateria"	○
"Lack of charging stations" || "Falta de postos de carregamento"	○
"Lack of repair and maintenance workshops" || "Falta de oficinas de reparação e manutenção"	○
"Lack of long-term planning and goals on the government's part" || "Falta de planeamento e objetivos, a longo prazo, por parte do governo"	○
"Absence of an annual tax exemption" || "Ausência de isenção fiscal annual"	○
Other Option|| Outra Opção	○

Appendix 3:

Other option
Motivation to adopt an EV
Consumption
Less fuel consumption
Barriers to the adoption of an EV
The batteries
Environmental impact
Reliability, they are unreliable, many breakdowns and very high repair cost
I have concerns about the environmental impact of batteries
Batteries are also very harmful to the planet
Increasing cost of charging. And their duration
I have been told that the power grid in my building cannot handle a large number of cars charging at the same time
The future is liquid hydrogen. Electric is a fallacy
Proof that, post life-cycle, the environmental impact is reasonably less than an internal combustion vehicle either current or, most likely, in the future, synthetic fuel or hydrogen.
I believe the battery problem is still a bigger environmental problem than fuel pollution
Although low consumption and low environmental footprint in the immediate term, the true environmental impact remains to be clarified with more reliable LCA and carbon footprint studies and real comparisons with more current models and low consumption fossil fuels.
Possibly has more environmental impact than recycling a combustion car
It is not environmentally friendly
It takes time for normal charges; the fast ones are very expensive
In the current scenario, I do not believe it is as environmentally friendly as they make it out to be
Pollution from ore extraction and battery recycling
False green sustainability is to look at the example of countries in Latin and South America, and Africa. Environmental attacks and child labour in mines to make batteries
As or more polluting as the combustion engines ones
Lack of solutions on charging stations for those living in buildings
Lack of evidence that the carbon footprint of the electric, from its conception to its dismantling, is better than that of fossil fuel vehicles.
I am not convinced that it is currently less polluting than fossil fuels
I am not thinking of buying a new car
Environmental implications of the construction and disposal of used batteries