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ANALYSIS OF CONSUMER PERCEPTION REGARDING THE ELECTRIC  
VEHICLE MARKET

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## ABSTRACT (ENGLISH)

The objective of this study is to comprehend consumer perception regarding electric driven vehicles by analysing their attitude towards those them. More precisely, this study aims to clarify which features an electric driven vehicle would need to have to attract more consumers. Additionally, the aim is to analyse the attitude from environmental concerned consumers toward those cars as they have the reputation for being more ecological. Furthermore, the limitations from consumers side have been analysed and evaluated, this was followed by clarifying which features are in general important to them when they purchase a vehicle. For the evaluation of this, a survey has been published online. All in all, 326 participated in the questionnaire and the gathered information was analysed in SPSS. This has been done in order to respond to the research questions and draw conclusions form the hypothesis testing.

Looking at the results it becomes evident that sustainable concerned consumers have a deeper interest in more eco-friendly implementations in cars. Analysing consumer perception regarding some of the features, shows that for example limitations like limited choice of charging stations has a negative influence on their awareness about those cars. Furthermore, longer charging time as another feature has a negative effect on consumer perception. This is followed by high cost, limited knowledge about EV, whereas range anxiety does not play a significant role in their awareness regarding those vehicles. Looking at positive features like cheaper operation shows that it still does not contribute to a more positive viewpoint.

Keywords: Electric driven vehicles, Consumer perception, Purchasing decision, Car features, Limitations, Environmental damage

## ABSTRACT (PORTUGUESE)

O objetivo deste estudo é compreender a percepção do consumidor em relação aos veículos elétricos a partir da análise de suas atitudes em relação a eles. Mais precisamente, este estudo visa esclarecer quais características um veículo movido a eletricidade precisaria ter para atrair mais consumidores. Além disso, o objetivo é analisar a atitude dos consumidores preocupados com o meio ambiente em relação a esses carros, pois eles têm a reputação de serem mais ecológicos. Além disso, foram analisadas e avaliadas as limitações do lado do consumidor. Para a avaliação disso, uma pesquisa foi publicada online. Ao todo, 326 participaram do questionário e as informações coletadas foram analisadas no SPSS.

Olhando para os resultados, torna-se evidente que os consumidores preocupados e sustentáveis têm um interesse mais profundo em implementações mais ecológicas em carros. A análise da percepção do consumidor em relação a alguns dos recursos mostra que, por exemplo, limitações como a escolha limitada de estações de recarga tem uma influência negativa em sua consciência sobre esses carros. Além disso, o tempo de carregamento mais longo como outro recurso tem um efeito negativo na percepção do consumidor. Isso é seguido por alto custo e conhecimento limitado sobre EV, enquanto a ansiedade de alcance não desempenha um papel significativo em sua consciência em relação a esses veículos.

Palavras-chave: Veículos elétricos, Percepção do consumidor, Decisão de compra, Características do carro, Limitações, Danos ambientais

## EXECUTIVE SUMMARY

Environmental damages due to air pollution caused by road transportation has a high concern in society. More and more people adapt to a more sustainable life but still driving on road by gasoline powered vehicles. This stands in contrast with their sustainable lifestyle which brings up the question why people still do not purchase electric driven vehicles or bring interest in them. Considering this problematic, manufacturers have to understand the needs of consumer and their perception in order to contribute to a more “green” road transportation.

In that case manufacturers have to understand which features influence the purchasing process of a car positively and which features has a negative impact on that. Considering the needs, they can adapt their production to consumers requirements and contribute to a higher demand towards electric driven vehicles. Consequently, this can lead to a more “green” road transportation.

Given the circumstances that sustainability plays a major role in society and air pollution by road transportation still causes damages, this topic represents a relevant contribution to our nowadays life. This dissertation has a focus on understanding especially the behaviour of sustainable concerned consumers towards electric driven vehicles but also clarifying which features of those vehicles have a positive or more of a negative impact on the decision process towards them.

In order to gain an understanding of the research problematic and the importance of this topic a literature review has been conducted. Considering the literature review the seven hypotheses were phrased in order to be tested afterwards. For the analysis of the data, a survey has been published. It was online from the 2<sup>nd</sup> of May until the 15<sup>th</sup> of July and 326 participated in that survey. The data was then evaluated by the software SPSS. Considering the results, it can be concluded that sustainable importance significantly influences consumers’ interest towards more eco-friendly implementations in cars. Also, the limitation choice of charging station has moderate effect on consumer perception whereas longer charging time has a strong effect on that. Moreover, cost has a large significant effect on the willingness to pay a higher price for more environmental features in cars. Looking at another more challenging feature of those vehicles which is range anxiety, it becomes evident that there is no negative influence on consumer perception regarding that. In contrast to that a positive features like cheaper operation does not influence customers’ awareness positively.

Also, one of the objectives of this study was to indicate the features which were more and less of importance when purchasing a car. It is evident that consumers value features like a reasonable price, flexibility regarding charging points and charging time in their purchasing decision. Furthermore, impact of social surroundings plays an important role in the decision-making. In general, they require all the performance qualities from a conventional car to be considered for electric driven vehicles.

Concluding, it can be stated that especially environmental concerned consumers show a significant interest in vehicles with a “green” drive system, however electric driven vehicles have some limitations which position those cars less attractive to consumers. Those barriers are for example limited charging stations, charging time, cost of EV, limited knowledge etc.

## INDEX

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I.	INTRODUCTION.....	9
	MAIN RESEARCH QUESTIONS .....	11
	OBJECTIVES DEFINITION.....	11
	STRUCTURE OF THE DISSERTATION .....	12
II.	LITERATURE REVIEW .....	13
	HISTORY OF ELECTRIC CARS .....	13
	MOST KNOWN TYPES OF ELECTRIC VEHICLES .....	14
	ENVIRONMENTAL DAMAGES.....	16
	ELECTRIC VEHICLES AND THEIR BENEFITS.....	18
	CHALLENGES OF ELECTRIC VEHICLES .....	20
	CONSUMER PERSPECTIVE REGARDING EVS.....	22
	RESEARCH HYPOTHESES.....	25
III.	METHODOLOGY .....	26
	DATA COLLECTION.....	26
	QUESTIONNAIRE.....	27
IV.	DATA ANALYSIS .....	28
	DESCRIPTIVE ANALYSIS.....	28
	KEY TAKEAWAYS .....	37
	HYPOTHESES TESTING.....	40
V.	THEORETICAL AND MANAGERIAL CONTRIBUTIONS .....	54
	CONCLUSION .....	55
	LIMITATIONS OF RESEARCH .....	59
	FURTHER RESEARCH.....	59
	BIBLIOGRAPHY .....	61
	APPENDICES .....	64
	APPENDIX 1 – ONLINE SURVEY .....	65
	APPENDIX 2 – SURVEY RESULTS .....	72
	APPENDIX 3 – PERCEPTION OF BARRIERS CRONBACH’S ALPHA .....	81
	APPENDIX 4 – PURCHASING FEATURES CRONBACH’S ALPHA.....	82
	APPENDIX 5 – TEST OF H1 WITH SPEARMAN’S CORRELATION .....	83
	APPENDIX 6 – TEST OF H2 WITH CHI-SQUARED TEST.....	84
	APPENDIX 7 – TEST OF H3 WITH CHI-SQUARED TEST.....	85
	APPENDIX 8 – TEST OF H4 WITH CHI-SQUARED TEST.....	86
	APPENDIX 9 – TEST OF H5 WITH CHI-SQUARED TEST .....	87

APPENDIX 10 – TEST OF H6 WITH CHI-SQUARED TEST .....	88
APPENDIX 11 – TEST OF H7 WITH CHI-SQUARED TEST .....	89

## TABLE INDEX

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Table 1 Descriptive Statistics for features of a car purchase .....	34
Table 2 Test of reliability for the scale of features .....	35
Table 3 Descriptive Statistics about barriers regarding EVs.....	36
Table 4 Test of reliability for the scale of barriers .....	36
Table 5 Spearman’s correlation for H1 .....	41
Table 6 Chi-squared test for H2 .....	42
Table 7 Chi-squared test for H2 .....	43
Table 8 Chi-squared test for H3 .....	44
Table 9 Chi-squared test for H3 .....	45
Table 10 Chi-squared test for H4 .....	46
Table 11 Chi-squared test for H4 .....	47
Table 12 Chi-squared test for H5 .....	48
Table 13 Chi-squared test for H5 .....	49
Table 14 Chi-squared test for H6 .....	50
Table 15 Chi-squared test for H6 .....	51
Table 16 Chi-squared test for H7 .....	52
Table 17 Chi-squared test for H7 .....	53



## GRAPH INDEX

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Graph 1 Perception about challenges of electric vehicles .....	31
Graph 2 Concern about electric vehicles .....	33
Graph 3 Scatter plot of relationship between sustainability and environment .....	41

## I. INTRODUCTION

Within the years environmental interest took a rising trend. The reason for this was given to ecological damages which had been a consequence of greenhouse gas emissions (Vongurai, 2020). A transition in road transport from gasoline driven vehicles to electric powered vehicles will reduce air pollution (Tanwir and Hamza, 2020). In that case wider adaptation of electric vehicles on road transport can tackle environmental issues like climate change and oil consumption (Liao, *et al.*, 2016). So, a wider adaptation of those cars can lead to a lower greenhouse gas emission which as a consequence is contributing to healthier life both for humans and the environment (Hinnüber *et al.*, 2019). Also, switching to electric energy as a source for drive can contribute of becoming independent of oil usage. This transition is of importance in order to stop more damages in the environment. Just looking at the worldwide daily oil consumption of private cars, it becomes evident that a daily exhaustion of 36 million barrels still represents a to high consumption, in order to become more environmentally friendly. Therefore, a switch is needed to guarantee a lower rate of air pollution and more environmental damage (Tu and Yang, 2019).

From a global perspective the European Union has the highest market share for hybrid vehicles. In Asia, China represents to be a driver in the adoption of those vehicles (Tanwir and Hamza, 2020). Nevertheless, the electric vehicle market still remains small compared to the market for gasoline driven vehicles (MacInnis and Krosnick, 2020). Even regulations for gasoline driven vehicles but also incentives like free parking spots, tax reduction which have implemented in order to support the mass adoption of those cars, could not support the switch (Jones, 2018). Obviously, the market for electric car is facing obstacles which include among other things higher cost, range barriers, limited charging spots and a lower consumer knowledge about this technology and its benefits. (Jin and Slowik, 2017). Also, charging stations are limited to a certain number (MacInnis and Krosnick, 2020). The fact that the market still is low for those vehicles, brings up some questions which needs to be solved. One of those questions is if those cars are not promising enough to keep up with conventional ones (Tanwir and Hamza, 2020)? Furthermore, there are several other assumptions why the market penetration still did not happen for those vehicles. It could be the price but if this is the case it would need to be analysed which incentive would be needed to support consumers to purchase a car like this.

Another assumption is that it would be due to the lack of knowledge and consequently given concern regarding those vehicles which are more of a barrier than price to consumers. In order to verify the barriers and the assumption this study came up (Rahmani and Loureiro, 2018).

So, to support the mass adoption of electric driven vehicles on road, it is important to be aware of the challenges and limitations which the electric vehicle market is facing but also to understand what can actually support the adoption of those cars. Therefore, it is needed to understand consumer perception regarding electric vehicles (Rezvani, *et al.*, 2015). Also, it has to be noted that people who show an environmental interest tend to consider this aspect in their purchasing process. In that case, they will evaluate if the features of those products tend to be ecological correct (Vongurai, 2020).

Considering the information above, this study aims to comprehend consumer perception towards electric driven vehicles, aiming to let responsible parties better understand consumers' needs and to provide information for further research. Furthermore, there is a focus on consumers believes with an interest in sustainability. So, limitation but also benefits of those vehicles shall be revealed. Also, this study explores the potential drivers for a still remaining low adaptation of those vehicles on road transportation.

## MAIN RESEARCH QUESTIONS

This part deals with the research questions of this dissertation. The objective of those questions is to provide knowledge about the topic. In order to formulate the research questions the information from the literature review has been considered (Bryman and Bell, 2011).

This dissertation aims to answer the following research questions:

- i. Do environmental concerned consumers show a higher willingness to purchase electric driven vehicles?
- ii. What are the limitations for consumers in order to purchase cars with an electric drive?
- iii. Which features are important to consumers when buying a car?
- iv. What does an electric vehicle need to have to make someone purchase it?

## OBJECTIVES DEFINITION

This dissertation follows the objective to gain a better understanding about the attitude of sustainable concerned consumers regarding electric driven vehicles. Also, the aim is to figure out the importance of environment when it comes to the purchasing process of car but also indicating if environmental concerned consumers would be still willing to purchase an environmentally friendly vehicle even if it would come to a price increase.

Furthermore, the goal is to show the limitations of those vehicles by considering consumers' perception. This would help both manufacturers and car companies understand the barriers and find solutions to resolve them.

Another objective is to identify which features are of importance to consumers when they would consider buying a car. Especially, stating which feature has a high or low level of importance to them. This is followed by finding out what consumers believe an electric car additionally would need to have to attract potential customers to buy it. This information could be used from manufacturer side in order to satisfy consumer needs and attract more consumers to buy those vehicles.

## STRUCTURE OF THE DISSERTATION

This dissertation is structured in several parts in order to guarantee a logical and chronological order. The first part deals with an introduction about the theme and its importance to make a subject of discussion of it, this is followed by a literature review which serves to give an insight about the topic and its research problematic. The third part is about the methodology which gives clarity about the approach. Afterwards, the next section shows the data analysis and findings. Finally, the last part is about its conclusion, limitations, and further research.

The first part includes the introduction which provides the reader with background information about the topic, the objective of this research and the main research questions.

The second part is about the literature review which provides an overview of the topic but also shows the research gap. This is covered by the main research questions. Also, the hypothesis to test are formulated in this part. Therefore, the information of the literature review has been taken into consideration.

This is followed by the methodology, it shows the approach which has been chosen for this research and the reasoning for it.

The fourth section refers to the data analysis of the gathered information from the survey. Therefore, the hypothesis will be taking into consideration of it. To evaluate the gathered information a descriptive analysis has been chosen. The hypotheses were tested and conclusion drawn.

The last part deals with the results obtained from the research. The contribution shows the knowledge which has been added from the research, this is followed by the conclusion, the limitations which has been given due to different factors and the improvements and suggestions for further research.

## II. LITERATURE REVIEW

This section deals with the literature which needs to be elaborated in order to gain an understanding of the research and its problematic. As already mentioned before the dissertation topic refers to the effectiveness of sustainable vehicles in the automotive industry, focusing on the electric vehicle market and their consumer perception. Therefore, the reader needs to be provided with information on the electric vehicle market, most popular types of it on road, their link to environmental impact, the challenges they face and the consumer perception regarding those cars.

### HISTORY OF ELECTRIC CARS

The first electric car on the market has been dated around the late eighteen centuries. It was invented by Thomas Parker, an English engineer. His invention was the first electric car which was suitable on road transport in the year 1895 (Patel, *et al.*, 2021). By contrast to that, the first hybrid electric vehicle is stated to have been built around 1900 by Ferdinand Porsche (Schmidt, 2018). Those cars gained popularity among the population. Compared to conventional cars they were quietly on road, without carbon dioxide emission and no shaking while driving. On the contrary, conventional cars had a high noise level, produced CO<sub>2</sub> emissions, and had a more complex operation as the engine usually did not start with the first attempt (Vieweg, 2010). Electric cars were considered to be a more reliable transportation as the engine would start immediately (Larminie and Lowry, 2012). As a consequence of this, more electric cars were operating on the road than conventional ones. In the USA 1575 electric cars were operating in the year 1900 whereas 929 gasoline powered cars were counted in that time (Vieweg, 2010).

Around the 1930s the demand for electric vehicles started to decline due to higher cost, shorter driving range and their heavy battery which would limit their speed (International Energy Agency, 1993). Furthermore, during the Great War from 1914-1918 gasoline driven vehicles were deployed. Those cars showed their proper functioning compared to electric drives during difficult times (Westbrook, 2001). Another reason for the failure of electric cars was the fact that it would take several hours for the recharging of the battery. Especially, in that time the access to electricity in rural areas was restricted (Mi, *et al.*, 2014). Also, the demand for hybrid electric cars was declining.

The reasons for that were a too heavy car structure and high manufacturing costs (Schmidt, 2018). Furthermore, oil prices were relatively cheap and infrastructure for service stations started to expand (Vieweg, 2010). In those days environment did not play a major role in society, instead consumers were more concerned about lower initial costs and fast acceleration (Patel, *et al.*, 2021).

In the 1960s interest for electric vehicles came back alive. Air pollution caused by gasoline driven transportation started to play a role in society (Westbrook, 2001). Governmental institutions and electricity companies wanted to take advantage of it. In that case governmental institutions were aiming to gain popularity by repositioning their objectives towards a more environment-friendly transportation (Schweddes and Keichel, 2021). For this reason, they started to support the distribution of those cars by granting financial advantages to owners of electric driven vehicles (Westbrook, 2001). In contrast to that the electricity companies wanted to capture a new market. Therefore, electric cars were advertised as suitable cars for the urban transport as their driving range would fit the daily journal (Schweddes and Keichel, 2021).

## MOST KNOWN TYPES OF ELECTRIC VEHICLES

An electric vehicle consists of four major essential parts which are the electric motor, batteries, charger and controller. The function of an electric motor can be compared with the engine of a conventional car. In that case, it transforms energy into mechanical motion. The energy source for conventional cars can be for example gasoline, diesel, hydrogen etc. whereas for the electric car the energy source constitutes of electricity. The electricity can have its origin from fuels like oil, solar cells, hydropower or wind machines. The role of the controller is to ensure the transition of the electricity from the battery to the electric motor. More precisely, the amount of electricity which will be supplied to the electric motor depend on the intensity of pressing the pedal as this is linked together. The charger has the responsibility to recharge the battery once the energy has been used by the motor (Hackleman, 1996). Fully electric vehicles are only driven by electric power (Patel, *et al.*, 2021).

A hybrid vehicle combines at least two power sources for their drive system. Mostly, it consists of a heat engine and an electric motor (Westbrook, 2001). Given the fact that gasoline driven vehicles and electric driven cars have both benefits, engineers wanted to combine their positive aspects into a new model which came out as the invention of the hybrid vehicle. In that case, drivers could benefit from the gasoline engine as it has no range limit (Fuhs, 2009), whereas the electric motor contributes to a lower fuel consumption which leads to a more environment-friendly drive system (Plechaty, 2007). Moreover, the combination of two motors enables to implement smaller power sources. For example, a smaller engine can lead to better efficiency but also the electric motor has a smaller size compared to the ones in fully electric driven cars (Fuhs, 2009). Regarding the drive: the power sources will either work together or one on its own. The gasoline engine will only be used either for longer journeys, higher speed and fast acceleration (Plechaty, 2007). Consequently, there is only a switch to the gasoline engine when it comes to a higher energy consumption (Patel, *et al.*, 2021).

The plug-in-hybrid vehicle is similarly constructed. Additionally, it consists of a battery with a higher capacity which enables to reach longer distances and maximum speed. This battery can be charged from a power socket (Schmidt, 2018). Therefore, the manufacturer will provide a charging cable which enables to charge it from a “usual” power socket (Schmidt, 2018). On this account, this type of vehicle has been named as plug-in-hybrid as you plug the car to be recharged. On the contrary, the battery of the hybrid vehicle can not be charged from a power socket, instead it can only recover energy through the braking system. Therefore, hybrid vehicles are more dependent of gasoline motor than plug-in-hybrid vehicles. Plug-in-hybrid vehicles can drive approximately 40-45 km just on the electric motor. Once the electric motor is overworked, there will be a switch to the gasoline engine (Patel, *et al.*, 2021). As a result of this, shorter distances are solely driven by the electric motor whereas a switch takes place once longer distances have to be travelled (Hofmann, 2014).

Comparing the sales of the three vehicle types, it can be stated that in the European Union hybrid electric vehicles are very popular. In 2015 they have been the most sold vehicle type in comparison to the three vehicle types. Especially in France and in the Netherlands in that year there was a high registration of hybrid vehicles.



Some studies investigated the willingness of participants to pay a higher price for electric vehicles. Looking closer at one of those studies which took place in Turkey, it becomes evident that those participants were willing to pay around a maximum of 720 euro more in order to switch to hybrid electric vehicles (Rahmani and Loureiro, 2018).

## ENVIRONMENTAL DAMAGES

In the 1980s concerns about the automotive industry raised with their mass production and consequently their destructive impact on the environment which became evident through air pollution and rising temperature. To counteract this development alternative drives had to be found (Schwedes and Keichel, 2021). The need towards a fundamental rethinking in the automotive industry was tackled by the European Union. All members of the European Union agreed on reducing their CO<sub>2</sub> emissions by a minimum of 40% from 1990 until 2030. To reach this objective a target of 20% reduction has been set for 2020 (Arcos-Vargas, 2021). A set of actions have taken place to improve air quality. One of those actions was the regulation of the fleet consumption. From 2012 all vehicles which has been entering the market in the European Union were only allowed to emit to a maximum of 120g CO<sub>2</sub>/km (Hofmann, 2014). To ensure that those targets would have been reached, manufacturers had to face penalties in case they would not follow those regulations (Liebl, 2017). This means that for exceeding the formality by 1g manufacturers would have to pay 5 Euro per car, for 2g this would mean 20 Euro per car, for 3g this would be set to 45 Euro per vehicle etc. (Hofmann, 2014). For this reason, it was necessary for car manufacturers to follow the regulations in order to avoid penalties and corporate damages. Consequently, they had to adapt their production to those targets. To support the acceptance from customers side some benefits were set by the politics. Those advantages were among other things lower taxes or free parking spots (Liebl, 2017).

Compared to earlier days the number of operating cars on road has been increasingly rapidly within the years. It is estimated that by 2050 in each continent around two billion cars would be operating on the roads. China, India and additional emerging and developing countries will count the highest increase of operating cars. Not only the number of operating cars will increase in future times but also the population living in cities. According to estimations by 2050 half of the population will be living in cities. This will lead to a higher increase of CO<sub>2</sub> emissions. An increasing population in cities means also more traffic on road (Vieweg, 2010).

In that case traffic or rather short journeys contribute to the highest release of CO<sub>2</sub> emissions. Especially, the initial phase of drive causes the highest environmental pollution as the car needs to reach a certain temperature level. This leads to a higher energy consumption (Plechaty, 2007).

The extensive fuel consumption which leads to a scarcity of resources and rising restrictions regarding CO<sub>2</sub> emissions represent gasoline driven vehicles as the inappropriate choice as means of transportation. Despite the fact, that several implementations have been developed to reduce the pollution rate of conventional cars, those improvements still did not stop the negatively impact on the environment (Hüttl, *et al.*, 2010). The use of fossil fuels leads to greenhouse gas emissions and poor air quality. In particular, large cities are highly affected by those environmental impacts. According to statistics, 22% of air pollution has been caused due to the transportation sector. The road transportation contributes to the most pollution whereas water transportation, aviation etc. had a lower negative impact (Egede, 2017). Many of the discovered oil wells are close to exhaustion. Therefore, oil exploration in the future will happen in places which are more difficult to access or production from other fossil fuels like coal have to be considered (Larminie and Lowry, 2012). In that case the extensive use of fossil fuels has been leading to a greater demand than supply. This development has been recognised as critical since oil is a finite resource (Vieweg, 2010). As oil exploration is limited to the given availability of the resources this can lead to an increase of fossil fuel prices (Lienkamp, 2012). A significant price increase can contribute to a more established market for electric drives (Larminie and Lowry, 2012).

Concern and knowledge about environmental impacts due to the transportation sector has increased. Also, the demand towards more eco-friendly implementations has been requested (Derbel, *et al.*, 2020). In contrast to earlier times around 1990, nowadays more and more consumers have an interest in electric vehicles. This is given due to the demand for more innovative transportation but also this development is supported by the so called “early adopters” who always want to stay up to date with trends on the market. Also, request from environmental concerned consumers regarding electric drive systems took a rising trend (Proff, *et al.*, 2016). With the concern for environmental changes the demand for vehicles with alternative drive to fuel took a rising trend. Especially, in the European Union in countries like Italy, Norway and Poland between 2013 to 2015 a high increase in registrations of those vehicles have been recorded. The demand for that was given due to governmental subsidies, a broader choice, tax incentives and other benefits like exclusive parking spots.

Nevertheless, the switch to alternative fuel vehicles is still very low in other European countries (Rahmani and Loureiro, 2018). Electric vehicles will have a positive impact on climate change if the electricity comes from renewable energy (Proff, *et al.*, 2016).

Considering the information which has been mentioned above, the following hypothesis was built and tested:

H1. Sustainable importance in nowadays life has a positive influence on consumers interest regarding more eco-friendly implementations in cars

## ELECTRIC VEHICLES AND THEIR BENEFITS

Electric vehicles not only have a positive impact on the environment but also EV owners can profit from a financial aspect (Vieweg, 2010). Indeed, the initial costs for electric vehicles are higher than for fuel driven vehicles. Regarding the operating costs electric vehicles have a financially better position (Plechaty, 2007). In comparison with gasoline driven vehicles, they have lower operating costs. Furthermore, EV drivers can gain advantage regarding vehicle taxes. For example, in Germany EV owners are excluded from the tax payment for five years. After that the tax rate will be amounted between 11,25 Euro to 12,02 Euro. This will depend on the car weight if its either categorised as light or heavy car (Vieweg, 2010). In comparison to conventional cars electric vehicles have about 50% less mechanical components (Arcos-Vargas, 2021). Therefore, another benefit is given by maintenance costs as the electric motor does not need any changing of oil and sparking plug. Therefore, the maintenance for electric vehicles only includes changing of the brake pads, headlights and other lights which are included in the car and shock absorbers (Vieweg, 2010). Following studies, the maintenance costs are around 40% cheaper than for gasoline driven vehicles (Arcos-Vargas, 2021). Also, it is estimated that electric vehicles have a higher resale value than conventional cars, thus they have a lower decline in value. For example, the reselling value for Honda Civic with a hybrid drive can be sold for around 10.600 Euro whereas a VW Golf from the same year and amount of drive will have reselling value of around 7.900 Euro (Vieweg, 2010). In terms of city traffic vehicle cars have a lower fuel consumption. Among other things this given due to the energy recovery through the braking process (Plechaty, 2007).

Also, they contribute to a more environment-friendly transportation if the energy for the drive comes from a sustainable power source. Consequently, they emit no pollution (Egede, 2017). In comparison to conventional cars they also contribute to a lower noise level (Derbel, *et al.*, 2020).

Financial support is also given from governmental side. Therefore, several state promotional programmes have been established. For example, France supports the distribution of those cars by granting each customer 5000 Euro for their purchase. Other European countries went along with this programme. In Spain customers will receive the highest amount with 6000 Euro, whereas Italy grants customers for their purchase 3000 Euro. Non-European countries like Japan take on part of the initial costs. This means that they take between 25% to 40% of the purchase cost, the remaining part will be paid by the customer itself (Vieweg, 2010). Another way to tackle CO<sub>2</sub> emissions is done by entrance limitations to gasoline driven vehicles in large cities. For example, in London drivers of fuel vehicles have to pay an entry fee to get into the city centre. During weekdays car drivers will have to pay 10 pounds to be able to enter the restricted area. Electric vehicles, hybrid vehicles and environment-friendly vehicles which emit a maximum of 100g/km are excluded from this payment fee. They can enter the city centre without any restriction (Hofmann, 2014).

Those benefits of the electric car lead to an increase in their popularity. Also, they obtained a green image by customers who care about environmental-friendly aspects. Furthermore, financial help by governmental institutions encouraged to reach a wide client base (Derbel, *et al.*, 2020). Also, their electric motor contributes to a lower dependence on oil and as a consequence of this to a lower fuel consumption (Larminie and Lowry, 2012). Nowadays, the reduction of fuel consumption and the switch to sustainable energy is unavoidable. This transition is necessary to secure a both stable environment and economy (Derbel, *et al.*, 2020).

## CHALLENGES OF ELECTRIC VEHICLES

In present time charging infrastructure for electric vehicles is still limited to couple of charging points (Patel, *et al.*, 2021). Within the years more charging points have been established but compared to fuel stations there are less visible as those are easy to see due to their appearance. This can lead to the fact that people do not know exactly where those stations are located (MacInnis and Krosnick, 2020). The fact that in present time there is still a lack of charging stations prevents the mass adoption of electric cars on road (Jing, *et al.*, 2015). For the short range which means the daily commute the current charging infrastructure will be suitable but for longer distances it is unavoidable to have a flexibility regarding charging points which is given for conventional cars (Patel, *et al.*, 2021). The reason for this is due to the limited number of electric vehicles operating on road compared to conventional cars. It is not seen as profitable enough to extend the charging stations due to the lack of operating EV vehicles. Without taking this investment this can prevent the use of those cars for longer distances (Arcos-Vargas, 2021). Only with the availability of a wide and fast charging infrastructure electric vehicles can be used for regular transport (Westbrook, 2001). For this transition it is of importance to secure an easily accessible charging infrastructure.

A combination of private and public charging stations is needed for that. Also, at places like work, supermarkets and parking stations the infrastructure for that needs to be extended (Proff, *et al.*, 2016). Providing a charging structure at work locations can support a green image, this can attract employees to stay or even attract future employees who value environment implementations from their employer (National Research Council, 2015). Furthermore, the implementation of quick charging stations is of importance which counteract drive range anxiety (Proff, *et al.*, 2016).

Charging time for electric vehicles requires a minimum time to be ready for drive, whereas conventional cars can be filled with petrol in couple of minutes. Indeed, the charging time for newly developed batteries has been reduced to one hour, nevertheless this is still longer than refuelling a conventional car at a petrol station (Larminie and Lowry, 2012). The time to recharge a battery will depend on two factors. On the one hand, it depends on how much energy is left in the battery. On the other hand, it depends on the charging which has been picked for it. A distinction is made between level 1, level 2 and level 3 chargers. The level 1 charger adds approximately 8 km range per hour charging. It can be used at a standard household power socket and does not need any further implementations.

To have the battery fully charged it can take up to 8 hours, therefore it is convenient for carrying out the charging overnight. The level 2 charger adds up to 40km per hour. Level two chargers are located outdoor. For example, close to supermarkets or workplaces. The level 3 charger is the quickest method to use. This charging type can add up to 270km per 30 minutes (Patel, *et al.*, 2021). Nevertheless, only few drivers will drive on a daily basis more than 80 km, therefore a slow charger would still be suitable for the everyday drive. Apart from the limited choice of charging stations, charging time presents another concern for drivers (Patel, *et al.*, 2021).

The driving range of electric vehicles will depend on two factors which are the charging state and their energy consumption. Indeed, the state of charge is clear from the beginning of the drive. However, the energy consumption is influenced by different factors like use of air conditioning, radio, navigation and driving pattern (Egede, 2017). This limited range can lead to concerns from drivers side as they are used to flexibility which is given by conventional cars as they can drive longer distances and secure a quick refuelling (Arcos-Vargas, 2021). Despite the range limitation, for the daily commute most of the drivers will only need a range between 50-60km. Considering this aspect the disadvantages of those cars are less severe. Therefore, preoccupation from drivers side not being able to reach their destination is exaggerated (Vieweg, 2010). In that case range limitation might represent a lower concern for consumers who would consider those vehicles for driving in the city (Rezvani, *et al.*, 2015).

Drivers who have interest in electric vehicles are at the same time concerned about the initial costs of those cars (Fuhs, 2009). From a cost perspective, purchase price of those cars are more expensive than for conventional cars (Vieweg, 2010). Especially, the battery cost represents one of the largest cost elements. In case the battery would need a replacement, this would lead to an increase of the running costs (Westbrook, 2001). For example, the electric vehicle Honda Insight is about 2000 Euro more expensive than a gasoline driven VW Golf (Vieweg, 2010). As a consequence, a higher price can have an influence on consumers' perception against those vehicles. So, if those vehicles would have a lower price which would be categorized as affordable, it could lead to a higher interest and adoption of them (Tanwir and Hamza, 2020).

As already mentioned before, the initial cost qualifies itself with tax benefits, lower maintenance costs and lower fuel consumption (Vieweg, 2010). Furthermore, recharging with electricity is cheaper than refuelling the car with gasoline (Lienkamp, 2012).

Considering those aspects, in the long-run electric vehicles are located on the same cost level (Vieweg, 2010). Therefore, purchasing an electric vehicle from a cost perspective is only profitable considering the total costs in the long-run (Lienkamp, 2012). An increase in the manufacturing of electric vehicles will lead to lower initial costs as it allows mass production but this will depend on the future demand of those vehicles (Larminie and Lowry, 2012).

Taking the information above into account, the following hypotheses have been elaborated and tested:

H2. Limited choice of charging stations has a negative impact on consumers perception regarding electric vehicles

H3. Longer charging time of EVs has a negative impact on consumers perception

H4. Initial cost of EVs has a negative influence on costumers purchasing decision

## CONSUMER PERSPECTIVE REGARDING EVS

The demand for electric driven vehicles mostly depends on consumers' attitude towards those cars. Therefore, it is necessary to understand consumers' perception by considering the limitations and benefits from those vehicles. By analysing that it can be figured out which factors would influence the purchasing process in favour of electric driven vehicles (Rezvani, *et al.*, 2015).

Purchasing a car involves a long process as it comes with the need of research and influence of consumer perception (National Research Council, 2015). Therefore, consumer decision is not only influenced by the product features but also by other influencing factors like the necessary information which the consumer needs to make a proper decision, the consultation from the car dealer and the attitude of his social surroundings regarding the product itself. Since the car represents are more complex product due to its mechanical aspect and wide variation of cars to select, consumers are more likely to seek advice from their social surroundings like friends and family. Consequently, the decision process involves the participation of several people and is rarely made just by one person. The car dealer can make an impact on the decision process by building up a relationship of trust with the potential customer but also the given expertise can influence the decision process (Unger, 1998).

The importance of social surroundings becomes evident when you look at a survey in Norway which shows that 67% of consumers who were owning an electric driven vehicle would have at least influenced one person in their social surroundings in the first two years to show interest in those vehicles and about 14% of those consumers were able to convince their social surroundings that means for example three or more friends to even buy those vehicles. Nevertheless, it has to be considered that Norway is the only country in the European Union which has about 20% of new car sales which just refer to plug-in-electric cars (Jin and Slowik, 2017). The reason for the broad use of this vehicles in Norway is given to advantages which has been provided by the government. Those benefits are among other things free parking spots, exclusive lanes on the road for those vehicles and no toll fee (Hinnüber, 2019).

Furthermore, other factors like the fuel consumption, safety features and the green image can impact the purchasing process (Unger, 1998). Also, the driving experience with this car is stated to be with high comfort as there are no gear changes and a quick acceleration even during low speed (Hünüber, *et al.*, 2019). Considering the education level of consumers, it can be stated that those with a higher education, tend to show interest in owning hybrid cars. In general, consumers with a higher social status indicate to own electric cars. The most influential factor for consumers who decide in favour of those vehicles is the protection of the environment and as a consequence of this a sustainable energy management (Tu and Yang, 2019). In contrast to that, not only consumers with a sustainable mindset show interest in those vehicles but also consumers who see those cars as a status symbol (Jones, 2018).

The industry for electric vehicles is having difficulties to convince consumers by their features (Scrosati, *et al.*, 2015). Some classify those vehicles as technology which has not been discovered enough yet (Jones, 2018). Barriers are among other things limited knowledge about new technologies, concerns about range limits, long charging time and features which are required on an individual basis (Scrosati, *et al.*, 2015). Especially, higher initial cost is negatively affecting the purchasing process. Other factors which negatively affect the purchasing decision are among other things limited knowledge about range, less variation to select but also low awareness about the interaction between fuel and energy consumption, believing the implementation of home charging would be a too complex procedure and poor knowledge about the positive environment aspects of those cars and the financial governmental support for EV owners (National Research Council, 2015). Many studies found out that there is a general low understanding about those vehicles. Only few participants were able to name for example a plug-in-electric vehicle.



Also, the participants who were able to name it, it become evident that most of them would either name the Nissan Leaf or the Tesla Model S which shows that even participants with a better knowledge would not be aware about the wider choice of those cars. Even some of the participants were not aware of governmental incentives for those cars (Jin and Slowik, 2017). There is a possibility that limited driving range represents more a limitation which is based on believes and not the actual experience. In a study about 56 households in the UK had the opportunity drive an electric driven vehicle for a week. Those cars had a driving range of 160 km. Those participants stated that those vehicles would be suitable to have it as a second car. 34% of the participants even stated if those cars would have a range of 240 km they could be even considered as their first car (Rezvani, *et al.*, 2015). Furthermore, limited choice of electric vehicles can influence consumer perception negatively as there are more gasoline driven vehicles on the market available (MacInnis and Krosnick, 2020). Consequently, limited understanding about their features and financial benefits can contribute to a wrong decision (National Research Council, 2015). From all the barriers which have been mentioned, vehicle charging represents the biggest concern to consumers (Tu and Yang, 2019). Nevertheless, it has to be stated that even consumers who are better informed might decide against electric vehicles as those cars would not fulfil their requirements. According to that, not even well-informed consumers decide in favour for those vehicles as consumer might look for other or additional features in a car (National Research Council, 2015).

Indeed, the initial cost plays a role during their purchasing process. Nevertheless, consumers would still pay a higher price in case the features of the car would be what they have been looking for in a vehicle (Perdontis, 2013). Especially, consumers being highly environmental concerned are more willing to pay the price for those vehicles although they come with certain limitations (Jones, 2018). Furthermore, features like fast acceleration and lower operating cost in the long-run can influence the purchasing decision positively (Perdontis, 2013). Also, some of the participants of the study in the UK which has been mentioned before stated that they experienced positively the fast acceleration and low noise level of those vehicles (Rezvani, *et al.*, 2015).

Considering the information above, the following hypotheses have been built and tested:

H5. Range anxiety has a negative influence on consumers' perception towards those vehicles
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H6. Limited knowledge about EVs has a negative impact in the decision-making process
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H7. Cheaper operation of electric driven vehicles has a positive impact on consumers' perception about those vehicles

## RESEARCH HYPOTHESES

Hypotheses are assumptions which are stated in order to elaborate if those assumptions emphasize to be a correct statement or remain an incorrect claim. Therefore, those hypotheses need to be tested in order to verify that (Devore, *et al.*, 2021). By investigating those hypotheses, it will support to answer the research question of this dissertation (Pruzan, 2016).

Below all the hypotheses are listed. For the elaboration of those hypotheses the literature review has been taking in to account.

Hypotheses:

H1. Sustainable importance in nowadays life has a positive influence on consumers interest regarding more eco-friendly implementations in cars

H2. Limited choice of charging stations has a negative impact on consumers perception regarding electric vehicles

H3. Longer charging time of EVs has a negative impact on consumers perception

H4. Initial cost of EVs has a negative influence on costumers purchasing decision

H5. Range anxiety has a negative influence on consumers' perception towards those vehicles

H6. Limited knowledge about EVs has a negative impact in the decision-making process

H7. Cheaper operation of electric driven vehicles has a positive impact on consumers' perception about those vehicles

### III. METHODOLOGY

This part deals with the methodology which aims to validate the approach of the investigation by providing an overview of the structure which has been used.

This study is focusing on gaining knowledge about consumer perception towards features of electric driven vehicles. The objective is to understand better which features of an EV would influence the purchasing decision either positively or negatively. Also, figuring out which features those cars would need to have to make someone buy it. In order to achieve this objective a research question and hypotheses were elaborated and investigated (Malholtra, *et al.*, 2017).

For this dissertation a quantitative research technique has been applied in order to validate the information from the collected data and carry out a statistical analysis. In order to conduct the statistical analysis a survey has been established to evaluate the gained information. The survey was structured in several questions which were answered by a sample of target population. In order to participate in this survey access to the Internet was needed, as it was published online (Malholtra, *et al.*, 2017). The survey was accessible to participants from the 2<sup>nd</sup> of May 2020 until the 15<sup>th</sup> of July 2020.

#### DATA COLLECTION

The questionnaire which has been published as a survey on the internet was published on the 2<sup>nd</sup> of May through Google forms. Participants had the chance to participate in this survey until the 15<sup>th</sup> of July. In order to gain a broad view on this topic, the questionnaire has been released in English. After reaching a certain number of participants to make a validate statistical evaluation, the data was transferred to the statistical software SPSS, following by analysing the collected data.

## QUESTIONNAIRE

The questionnaire serves as a support to verify the stated hypotheses and as a conclusion to answer the research question. It is composed of four sections which are questions about socio demographics, the driving habit, knowledge about features of electric driven cars and their perception about those features. Those questions were built by considering the literature review which has been conducted before. The questionnaire will be found in appendix 1.

The first section of the questionnaire refers to socio demographic aspects such as gender, age, country of residence, education level and monthly income. All the questions have been asking by providing multiple choice answers, except for the question about nationality. This question had to be responded in a written format.

The following section focuses on the driving pattern of the participants. The objective is to understand the choice of transport which will be taken and their frequency of use. In that case they had to indicate what type of car they are driving in case this was given and the frequency of use of cars and public transport.

The third section is aiming to clarify participants knowledge about electric vehicle features. Therefore, statements were formulated with the option to either agree or disagree on that. Furthermore, they had to indicate the challenges which the EV industry would be facing in their opinion.

The last section deals with consumer perception and attitude towards features of EVs. This section was aiming to understand what an EV would need to have to make someone buy it but also the influencing factors in the general purchasing process of a car.

## IV. DATA ANALYSIS

The questionnaire was published on the 2<sup>nd</sup> of May and online for participation until the 15<sup>th</sup> of July. 326 participants were taking part in the survey.

Afterwards, the data from the survey was transferred to the statistical software SPSS and analysed. The gathered information was evaluated by a descriptive analysis.

In the last part of this section the seven hypotheses were tested. Therefore, statistical tests were conducted. Considering the requirements for those tests it was either conducted a Spearman's correlation or a chi-squared test.

### DESCRIPTIVE ANALYSIS

#### a. Demographic Analysis

This part deals with the descriptive analysis of socio-demographic variables from the survey. In that case gender, age, country of residence, education and monthly net income will be analysed in the next step.

These were the results from the analysis of the socio-demographic variables:

- most of the participants are female with 54,6% of participants whereas male account for 45,1%. A minority of 0,3% did not give any indication about their gender;
- with respect to the age bracket, the majority of the participants were referring to the age group of 18 to 25 and 26 to 35. Each of them were accounting for 37,4%, this was followed by 12,6% who were belonging to the age of 36-45. 8,6% of the participants were aged in the group of 46 to 55. The rest of 3,7% were part of an older age bracket of 56 to 65 and the oldest age bracket of 0,3% were part of generation 65+;
- the question regarding country of residence represented the only section where participants had the chance to phrase the answer on their own. The majority of 50,3% with 164 responses are living in Germany, the second largest nationality was Portugal with 48 participants and a share of 14,7%.

The rest of 35% were coming from Australia, Austria, England, France, India, Japan, Spain, Switzerland and the Netherlands. Two participants gave a non-valid answer, according to this the number of valid participants reduces itself to 324;

- with reference to the education level, the largest number with 205 replies and accounting for 62,9% belongs to graduates with a Bachelor degree, this is followed by 88 responses with a Master degree. They represent a portion of 27%. The third largest group with 23 replies and accounting for 7,3% refers to participants who completed an apprenticeship. Only 1,5% have completed a doctorate and the rest of 1,2% belongs to participants with a high school degree;
- regarding the monthly income about 44,8% stated to earn between 2000 to 3000 Euro per month, another major group of 25,8% indicated to have a monthly net salary of less than 1500 Euro. About 15% were classified in the salary bracket of 1500 to 1999 Euro per month. The smallest group of 14,4% were part of the highest earners and therefore referring to the salary bracket of more than 3000 Euro per month;

#### b. Driving habit

This part is aiming to get more information about participants driving habit, choice of transport and the frequency of its usage. These were the obtained results from the survey:

- with reference to the question which was figuring out if the participants would be in possession of a car, the majority of 55,5% indicated to own a car, the second largest majority of 26,4% stated that they were not in possession of a car but they would be driving on a regular basis. About 9,8% responded to this question with a no. For this question, participants also had the choice to write an individual answer. So, the rest were mostly indicating that they do not own a car with a small explanation such as that they would not need or instead would be driving bicycle;
- furthermore, most of them with 86,8% indicated to drive a fuel vehicle, whereas only 6,7% were driving a hybrid vehicle and 3,7% an electric car. Also, for this question they had the chance to write an individual response in case none of those options would fit their choice of car. In that case most of them either indicated no car or bike;

- regarding their frequency of travel by car, the biggest group accounting for 37,4% stated to travel at least once a day by car, this was followed by 24,5% who specified to be travelling less than once a day but at least two times per week. The third biggest group with 15% marked to be on road once a week. The rest were accounting for between 6% to 8% who represented the group of a lower frequency in travelling by car
- finally, the last question was referring to the frequency of usage for public transport, 24,8% replied to be travelling by public transport at least once a day, 19,9% stated to use public transportation less than once a day but at least three times per week, however 17,5% would use it once or twice per week. The rest of 28,9% were representing the ones who would either use it once or twice a month or even less than that;

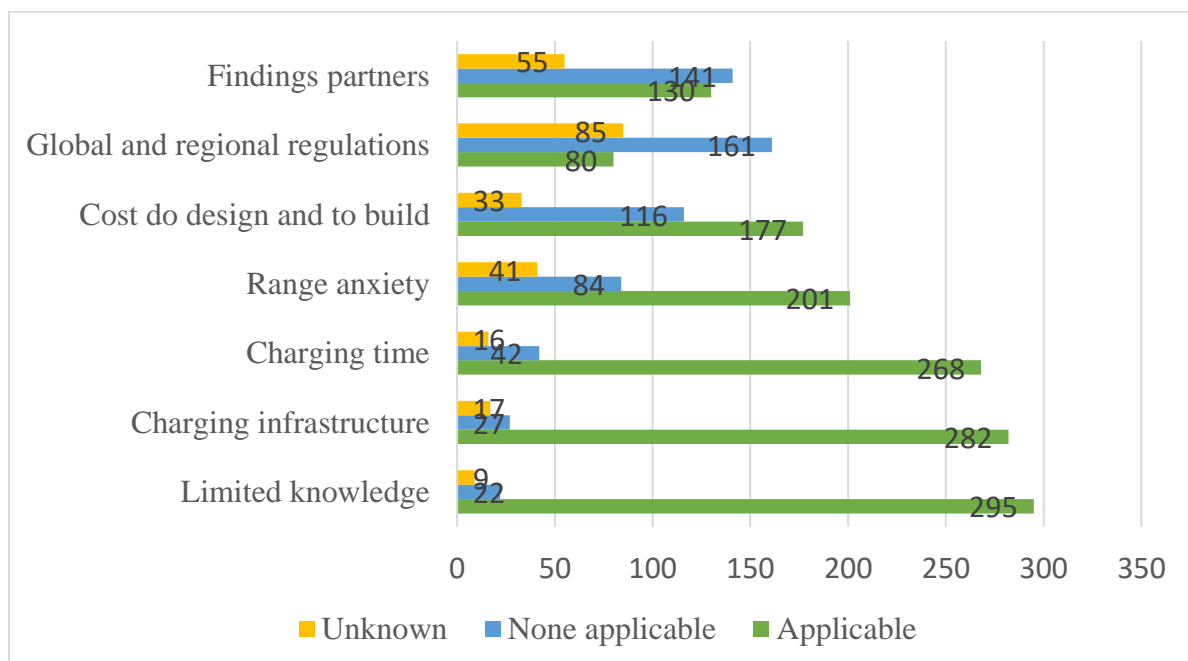
c. Knowledge about features of electric driven vehicles

This section is there to figure out the knowledge of participants regarding electric vehicle features. Therefore, statements were built where they had the choice to either agree or disagree on that. Furthermore, they have been asked on raking features which are important to them when purchasing an electric driven car but also indicating the concerns about those cars by classifying possible concerns from either applicable and none applicable. These were the outcomes:

- with reference to the statement “Plug-in electric vehicles are often cheaper to operate than gasoline vehicles” most of them with 62% agreed on this statement, in contrast to that 10,7% disagreed and 27% were stated not to be sure about the correct answer;
- in the next statement “Plug-in electric vehicles can be charged from a regular home outlet” the majority of 79,1% agreed on that, whereas only 8,6% disagreed. Another 12,3% marked not to be sure about it;
- regarding the question about the importance of sustainability to their personal life most of the respondents with 70,2% stated that it would be somehow important to them, whereas 27,9% indicated that it would have a high importance to them. Only 1,8% specified that it does not have any importance to them;

- the next section requested to name a vehicle with an alternative drive, therefore the respondents had the chance to phrase it on their own. It appears that a number of respondents were able to specifically name type of hybrid and fully electric vehicle, whereas some just responded with a no;
- moreover, 35% are not sure about buying/leasing an electric vehicle, this is followed by 31,9% who would not do this at all and 23,9% who have interest to get one at some stage. 9,2% indicated to be already in the possession of an electric vehicle;

The chart below presents the frequencies of participants' perception regarding the challenges which the industry of electric vehicles would be facing. In that case they had to rank possible challenges by either being applicable, none applicable and unknown. It is evident that "Limited knowledge from consumers' side" presents a challenge for the EV industry as it received 295 responses specifying it to be applicable. Furthermore, "Charging infrastructure" represents another major challenge. This statement received 282 responses which marked it as being applicable. This was followed by "Charging time" with 268 compliances on that. "Range anxiety" and "Cost to design and to build the vehicles" also received a high correspondence, whereas "Global and regional regulations" and "Finding partners with experience in electrification" only received a lower agreement on being a challenge.



Graph 1 Perception about challenges of electric vehicles  
Source: SPSS

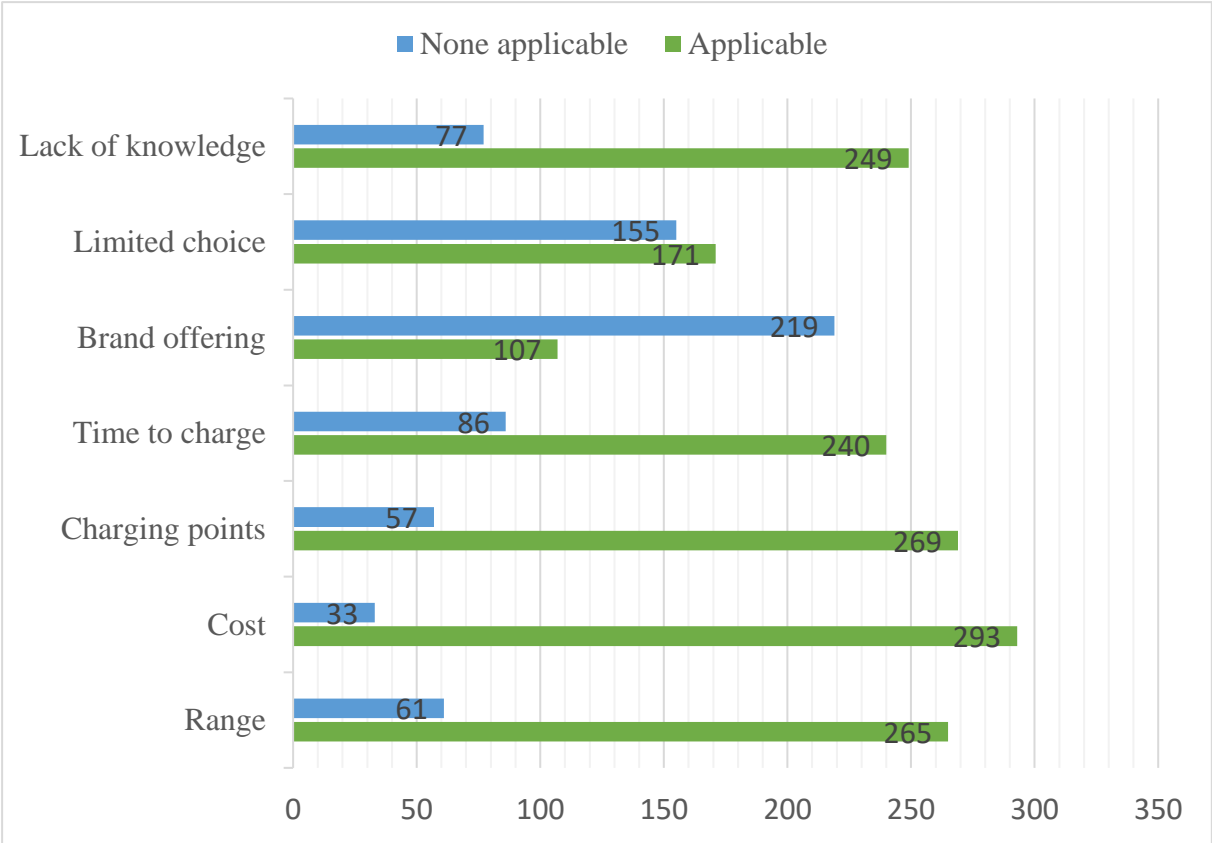


#### d. Consumer perception about electric vehicle features

This part deals with the features which are of importance when purchasing a car but also the influences which are directing someone's purchasing decision but also clarifying what electric vehicles would need to have to make someone buy it. These were the obtained results:

- about 74,5% specified that they would not be willing to pay more for a car even if their features would be more environment-friendly, whereas 25,5% showed that they would be willing to pay a higher price for that;
- considering social surroundings in their decision-making process, about 45,7% stated that they would consider buying an electrical car if there would a growing number of people in their network who would drive those cars, in contrary to that 39,9% showed that they still would not consider buying those vehicles even if there would be a growing number of people in their network having those cars. About 14,4% were not sure if this would have an influence in their purchasing process of a car
- with reference to the question what an alternative fuel vehicle would need to have to make someone decide for it, the majority of 65% indicated that it would need to have all the performance qualities of a traditional car, 27,6% responded that it would need to be sold for a lower price. Also, the participants had the option to answer this question by providing an individual answer. Some mentioned that the infrastructure and charging options would need get better, others were questioning the real sustainability of those vehicles.

The graph below shows participants' concerns about challenges of alternative driven vehicles. Indeed, the biggest concern was stated to be the cost of those vehicles with 293 agreements on that. This was followed by charging points, range/driving distance, time to charge and lack of knowledge as a concern. The agreements on that were varying between 240 to 269 responses on that. In comparison to that, limited choice and brand offering were seen as smaller concerns. In that case brand offering was the smallest concern with 107 participants agreeing on that.



Graph 2 Concern about electric vehicles  
Source: SPSS

## Influential features when purchasing a car

The following table (table 1) shows the means and standard deviations of the features which has been given for the question “How important are the following aspects to you when buying a car?” The participants had the choice to answer to this question by a 4-likert scale of either choosing 4 – very important, 3 – important, 2 – somewhat important or 1 – not important. Considering the table, it becomes evident that three statements show the highest mean. Those are “Safety” (3.6), then “Comfort” (3.3) and lastly “Cost efficiency” (3.2). Consequently, those features have been ranked as the most important to consider when purchasing a car. In contrast to that, there were two statements with the lowest means. Those are “Brand image” (2.6) and “Environment” (2.6) which means that those features are of less importance when consumers purchase a vehicle. Statements with an intermediate importance are “Latest technology” (2.7) and “Performance” (2.8). Therefore, those can be categorised into the somehow important part.

### Descriptive Statistics

	N	Mean	Std. Deviation
Environment	326	2,6472	,78531
Latest technology	326	2,7117	,79012
Cost efficiency	326	3,2117	,63826
Comfort	326	3,3466	,60213
Brand image	326	2,5552	,84945
Safety	326	3,5798	,53039
Performance	326	2,8896	,84494
Valid N (listwise)	326		

*Table 1 Descriptive Statistics for features of a car purchase*  
*Source: SPSS*

In order to test the reliability of the scale, the test of Cronbach’s alpha has been carried out. The test shows if the items indicate reliability to the scale. Looking at the table 2 it becomes evident that Cronbach’s alpha has a value of .690 which is categorised as reasonable value.

**Case Processing Summary**

		N	%
Cases	Valid	326	100,0
	Excluded <sup>a</sup>	0	,0
	Total	326	100,0

a. Listwise deletion based on all variables in the procedure.

**Reliability Statistics**

Cronbach's Alpha	N of Items
,690	7

Table 2 Test of reliability for the scale of features  
Source: SPSS

Perception about barriers regarding electric driven vehicles

Looking at the table 3 below, it will present the means and standard deviations of the possible barriers regarding the statement “My biggest concern regarding alternative fuel vehicles are:”. In that case participants could choose between either 1- Applicable and 2 – None applicable. It becomes apparent that four features would show the biggest barriers. Those are “Cost” (1.1), “Charging point” (1.2), “Range” (1.8), “Lack of knowledge” (1.2) and “Time to charge” (1.3). In that case participants would show the biggest agreement to see those features as the biggest barriers in the electrification of the road transport. In contrast to that, the lowest agreement was given for two features which are “Brand offering” (1.6) and “Limited choice” (1.5). Those features are seen less as challenges in order to enable an electrification on road.

### Descriptive Statistics

	N	Mean	Std. Deviation
Range	326	1,1871	,39060
Cost	326	1,1012	,30209
Charging point	326	1,1748	,38042
Time to charge	326	1,2638	,44137
Brand offering	326	1,6718	,47029
Limited choice	326	1,4755	,50017
Lack of knowledge	326	1,2362	,42540
Valid N (listwise)	326		

Table 3 Descriptive Statistics about barriers regarding EVs  
Source: SPSS

Also, here the reliability of the scale has been tested by conducting the test of Cronbach's alpha. The result shows a value of .615. for Cronbach's alpha which fits into the reasonable category. Consequently, the scale is reliable.

### Case Processing Summary

		N	%
Cases	Valid	326	100,0
	Excluded <sup>a</sup>	0	,0
	Total	326	100,0

a. Listwise deletion based on all variables in the procedure.

### Reliability Statistics

Cronbach's Alpha	N of Items
,615	7

Table 4 Test of reliability for the scale of barriers  
Source: SPSS

## KEY TAKEAWAYS

Just looking at the responses from the survey, it is possible to summarize some key takeaways from it in order to support the answer of the research questions.

So, looking at the percentage of car owners in the survey, it becomes apparent that with a share of 55,5% owning a vehicle and 26,4% of participants who drive on a regular basis, there are enough participants (81,9%) who have a connection to cars in order to provide a valid answer on the research questions as those questions require at least a connection to cars or even owning them.

Furthermore, the question about sustainability (“How important is sustainability to your personal life?”) shows that a high percentage of the participants see sustainability as important in their life. About 70% indicated that it is somehow important to them and about 28% stated that it is highly important to them. For the evaluation of the research questions it is important to have enough participants who have a connection to an ecological lifestyle as one of the objective is to analyse if environmental concerned consumers would show a higher willingness to purchase electric driven vehicles. Also, this is given which enables to have a valid analysis of this question in the next step.

Moreover, the questionnaire included several questions where it would become clear which knowledge participants actually had about electric cars. When the participants were asked to mention the name of any alternative drive vehicle, it was visible that some were able to specifically name vehicle types on the market and a lot of them would be referring to Tesla but also another majority were not able to name any which shows a lack of knowledge regarding the diversity of the vehicle types for electric driven cars. The statement “Plug-in electric cars are often cheaper to operate than gasoline vehicles” has been phrased in order to estimate the comprehension about the benefits of those vehicles. Looking at the responses, it becomes evident that 62% persons agreed on the statement which is the correct answer and indicates the right knowledge about it. Still there was a high number of people who either were not sure about the correct answer or even disagreed on that (38%). Another statement (Plug-in-electric vehicles can be charged from a regular home outlet) which has been phrased with the same objective of figuring out the understanding of the participants regarding electric vehicles shows that the majority of 79% decided for the right option by agreeing with this statement, only 21% either decided for the wrong option or were not sure about the correct answer. Also, here knowledge has been proved.

The question about the limitations (“What challenges does the automotive industry face with the electrification of vehicles?”) of electric vehicles shall provide information about consumer perception and their beliefs. So, the biggest barriers were limited knowledge, charging infrastructure, charging time and range anxiety. Taking those concerns in consideration, it is needed to provide potential customers with more information about those vehicles in order to enable them taking proper decision and probably in favour of them. Nevertheless, certain features about those vehicles need to be improved to making it more attractive to people.

Moreover, there was a statement which was referring to consumers perception about electric driven vehicles. The statement is “My biggest concern regarding alternative fuel vehicles”. The response of this question will help to understand which features need to be improved in order to be more attractive on the market. The results reveal that again range, cost, charging points and lack of knowledge are representing the biggest concern to the participants. Only when the concerns vanish, those vehicles can be accepted by consumers.

Also, the question about the tendency of buying an electric vehicle will be an indicator to show how many will actually consider buying those cars despite the limitations. Looking at the result, it becomes clear that only a small share (9.2%) of participants indeed own a car like this already. Furthermore, only about 24% indicate interest to own such a car. The other remaining part either is not sure about it or does not consider that at all. Since there is a lower percentage of showing interest in that, the mentioned barriers definitely affect the decision regarding that.

In the questionnaire there was also one question dedicated to the purchasing behaviour of the participants (“How important are the following aspects to you when buying a car?”). Features like environmental aspects, cost efficiency, comfort and safety were either categorized as somehow important or important. Those responses will support to answer the research question “Which features are important to consumers when buying a car?”

To see, which role social surroundings play in the decision-making process the following question have been asked “If there would be a growing number of people in your network f.e. friends/family/colleagues who would drive electrical vehicles, would you consider also buying an electrical car?” About 40% would consider buying an electric car in case their social surroundings would start the adaptation of those vehicles, whereas about 60% either would not consider it or are not sure how they would react to that.

The responses show that social surroundings can have an influential impact on the decision-making process of someone.

With the next question the aim was to understand how far consumers would go for sustainability. So, the question was “If environmentally friendly features would increase the price of a vehicle would you be willing to pay more for it?”. The majority of 75% stated no, whereas 25% would go the extra mile for having a sustainable car. This question shows that there is discrepancy between cost and sustainability where people have to make a choice what they value more.

So, in order to support the answer of the last research question (“What does an electric vehicle need to have to make someone purchase it?”) there was a specific question in the survey which was only dedicated to analyse that which is “What does an alternative fuel vehicle need to have to make someone buy it?”. In that case participants had the option to either choose from already phrased answers or write their answer. The outcome of this was that the majority of 65% indicated that those vehicles would need to have all the performance qualities of traditional cars, whereas 28% indicated a lower price. The remaining part gave individual answers which also could be categorized in different groups. Some of them were referring to better charging infrastructure and range, then others would refer to the price again. Those results show that for consumers believes electric cars and traditional ones are not on the same level considering benefits to them and this would be something they would require it to be in order to make a switch to those vehicles. But obviously some people are still interested in a switch although those cars come with limitations as they rather focus on a reasonable price. In that case manufacturers have to evaluate to themselves on what they can do improvements and what is worth it to improve to them.

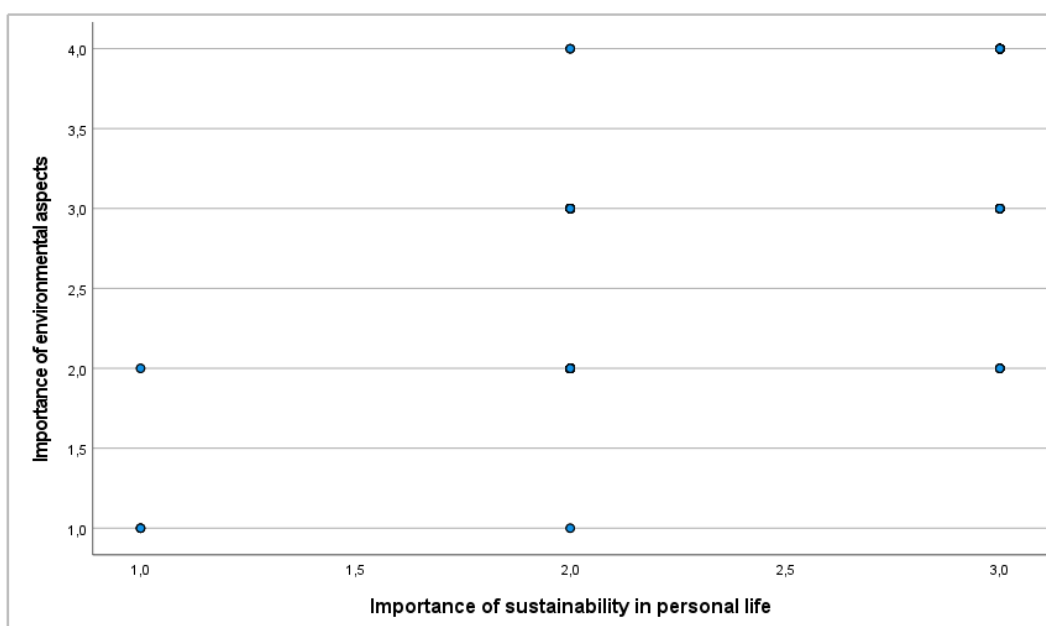
So, just looking at the questionnaire results themselves, answers to some of the research questions were provided. Also, reference points were given for key player in this industry to understand what barriers are given and still need improvement.



## HYPOTHESES TESTING

This part of the dissertation is dedicated to test the stated hypotheses.

To check out the validity of the hypothesis H1. “Sustainable importance in nowadays life has a positive influence on consumers interest regarding more eco-friendly implementations in cars” - a dependency analysis has been conducted by considering Spearman’s correlation. First, it is needed to test if all the requirements for this test have been fulfilled. The requirement of having at least two ordinal variables is given, as sustainable importance in personal life and environmental aspect as a feature of importance during a purchasing decision of a car has been measured by a likert scale of considering the importance of those aspects which can be ranked by a scale of being more to less important. Furthermore, a monotonic relationship exists between those two variables. This is demonstrated by a scatter plot which shows a positive relationship between the importance of sustainability in personal life and the importance of environmental aspects. The graph shows that participants who indicated to value highly sustainability in their personal life tend to put emphasis on environmental aspects as a feature in their purchasing decision for a car. On the contrary, participants who indicated a lower level of sustainable importance in their personal life were less interested in environmental features in their decision-making process for a car. As a consequence of this a monotonic relationship between those variables is given as they either increase or decrease as variables together. All the requirements were met, therefore a Spearman’s correlation could have been conducted.



Graph 3 Scatter plot of relationship between sustainability and environment  
 Source: SPSS

The next step involves the Spearman’s correlation. In that case importance of sustainability in personal life has been correlated to importance of environmental aspects. The table shows that the correlation coefficient is stated to be .652 which means there is a strong positive correlation between those two variables. The sig. (2-tailed) also known as the p-value is .001. It indicates that the correlation is statistically significant as the p-value of .001 is smaller than alpha which has a value of .01, therefore it can be concluded that the alternative hypothesis of H1 can be accepted. According to this, sustainable importance in nowadays life significantly influences consumers’ interest towards more eco-friendly implementations in cars. This result is in line with the findings of Derbel (2020) and Proff (2016) who stated a relationship between environmental concern and knowledge and the demand towards more eco-friendly implementations for cars.

**Correlations**

			Importance of environmental aspects	Importance of sustainability in personal life
Spearman's rho	Importance of environmental aspects	Correlation Coefficient	1,000	,652**
		Sig. (2-tailed)	.	<,001
		N	326	326
	Importance of sustainability in personal life	Correlation Coefficient	,652**	1,000
		Sig. (2-tailed)	<,001	.
		N	326	326

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Table 5 Spearman’s correlation for H1  
 Source: SPSS

In order to test the hypothesis H2. “Limited choice of charging stations has a negative impact on consumers perception regarding electric vehicles” a chi-squared test has been carried out. Therefore, the assumptions needed to be verified. The first assumption which requires the variables to be a nominal scale is given. The variable “limited choice of charging station” was evaluated by either indicate to be “applicable”, “none applicable” and “unknown”. The other variable was similarly constructed where the choice was given between “applicable” and “none applicable”. The next assumption of having at least an expected of five in every cell will be verified by having a look at the table below. It is apparent that two cells have an expected count less than five. Those values are 3.0 and 4.7. In conclusion, the assumptions were not fulfilled.

### Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
What challenges does the automotive industry face with the electrification of vehicles? [Charging infrastructure] * My biggest concern regarding alternative fuel vehicles are: [Charging points]	326	100,0%	0	0,0%	326	100,0%

### What challenges does the automotive industry face with the electrification of vehicles? [Charging infrastructure] \* My biggest concern regarding alternative fuel vehicles are: [Charging points] Crosstabulation

			My biggest concern regarding alternative fuel vehicles are: [Charging points]		Total
			Applicable	None applicable	
What challenges does the automotive industry face with the electrification of vehicles? [Charging infrastructure]	Applicable	Count	244	38	282
		Expected Count	232,7	49,3	282,0
	None applicable	Count	16	11	27
		Expected Count	22,3	4,7	27,0
	Unknown	Count	9	8	17
		Expected Count	14,0	3,0	17,0
Total	Count	269	57	326	
	Expected Count	269,0	57,0	326,0	

Table 6 Chi-squared test for H2  
Source: SPSS

As the assumptions have not been met, for the hypothesis test the Likelihood Ratio needs to be considered. It has a p-value of .001 which means that it is smaller than alpha (value of .01). Consequently, the test is statistically significant. So, the H0. hypothesis will be rejected and the H2. hypothesis accepted. Accepting the hypothesis indicates that there is a significant relationship between limited choice of charging stations and consumer perception regarding electric vehicles. Since there is an existing dependency between those variables now the strength of this relationship needs to be specified. Therefore, the table “Symmetric Measures” will give information about that. Looking at the phi-value of .269 it is evident that limited choice of charging station has a moderate effect on consumer perception.

<b>Chi-Square Tests</b>			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	23,570 <sup>a</sup>	2	<,001
Likelihood Ratio	19,227	2	<,001
N of Valid Cases	326		

a. 2 cells (33,3%) have expected count less than 5. The minimum expected count is 2,97.

<b>Symmetric Measures</b>			
		Value	Approximate Significance
Nominal by Nominal	Phi	,269	<,001
	Cramer's V	,269	<,001
N of Valid Cases		326	

Table 7 Chi-squared test for H2  
Source: SPSS

A chi-squared test has been conducted in order to test the hypothesis H3. “Longer charging time of EVs has a negative impact on consumers perception”. In the first place the requirements for this test had to be tested and fulfilled. The first condition which requires a nominal scale for both variables is given. The variable “longer charging time” is measured by either stating “applicable”, “non applicable” and “unknown”. The other variable which refers to the consumer perception regarding charging time is analysed by stating either “applicable” and “non applicable”. As this is approved, now it has to be investigated if all the expected cells have at least a count of five. Considering the table below it becomes evident that one cell has an expected count less than five which is 4.22. According to this the requirements have not been fulfilled.

Case Processing Summary						
	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
What challenges does the automotive industry face with the electrification of vehicles? [Charging time] * My biggest concern regarding alternative fuel vehicles are: [Time to charge]	326	100,0%	0	0,0%	326	100,0%

**What challenges does the automotive industry face with the electrification of vehicles? [Charging time] \* My biggest concern regarding alternative fuel vehicles are: [Time to charge] Crosstabulation**

				My biggest concern regarding alternative fuel vehicles are: [Time to charge]		Total
				Applicable	None applicable	
What challenges does the automotive industry face with the electrification of vehicles? [Charging time]	Applicable	Count	215	53	268	
		Expected Count	197,3	70,7	268,0	
	None applicable	Count	18	24	42	
		Expected Count	30,9	11,1	42,0	
	Unknown	Count	7	9	16	
		Expected Count	11,8	4,2	16,0	
Total	Count	240	86	326		
	Expected Count	240,0	86,0	326,0		

Table 8 Chi-squared test for H3  
Source: SPSS

To proceed with the test the likelihood ratio has to be taken into consideration. The p-value is .001 which is a smaller value than alpha (.01). So, the test is statistically significant and the alternative hypothesis H3 will be accepted. Accepting the alternative hypothesis means that there is a significant relationship between longer charging time and negative impact on consumer perception. Considering the table “Symmetric Measures” below will give an indication about the strength of this relationship. Looking at the phi-value of .332 it is apparent that longer charging time has a strong effect on consumer perception.

### Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	33,834 <sup>a</sup>	2	<,001
Likelihood Ratio	30,365	2	<,001
N of Valid Cases	326		

a. 1 cells (16,7%) have expected count less than 5. The minimum expected count is 4,22.

### Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,322	<,001
	Cramer's V	,322	<,001
N of Valid Cases		326	

Table 9 Chi-squared test for H3

Source: SPSS

In the next step the hypothesis H4. “Initial cost of EVs has a negative influence on customers purchasing decision” was tested to show its validity. Therefore, the chi-squared test has been conducted. First, the assumptions needed to be verified. In that case the variables cost and consumers adaption towards more environmentally friendly adaption for cars both represent nominal scales. For the variable cost the scale of normality is given as participants had to respond to the statement: my biggest concern regarding alternative fuel vehicles are by indicating the options to be either applicable or non applicable as those options are ruling out against each other the requirement for nominal scale is given. The other variable needs to be responded by an either yes or no which also fulfils the requirement. By looking at the table below the next assumption of having at least an expected count of five in every cell is confirmed. The table shows the minimum expected count is 8.4 and maximum 243. The next assumption requires for a 2x2 that all the expected counts need to have at least a value of ten, since the minimum expected count is 8.4 this assumption has been violated. Consequently, the requirements for this test have not been fulfilled.

#### Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
My biggest concern regarding alternative fuel vehicles are: [Cost] * If environmentally friendly features would increase the price of a vehicle would you be willing to pay more for it?	326	100,0%	0	0,0%	326	100,0%

#### My biggest concern regarding alternative fuel vehicles are: [Cost] \* If environmentally friendly features would increase the price of a vehicle would you be willing to pay more for it? Crosstabulation

			If environmentally friendly features would increase the price of a vehicle would you be willing to pay more for it?		Total
			No	Yes	
My biggest concern regarding alternative fuel vehicles are: [Cost]	Applicable	Count	237	56	293
		Expected Count	218,4	74,6	293,0
	None applicable	Count	6	27	33
		Expected Count	24,6	8,4	33,0
Total	Count	243	83	326	
	Expected Count	243,0	83,0	326,0	

Table 10 Chi-squared test for H4

Source: SPSS

Looking at the table with the header “Chi-Square Test” will enable to proceed with the test. For that Fisher’s Exact Test needs to be considered. It has a p-value of .001 which is smaller than the alpha value of .01 as a consequence the result is statistically significant. This means that the alternative hypothesis of H4 will be accepted and there is a significant relationship between cost and the willingness to pay a higher price for environmentally-friendly implementations in cars. As the association is significant it is needed to indicate the strength of it, therefore the table “Symmetric Measures” will give information about that. The phi-value of .434 indicates that concern about cost has a large significant effect on the willingness to pay a higher price for more environmental features in cars.

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	61,451 <sup>a</sup>	1	<,001		
Continuity Correction <sup>b</sup>	58,191	1	<,001		
Likelihood Ratio	52,727	1	<,001		
Fisher's Exact Test				<,001	<,001
N of Valid Cases	326				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 8,40.

b. Computed only for a 2x2 table

		Value	Approximate Significance
Nominal by Nominal	Phi	,434	<,001
	Cramer's V	,434	<,001
N of Valid Cases		326	

Table 11 Chi-squared test for H4

Source: SPSS



To test H5. “Range anxiety has a negative influence on consumers’ perception towards those vehicles” a chi-squared test has been conducted. The first step involves the verification of the assumptions. A nominal scale is given for both variables. This becomes evident since range anxiety has been measured by an indication of “applicable”, “non-applicable” and “unknown” and the consumer perception has been also measured by stating either “applicable” and “non applicable”. The next assumption requires to have at least an expected count of five in each cell. Looking at the table below it becomes apparent that the minimum count is 7.7 and the maximum 265. Also, this assumption has been approved. However, a 2x2 table requires to have in every expected cell a value of at least then, since the minimum value of 7.7 is lower than that the assumptions have been violated.

### Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
→ What challenges does the automotive industry face with the electrification of vehicles? [Range anxiety] * My biggest concern regarding alternative fuel vehicles are: [Range/driving distance]	326	100,0%	0	0,0%	326	100,0%

### What challenges does the automotive industry face with the electrification of vehicles? [Range anxiety] \* My biggest concern regarding alternative fuel vehicles are: [Range/driving distance] Crosstabulation

			My biggest concern regarding alternative fuel vehicles are: [Range/driving distance]		Total
			Applicable	None applicable	
What challenges does the automotive industry face with the electrification of vehicles? [Range anxiety]	Applicable	Count	172	29	201
		Expected Count	163,4	37,6	201,0
	None applicable	Count	59	25	84
		Expected Count	68,3	15,7	84,0
	Unknown	Count	34	7	41
		Expected Count	33,3	7,7	41,0
Total	Count	265	61	326	
	Expected Count	265,0	61,0	326,0	

Table 12 Chi-squared test for H5  
Source: SPSS

Consequently, the likelihood ratio has to be taken into consideration in order to proceed with the test. The p-value of .013 is bigger than alpha with a value of 0.1, therefore the alternative hypothesis H5 needs to be rejected and H0. will be accepted. H0. states that there is no association between range anxiety and consumer perception which means that range anxiety is completed independent from consumer perception.

**Chi-Square Tests**

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9,241 <sup>a</sup>	2	,010
Likelihood Ratio	8,625	2	,013
N of Valid Cases	326		

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 7,67.

**Symmetric Measures**

		Value	Approximate Significance
Nominal by Nominal	Phi	,168	,010
	Cramer's V	,168	,010
N of Valid Cases		326	

Table 13 Chi-squared test for H5  
Source: SPSS

A chi-squared test has been carried out in order to test the hypothesis H6. “Limited knowledge about EVs has a negative impact in the decision-making process”. To conduct this test the assumptions for it needed to be checked. Both variables are measured by a nominal scale. The variable limited knowledge (regarding challenges in the electric car industry) was evaluated by two criteria which are “applicable, “non applicable” and “unknown”. Also, the variable decision-making process which comes from the concern lack of knowledge regarding alternative drive systems has been measured as well by the same criteria which are “applicable” and “non-applicable”. Those criteria represent a nominal scale. Therefore, this assumption is valid. In order to proof the next assumption, it is necessary to have a look at the table below. As already mentioned before the expected count of each cell has to be at least five. It is evident that for one cell this count is less than five, more precisely it has a value of 2.1. Considering this result, the assumptions were not met.

Case Processing Summary						
	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
What challenges does the automotive industry face with the electrification of vehicles? [Limited knowledge from consumer's perspective] * My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge]	326	100,0%	0	0,0%	326	100,0%

**What challenges does the automotive industry face with the electrification of vehicles? [Limited knowledge from consumer's perspective] \* My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge] Crosstabulation**

				My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge]		Total
				Applicable	None applicable	
What challenges does the automotive industry face with the electrification of vehicles? [Limited knowledge from consumer's perspective]	Applicable	Count	237	58	295	
		Expected Count	225,3	69,7	295,0	
	None applicable	Count	9	13	22	
		Expected Count	16,8	5,2	22,0	
	Unknown	Count	3	6	9	
		Expected Count	6,9	2,1	9,0	
Total	Count	249	77	326		
	Expected Count	249,0	77,0	326,0		

Table 14 Chi-squared test for H6  
Source: SPSS

Consequently, the Likelihood Ratio (table below) needs to be taken into consideration in order to proceed with the analysis. It has a p-value of .001 which is smaller than alpha with a value of .01. This means that the test is statistically significant. Therefore, the alternative hypothesis H6 will be accepted. It is evident that there is a significant relationship between limited knowledge and the decision-making process. To indicate the strength of the relationship a look in the next table “Symmetric Measures” will give information about that. As the phi-value is .289 it can be stated that the limited knowledge has a moderate effect on the decision-making process.

### Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	27,150 <sup>a</sup>	2	<,001
Likelihood Ratio	22,752	2	<,001
N of Valid Cases	326		

a. 1 cells (16,7%) have expected count less than 5. The minimum expected count is 2,13.

### Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,289	<,001
	Cramer's V	,289	<,001
N of Valid Cases		326	

Table 15 Chi-squared test for H6  
Source: SPSS

Finally, for the hypothesis H7. “Cheaper operation of electric driven vehicles has a positive impact on consumers’ perception about those vehicles” a chi-squared test has been conducted. In the first step the assumptions needed to be tested. Both variables have to be measured by a nominal scale. This was given as the cheaper operation was evaluated by either indicating “Agree”, “Disagree” or “I am not sure”. Also, the variable consumers’ perception fulfils this assumption as it was measured by specifying “Applicable” or “None applicable”. For the next assumption the table “Chi-Square Tests” has to be taken into consideration. In that case it is needed to have at least an expected count of five in each cell. This is given as the minimum expected count has a value of 8 and the maximum expected cell a value of 249. The last assumption requires for 3x2 table to have at least in every expected cell a value of 10 since the minimum expected count has a value of 8, this assumption has not been fulfilled.

<b>Case Processing Summary</b>						
	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
Plug-in electric vehicles are often cheaper to operate than gasoline vehicles. * My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge]	326	100,0%	0	0,0%	326	100,0%

**Plug-in electric vehicles are often cheaper to operate than gasoline vehicles. \* My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge]**  
**Crosstabulation**

				My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge]		Total
				Applicable	None applicable	
Plug-in electric vehicles are often cheaper to operate than gasoline vehicles.	Agree	Count	156	46	202	
		Expected Count	154,3	47,7	202,0	
	Disagree	Count	27	8	35	
		Expected Count	26,7	8,3	35,0	
	I am not sure	Count	66	23	89	
		Expected Count	68,0	21,0	89,0	
Total	Count	249	77	326		
	Expected Count	249,0	77,0	326,0		

Table 16 Chi-squared test for H7  
Source: SPSS

Consequently, the test has to be proceeded by considering the Likelihood ratio (table below). It indicates a p-value of 0.847 which is bigger than alpha with a value of .01. Therefore, the hypothesis H7. will be rejected and H0. accepted. So, there is no association between cheaper operation and consumers' perception. Both variables are completely independent from each other.

<b>Chi-Square Tests</b>			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,335 <sup>a</sup>	2	,846
Likelihood Ratio	,331	2	,847
N of Valid Cases	326		

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 8,27.

<b>Symmetric Measures</b>			
		Value	Approximate Significance
Nominal by Nominal	Phi	,032	,846
	Cramer's V	,032	,846
N of Valid Cases		326	

*Table 17 Chi-squared test for H7*  
*Source: SPSS*

## V. THEORETICAL AND MANAGERIAL CONTRIBUTIONS

This study investigated consumers perception regarding electric vehicles. Another objective was to find out which features would be of importance to consumers and what is needed in order to decide for those vehicles. To get a better understanding of this, first insight about the most known types of electric drives was given, but also showing the importance of transformation towards more green drives due to environmental damages. Furthermore, their benefits for consumers' themselves but also the environment were presented. In contrast to that, limitations about those vehicles were analysed and consumers perception regarding those vehicles analysed. This analysis will help to understand where consumers stand regarding those cars but also showing the importance of expansion of those vehicles due to ecological impacts. Finally, this study showed the obstacles of the expansion of electric drives on road and consequently the barriers to purchase them.

Furthermore, this study focused on consumers perception regarding the limitations of those vehicles, the influence of sustainable importance in personal life and impact of social surroundings in the decision-making process. In that case, the objective was to figure out which features, benefits but also limitations would either impact the decision process positively or negatively. Additionally, to show which of those features would have the highest importance to the customers.

Considering the fact that only about 24% would consider buying/leasing an electric drive shows that those vehicles have certain limitations which give reasons not to purchase them. This is align with the low percentage (9.2%) of participants who own an electric driven vehicle. It is evident that those vehicles do not fulfil all consumers requirements in order to decide for it. As a consequence, it is necessary to resolve the limitations of those vehicles by bringing those cars to the same standard as conventional ones. The need for it is apparent as about 65% of the participants responded to the question "What does an alternative fuel vehicle need to have to make you but it" with the following statement "All the performance qualities of a traditional car".

Furthermore, this study contributed to give a deeper insight on the fact that especially sustainable concerned participants had an interest in obtaining electric driven vehicles as they have several benefits to the environment. Considering this information, it is necessary to focus in the first place on consumers' who already have interest to those vehicles in order to build an established market for them.

Also, it is evident from this study that some participants had a limited knowledge about the features of those vehicles which could have lead to a wrong decision-making. Statements like “Plug-in electric vehicles are often cheaper to operate than gasoline vehicles” show that almost 40% either disagreed on this statement, although it was correct or were not sure about the correct answer. Moreover, participants stated range anxiety to be one of their bigger concerns. This is in contrast with the fact that about 63% travel less than once a day by car. Also, considering the findings from the literature review where it was stated that for the daily commute most of the drivers would only need a range of 50-60km, therefore range anxiety should have a lower value to them (Vieweg, 2010). Another contribution of this study is that consumers’ perception might be wrong about certain features of those cars as consumers are less self-reflected about their actual amount of daily/frequent commute. Therefore, it is needed once it comes to the purchase of vehicles to provide full information about its features and how it relates to the actual car usage.

## CONCLUSION

As environmental protection plays a major role in nowadays life, there is evidence from this study which shows that the majority in this investigation indicate a high importance to sustainability. Furthermore, the study showed that people who attach importance to a sustainable life, those would also look for more environmentally-friendly cars. This result goes in line with the findings from the literature review which shows a growing knowledge and concern about damages to the environment and consequently demand towards more eco-friendly implementations in the automotive industry (Derbel, *et al.*, 2020). So, the result from the hypothesis H1. “Sustainable importance in nowadays life has a positive influence on consumers interest regarding more eco-friendly implementations in cars” provides an answer to the research question “Do environmental concerned consumers show a higher willingness to purchase electric driven vehicles?” The gained results need to be considered in the automotive industry in order to satisfy customer demand and guarantee lower environmental damages from the car industry. However, it needs to be considered that sustainable importance in someone’s private life not always correlates with the need of buying an electric vehicle car. This is given to the fact that a car purchase represents a complex procedure where not only one feature would be considered, instead several ones.



The complexity in the decision making has been also discussed in the literature which states that the process involves research and additionally the perception of the consumer (National Research Council, 2015). So, in some cases sustainable concern leads to interest in electric vehicles but in other cases this is not given.

Moreover, this study analysed consumers perception about certain features of electric driven vehicles. One of those features was referring to the poor selection of charging stations. It becomes evident that this limitation indeed had a negative impact on consumers perception. Also, this was aligned with the discovery from the literature review which stated that the limited choice of charging station would represent one of consumers concerns (Patel, *et al.*, 2021).

Another feature which has been analysed regarding consumer perception was the longer charging time of those vehicles. In fact, the longer charging time compared to conventional cars has been categorised as a negative feature. This finding has been approved as well in the literature review which indicates that charging time appears to be another concern for consumers (Patel, *et al.*, 2021).

As pricing has been categorised as an influential factor in literature review, consumers perception about the initial cost of electric vehicles were analysed. The results showed that longer charging time has a strong effect on consumer perception. Also, in the literature the higher price involvement has been discussed as having a negative influence on consumers attitude (Tanwir and Hamza, 2020). Even drivers who have interest in those vehicles show concern about the initial costs (Fuhs, 2009).

To understand the impact of range anxiety on the decision-making process, a deeper look has been taken on that. The research outcome indicated that there is no association between range anxiety and consumer perception which means that range anxiety is completely independent from it. This result is different from the findings in the literature which state that there are concerns from consumer about range given (Scrosati, *et al.*, 2015). In addition, limited knowledge about range would represent another negative factor for consumers (National Research Council, 2015). In that case, results differ from the research and literature.

Since knowledge plays a key player in the decision making of more complex products, this feature has been analysed as well. The results from the research show that there is a significant relationship between limited knowledge and the decision-making process. The existing relationship has been approved from the literature as well.

This knowledge not just refers to the product features itself but also to beliefs that those vehicles could represent a too complex product to handle (National Research Council, 2015).

Summarising, the following hypotheses H2. “Limited choice of charging stations has a negative impact on consumers perception regarding electric vehicles”, H3. “Longer charging time of EVs has a negative impact on consumers perception”, H4. “Initial cost of EVs has a negative influence on customers purchasing decision”, H5. “Range anxiety has a negative influence on consumers perception towards those vehicles” and H6. “Limited knowledge about EVs has a negative impact in the decision-making process” helped to answer the following research question “What are the limitations for consumers in order to purchase cars with an electric drive?” which as a consequence at the same time provides answer to the next research question “Which features are important when buying a car?” as the limitations need to be vanished to make those cars attractive to consumers.

So, considering the mentioned and analysed limitations of those vehicles, more barriers have been even found in the literature review. Apart from product features the purchasing decision can be also influenced by social surroundings, so in order to make the right decision consumers would either seek advice from the car dealer or family/friends. So, if those family or friends would have a negative attitude regarding those vehicles, this could negatively affect the decision making (Unger, 1998). Also, the limited knowledge from consumer side has been discussed as being a negative influence. Some even are not aware of governmental incentives which they can gain from those vehicles (Jin and Slowik, 2017). In the contrary there are consumers who are well informed but still do not consider those vehicles for their usage as they do not fulfil their requirements for a car (National Research Council, 2015).

Considering the given scarcity of oil and the damage caused on the environment electric driven vehicles need to become a key player in the automotive industry and consequently on road (Tu and Yang, 2019). So, to tackle the perceived limitations from consumers side, manufacturers and automotive companies have to rethink their pricing strategy in order to be able to compete with other innovations on road. Another solution would be to provide an explanation for the higher price segment of those vehicles and to show the value they can receive from those vehicles. Those vehicles could be positioned to be a more extraordinary investment. Furthermore, the advertisement for those vehicles could have a focus on environmental concern and the given contribution from those vehicles.

To provide the answer to the last research question which is “What does an electric vehicle need to have to make someone purchase it?”, there are several possibilities to reposition the attractiveness of those cars which will be analysed in the next step. So, in order to support the adaptation of those vehicles, it is needed to advertise the benefits of those cars. This means that several parties need to be involved to make this happens. For example, this could be done from the manufacturers, government, suppliers etc. So, advertising regarding performance aspects can be done by manufacturers and governments. Therefore, they could use channels like television, newspaper, or the Internet. This approach will help understand potential consumers’ to understand the values of those vehicles. But also involving people in the advertisement process with a high influence like celebrities will show the importance of the adaptation regarding those vehicles. Also, considering the younger age, the promotion towards those vehicles can start during school years by educating them environmental knowledge (Tanwir and Hamza, 2020). A study made aware that participants showed more interest in the adaptation of those vehicles once they had a test drive with them. Also, another study showed that participants were more willing to pay an extra price for those vehicles after seeing a campaign about low carbon vehicle in the UK (Jin and Slowik, 2017). So, considering this information it is needed to provide possible customers an experience as already mentioned for example by a test drive. The experience they will gain from this will support them to make a valid decision in favour or against those vehicles as they will gain a connection to this car. Therefore, the market growth for those vehicles depend on consumers perception and knowledge about it, consequently it is necessary to take those measures (Jin and Slowik, 2017).

Focusing on the barrier charging limitation, the government has to interact by providing an attractive charging infrastructure to the user of those vehicles (Tu and Yang, 2019). It is needed to increase the number of charging stations and in the same time making it visible to drivers of electric vehicles. Also, it is important to provide more flexibility to the drivers by giving the possibility of swapping the battery at those stations. Consequently, this would eliminate the barrier charging time as the swap of battery would guarantee a full charge (Hinnüber, *et al.*, 2019).

In conclusion, there are actions which can and have to be taken by the involving parties in order to raise the popularity of those vehicles. Especially, considering the fact that the research opened up about the limited awareness of the features and incentives of those vehicles, show that consumers need to be educated about that.

Also, nowadays more and more people start to become environmental concerned and as those vehicles reduce greenhouse gases, it could have a wide audience to attract. It only needs to be promoted with more advertisement and sensitivity on this topic. So, nowadays gasoline powered vehicles still are more in demand on road transport, but in the long-run electric vehicles might be the more popular choice to consumers. This transformation then will be influenced by factors like governmental incentives, better battery technology etc. (MacInnis and Krosnick, 2020).

## LIMITATIONS OF RESEARCH

Every study has its limitations, so as this. First, the survey was only published on the Internet, therefore only participants with an access to the Internet were able to participate on that. Consequently, the majority of the participants were belonging to a younger age group as they have a high affinity to digital media compared to the elderly group. Secondly, when it comes to figuring out participants knowledge about electric driven vehicles, statements and questions were phrased in a way that participants did not have to think on their own for example about challenges and concerns. This can lead to false knowledge as they did not come up with the challenges or concerns on their own. Moreover, a high percentage of the participants (37,4%) were belonging to the age bracket of 18-25. It is doubtful that younger consumers would buy as their first car an electric driven vehicle. Therefore, there were only a small number of participants (9.2%) who were actually owning those vehicles. This can lead to a one-side view of the survey by only considering participants who have no linkage to it.

## FURTHER RESEARCH

In the further research there could be a deeper focus on what electric vehicles exactly would need to have to make them buy it or having a better consumer perception as my own research was more focusing on understanding what barriers consumers might see in those vehicles. This could help to create a more established market for those vehicles as they are still facing challenges to convince consumers.

Furthermore, future research could include a question about travelled range per day/week/month in order to understand if range anxiety indeed represent a major barrier to consumers. Also, there could be a differentiated part for the ones who would answer to the question “Would you consider buying/leasing an alternative drive vehicle” with the following statement “I have already one” as they might have a different opinion than the ones who did not yet bought one. For example, a question could be included where you could figure out what made them decide for purchasing it by giving different options to answer this. This can be followed by another question where you would find out what owners of electric vehicles think is missing to make it a more popular car in society.

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APPENDICES

## APPENDIX 1 – ONLINE SURVEY

2. What is your gender? \*

*Mark only one oval.*

- Male
- Female
- Prefer not to say
- Other: \_\_\_\_\_

3. What is your age? \*

*Mark only one oval.*

- 18-25
- 26-35
- 36-45
- 46-55
- 56-65
- 65+

4. In which country do you currently live? \*

\_\_\_\_\_

5. What is the highest level of education you have completed? \*

*Mark only one oval.*

- Lower than High School
- High School
- Apprenticeship
- Bachelor's degree
- Master's Degree
- Doctorate

6. Please specify your monthly net income. \*

*Mark only one oval.*

- Less than 1500 Euro p.m.
- Between 1500 Euro - 1999 Euro p.m.
- Between 2000 Euro - 3000 Euro p.m.
- More than 3000 Euro p.m.

7. Do you own a car? \*

*Mark only one oval.*

- Yes, I own a car
- No, but I drive on a regular basis
- Other: \_\_\_\_\_

8. Which type of car do you drive? \*

*Mark only one oval.*

- Fuel vehicle
- Electrical vehicle
- Hybrid vehicle
- Other: \_\_\_\_\_

9. How often do you travel by car? \*

*Mark only one oval.*

- At least once a day
- Less than once a day but at least 2 times in a week
- Once a week
- Less than once a week but more than twice a month
- Once or twice a month
- Less than once a month but more than twice a year
- Less than once a year or never

10. How often do you travel by public transport, that is, buses, trains, trams, the underground or metro? \*

*Mark only one oval.*

- At least once a day
- Less than once a day but at least 3 times a week
- Once or twice a week
- Less than twice a week but more than twice a month
- Once or twice a month
- Less than twice a month but more than twice a year
- Less than that or never

11. Plug-in electric vehicles are often cheaper to operate than gasoline vehicles. \*

*Mark only one oval.*

- Agree
- Disagree
- I am not sure

12. Plug-in electric vehicles can be charged from a regular home outlet. \*

Mark only one oval.

- Agree
- Disagree
- I am not sure

13. What challenges does the automotive industry face with the electrification of vehicles? \*

Mark only one oval per row.

	Applicable	None applicable	Unknown
Limited knowledge from consumer's perspective	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Charging infrastructure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Charging time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Range anxiety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cost to design and to build the vehicles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Global and regional regulations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Finding partners with experience in electrification	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

14. How important is sustainability to your personal life? \*

Mark only one oval.

- Highly important
- Somehow important
- Not at all important

15. Can you mention the name of any alternative drive vehicle? \*

\_\_\_\_\_

16. Would you consider buying/leasing an alternative drive vehicle? \*

*Mark only one oval.*

- I have already one
- I am highly interested to buy it at some stage
- I am not sure
- No, I am not

17. How important are the following aspects to you when buying a car? \*

*Mark only one oval per row.*

	Very important	Important	Somewhat important	Not important
Environmental aspects	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Latest technology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cost efficiency	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Comfort	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Brand image	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Safety	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Performance/speed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

18. If environmentally friendly features would increase the price of a vehicle would you be willing to pay more for it? \*

*Mark only one oval.*

Yes

No

19. If there would be a growing number of people in your network f.e. friends/family/colleagues who would drive electrical vehicles, would you consider also buying an electrical car? \*

*Mark only one oval.*

Yes, I would consider that

No, I would not consider that

I am not sure

20. My biggest concern regarding alternative fuel vehicles are: \*

*Mark only one oval per row.*

	Applicable	None applicable
Range/driving distance	<input type="radio"/>	<input type="radio"/>
Cost	<input type="radio"/>	<input type="radio"/>
Charging points	<input type="radio"/>	<input type="radio"/>
Time to charge	<input type="radio"/>	<input type="radio"/>
Brand offering	<input type="radio"/>	<input type="radio"/>
Limited choice	<input type="radio"/>	<input type="radio"/>
Lack of knowledge	<input type="radio"/>	<input type="radio"/>

21. What does an alternative fuel vehicle need to have to make you buy it? \*

*Mark only one oval.*

- Lower price
- All the performance qualities of a traditional car
- Other: \_\_\_\_\_

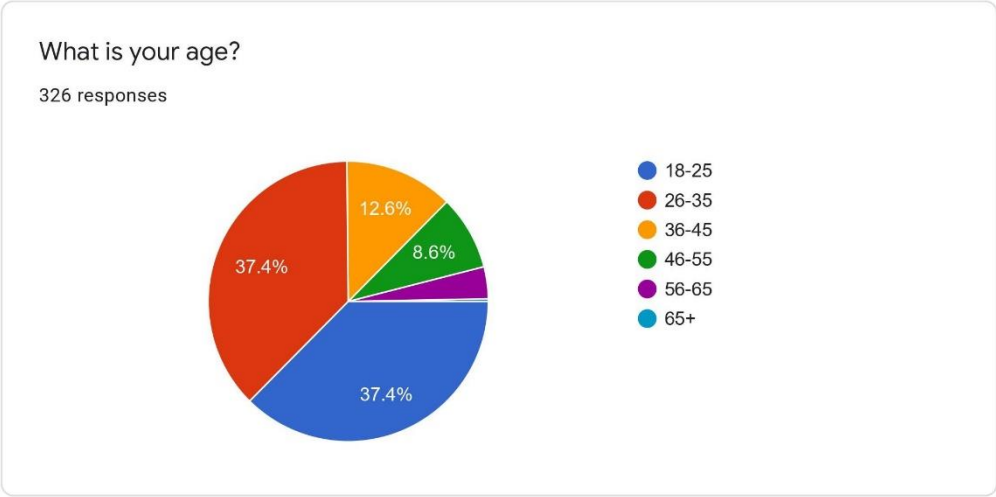
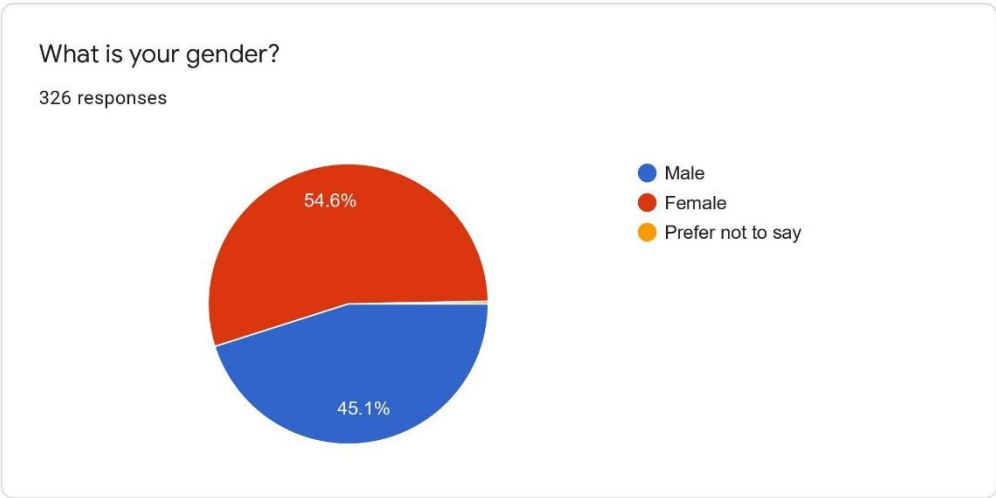
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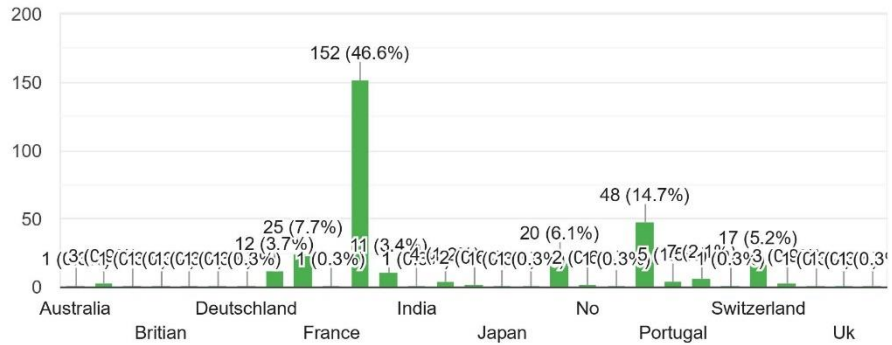


APPENDIX 2 – SURVEY RESULTS



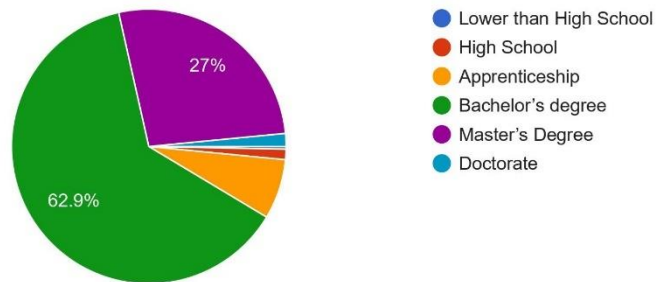
### In which country do you currently live?

326 responses



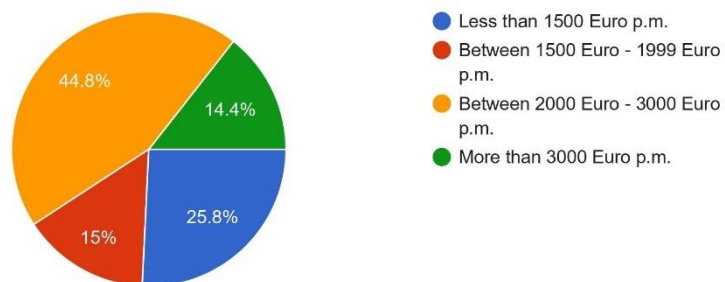
### What is the highest level of education you have completed?

326 responses



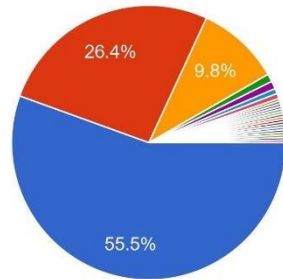
### Please specify your monthly net income.

326 responses



### Do you own a car?

326 responses

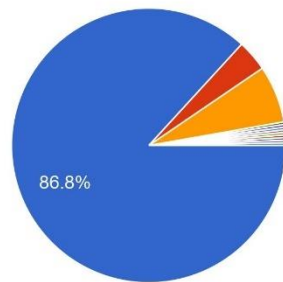


- Yes, I own a car
- No, but I drive on a regular ba...
- No
- No, I do not own a car
- No, I do not have a car
- No, I do not have one
- No, I do not
- Only bike

▲ 1/3 ▼

### Which type of car do you drive?

326 responses

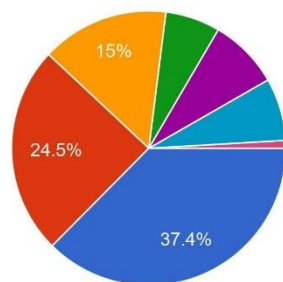


- Fuel vehicle
- Electrical vehicle
- Hybrid vehicle
- Only bike
- No car.
- NA
- I dont drive by car usually
- Fuel and Elektrical

▲ 1/2 ▼

### How often do you travel by car?

326 responses

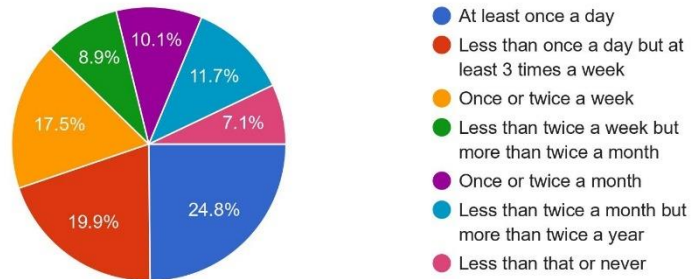


- At least once a day
- Less than once a day but at least 2 times in a week
- Once a week
- Less than once a week but more than twice a month
- Once or twice a month
- Less than once a month but more than twice a year
- Less than once a year or never



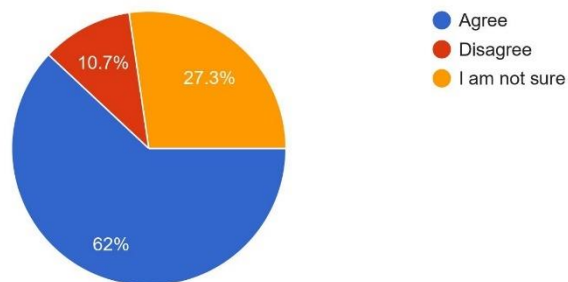
How often do you travel by public transport, that is, buses, trains, trams, the underground or metro?

326 responses



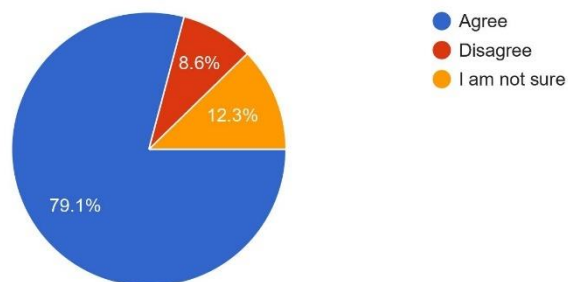
Plug-in electric vehicles are often cheaper to operate than gasoline vehicles.

326 responses

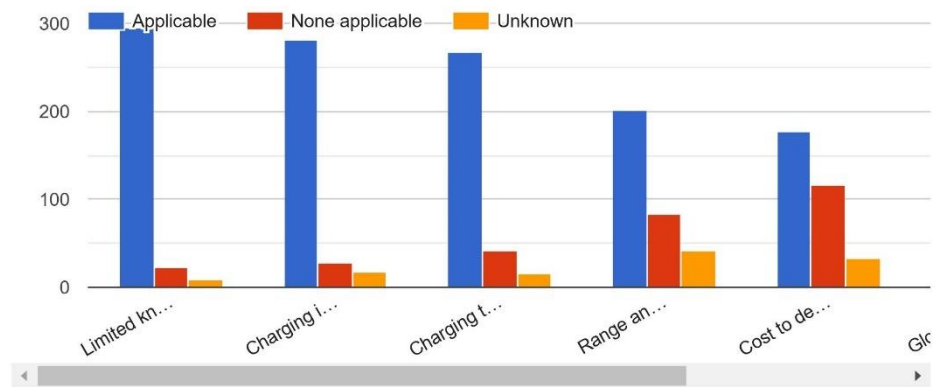


Plug-in electric vehicles can be charged from a regular home outlet.

326 responses

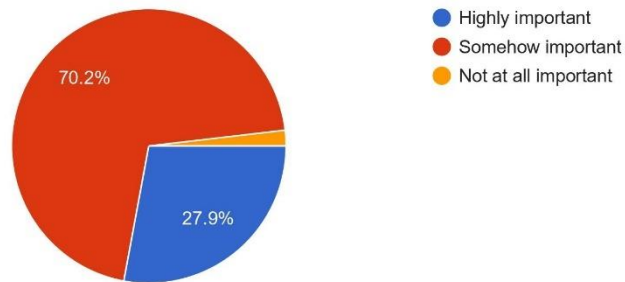


What challenges does the automotive industry face with the electrification of vehicles?



How important is sustainability to your personal life?

326 responses



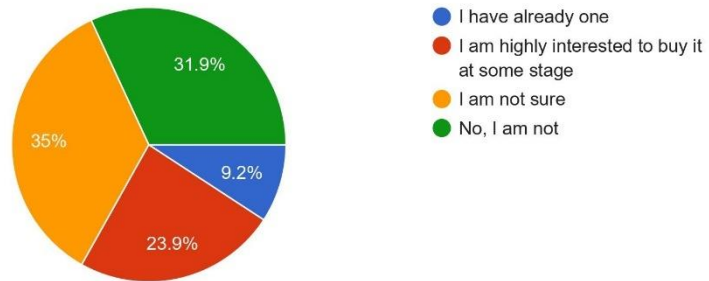
Can you mention the name of any alternative drive vehicle?

326 responses

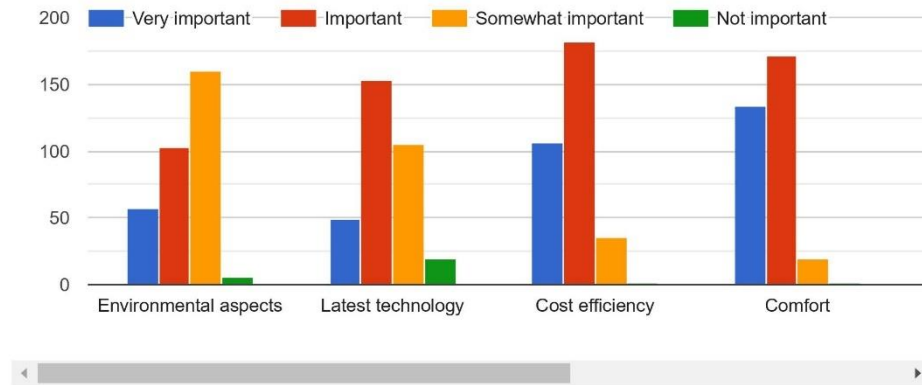
No  
Tesla  
Tesla Model Y  
Tesla  
Hyundai Ioniq  
BMW ix3  
Bike  
BMW i8  
Honda Jazz

Would you consider buying/leasing an alternative drive vehicle?

326 responses

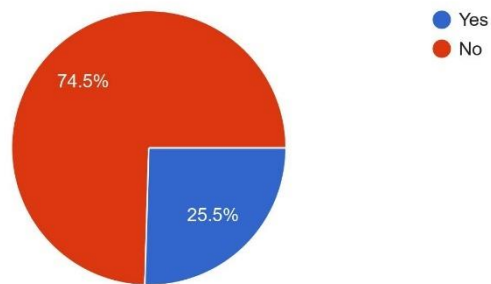


How important are the following aspects to you when buying a car?



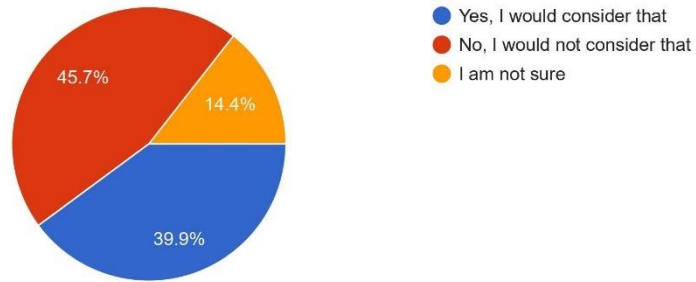
If environmentally friendly features would increase the price of a vehicle would you be willing to pay more for it?

326 responses

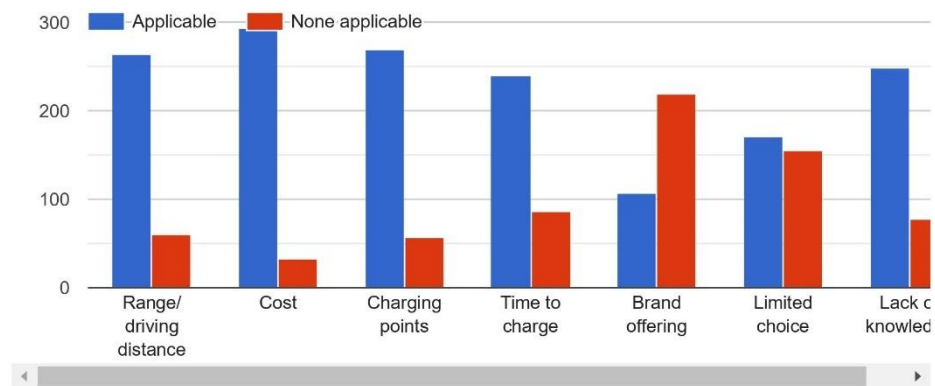


If there would be a growing number of people in your network f.e. friends/family/colleagues who would drive electrical vehicles, would you consider also buying an electrical car?

326 responses



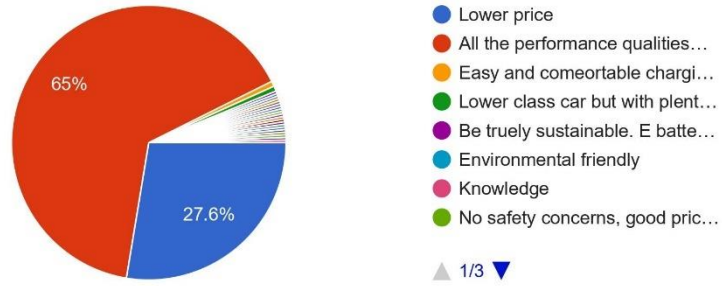
My biggest concern regarding alternative fuel vehicles are:





What does an alternative fuel vehicle need to have to make you buy it?

326 responses



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## APPENDIX 3 – PERCEPTION OF BARRIERS CRONBACH'S ALPHA

### ➔ Reliability

[DataSet2]

**Scale: ALL VARIABLES**

#### Case Processing Summary

		N	%
Cases	Valid	326	100,0
	Excluded <sup>a</sup>	0	,0
	Total	326	100,0

a. Listwise deletion based on all variables in the procedure.

#### Reliability Statistics

Cronbach's Alpha	N of Items
,615	7

#### Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Range	7,9233	2,009	,409	,553
Cost	8,0092	2,274	,275	,596
Charging points	7,9356	2,177	,261	,599
Time to charge	7,8466	1,921	,408	,550
Brand offering	7,4387	1,810	,462	,527
Limited choice	7,6350	2,011	,250	,612
Lack of knowledge	7,8742	2,110	,262	,600

## APPENDIX 4 – PURCHASING FEATURES CRONBACH'S ALPHA

### ➔ Reliability

#### Scale: ALL VARIABLES

#### Case Processing Summary

		N	%
Cases	Valid	326	100,0
	Excluded <sup>a</sup>	0	,0
	Total	326	100,0

a. Listwise deletion based on all variables in the procedure.

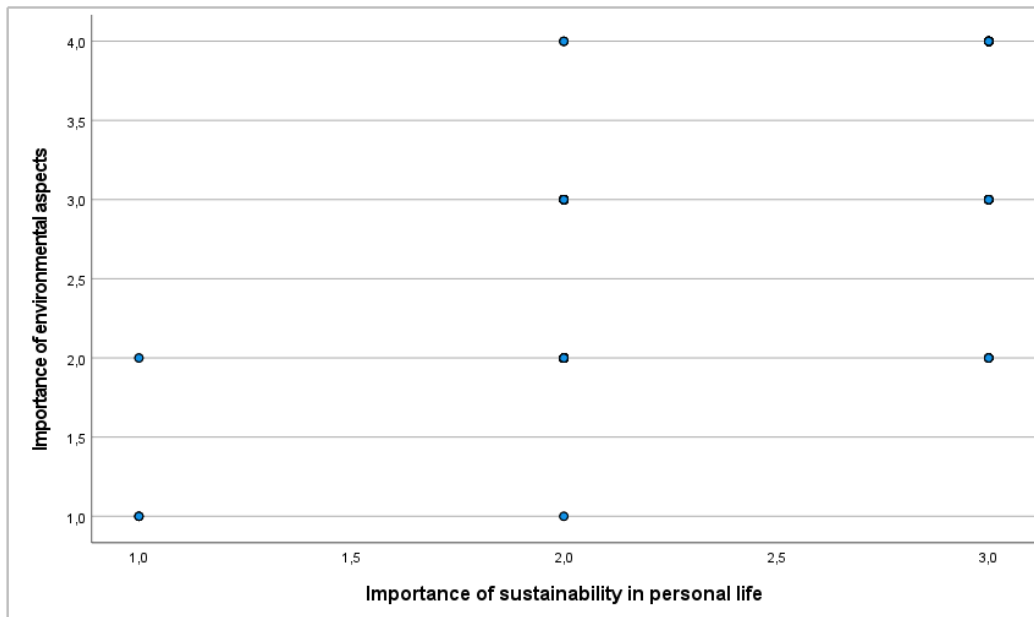
#### Reliability Statistics

Cronbach's Alpha	N of Items
,690	7

#### Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Environment	18,2945	7,901	,136	,727
Latest technology	18,2301	6,504	,494	,627
Cost efficiency	17,7301	7,287	,414	,653
Comfort	17,5951	6,802	,623	,606
Brand image	18,3865	6,712	,383	,663
Safety	17,3620	7,413	,493	,642
Performance	18,0521	6,708	,388	,661

## APPENDIX 5 – TEST OF H1 WITH SPEARMAN’S CORRELATION



### ➔ Nonparametric Correlations

#### Correlations

			Importance of environmental aspects	Importance of sustainability in personal life
Spearman's rho	Importance of environmental aspects	Correlation Coefficient	1,000	,652**
		Sig. (2-tailed)	.	<,001
		N	326	326
	Importance of sustainability in personal life	Correlation Coefficient	,652**	1,000
		Sig. (2-tailed)	<,001	.
		N	326	326

\*\* . Correlation is significant at the 0.01 level (2-tailed).

## APPENDIX 6 – TEST OF H2 WITH CHI-SQUARED TEST

### Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
What challenges does the automotive industry face with the electrification of vehicles? [Charging infrastructure] * My biggest concern regarding alternative fuel vehicles are: [Charging points]	326	100,0%	0	0,0%	326	100,0%

### What challenges does the automotive industry face with the electrification of vehicles? [Charging infrastructure] \* My biggest concern regarding alternative fuel vehicles are: [Charging points] Crosstabulation

What challenges does the automotive industry face with the electrification of vehicles? [Charging infrastructure]			My biggest concern regarding alternative fuel vehicles are: [Charging points]		Total
			Applicable	None applicable	
	Applicable	Count	244	38	282
		Expected Count	232,7	49,3	282,0
	None applicable	Count	16	11	27
		Expected Count	22,3	4,7	27,0
	Unknown	Count	9	8	17
		Expected Count	14,0	3,0	17,0
Total	Count	269	57	326	
	Expected Count	269,0	57,0	326,0	

### Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	23,570 <sup>a</sup>	2	<,001
Likelihood Ratio	19,227	2	<,001
N of Valid Cases	326		

a. 2 cells (33,3%) have expected count less than 5. The minimum expected count is 2,97.

### Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,269	<,001
	Cramer's V	,269	<,001
N of Valid Cases		326	

## APPENDIX 7 – TEST OF H3 WITH CHI-SQUARED TEST

Case Processing Summary						
	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
What challenges does the automotive industry face with the electrification of vehicles? [Charging time] * My biggest concern regarding alternative fuel vehicles are: [Time to charge]	326	100,0%	0	0,0%	326	100,0%

### What challenges does the automotive industry face with the electrification of vehicles? [Charging time] \* My biggest concern regarding alternative fuel vehicles are: [Time to charge] Crosstabulation

What challenges does the automotive industry face with the electrification of vehicles? [Charging time]	Applicable	None applicable	My biggest concern regarding alternative fuel vehicles are: [Time to charge]		Total
			Applicable	None applicable	
	Count	Expected Count	215	53	268
			197,3	70,7	268,0
	Count	Expected Count	18	24	42
			30,9	11,1	42,0
Count	Expected Count	7	9	16	
		11,8	4,2	16,0	
Total	Count	Expected Count	240	86	326
	240,0	86,0	326,0		

### Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	33,834 <sup>a</sup>	2	<,001
Likelihood Ratio	30,365	2	<,001
N of Valid Cases	326		

a. 1 cells (16,7%) have expected count less than 5. The minimum expected count is 4,22.

### Symmetric Measures

	Value	Approximate Significance
Nominal by Nominal	Phi	,322
	Cramer's V	,322
N of Valid Cases	326	

## APPENDIX 8 – TEST OF H4 WITH CHI-SQUARED TEST

### Crosstabs

#### Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
My biggest concern regarding alternative fuel vehicles are: [Cost] * If environmentally friendly features would increase the price of a vehicle would you be willing to pay more for it?	326	100,0%	0	0,0%	326	100,0%

#### My biggest concern regarding alternative fuel vehicles are: [Cost] \* If environmentally friendly features would increase the price of a vehicle would you be willing to pay more for it? Crosstabulation

			If environmentally friendly features would increase the price of a vehicle would you be willing to pay more for it?		Total
			No	Yes	
My biggest concern regarding alternative fuel vehicles are: [Cost]	Applicable	Count	237	56	293
		Expected Count	218,4	74,6	293,0
	None applicable	Count	6	27	33
		Expected Count	24,6	8,4	33,0
Total	Count	243	83	326	
	Expected Count	243,0	83,0	326,0	

#### Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	61,451 <sup>a</sup>	1	<,001		
Continuity Correction <sup>b</sup>	58,191	1	<,001		
Likelihood Ratio	52,727	1	<,001		
Fisher's Exact Test				<,001	<,001
N of Valid Cases	326				

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 8,40.

b. Computed only for a 2x2 table

#### Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,434	<,001
	Cramer's V	,434	<,001
N of Valid Cases		326	

## APPENDIX 9 – TEST OF H5 WITH CHI-SQUARED TEST

### Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
→ What challenges does the automotive industry face with the electrification of vehicles? [Range anxiety] * My biggest concern regarding alternative fuel vehicles are: [Range/driving distance]	326	100,0%	0	0,0%	326	100,0%

### What challenges does the automotive industry face with the electrification of vehicles? [Range anxiety] \* My biggest concern regarding alternative fuel vehicles are: [Range/driving distance] Crosstabulation

			My biggest concern regarding alternative fuel vehicles are: [Range/driving distance]		Total
			Applicable	None applicable	
What challenges does the automotive industry face with the electrification of vehicles? [Range anxiety]	Applicable	Count	172	29	201
		Expected Count	163,4	37,6	201,0
	None applicable	Count	59	25	84
		Expected Count	68,3	15,7	84,0
	Unknown	Count	34	7	41
		Expected Count	33,3	7,7	41,0
Total	Count	265	61	326	
	Expected Count	265,0	61,0	326,0	

### Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9,241 <sup>a</sup>	2	,010
Likelihood Ratio	8,625	2	,013
N of Valid Cases	326		

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 7,67.

### Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,168	,010
	Cramer's V	,168	,010
N of Valid Cases		326	



## APPENDIX 10 – TEST OF H6 WITH CHI-SQUARED TEST

Case Processing Summary						
	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
What challenges does the automotive industry face with the electrification of vehicles? [Limited knowledge from consumer's perspective] * My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge]	326	100,0%	0	0,0%	326	100,0%

### What challenges does the automotive industry face with the electrification of vehicles? [Limited knowledge from consumer's perspective] \* My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge] Crosstabulation

What challenges does the automotive industry face with the electrification of vehicles? [Limited knowledge from consumer's perspective]			My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge]		Total
			Applicable	None applicable	
	Applicable	Count	237	58	295
		Expected Count	225,3	69,7	295,0
	None applicable	Count	9	13	22
		Expected Count	16,8	5,2	22,0
	Unknown	Count	3	6	9
		Expected Count	6,9	2,1	9,0
Total	Count	249	77	326	
	Expected Count	249,0	77,0	326,0	

### Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	27,150 <sup>a</sup>	2	<,001
Likelihood Ratio	22,752	2	<,001
N of Valid Cases	326		

a. 1 cells (16,7%) have expected count less than 5. The minimum expected count is 2,13.

### Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	,289	<,001
	Cramer's V	,289	<,001
N of Valid Cases		326	

## APPENDIX 11 – TEST OF H7 WITH CHI-SQUARED TEST

<b>Case Processing Summary</b>						
	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
Plug-in electric vehicles are often cheaper to operate than gasoline vehicles. * My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge]	326	100,0%	0	0,0%	326	100,0%

### **Plug-in electric vehicles are often cheaper to operate than gasoline vehicles. \* My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge]** **Crosstabulation**

				My biggest concern regarding alternative fuel vehicles are: [Lack of knowledge]		Total
				Applicable	None applicable	
Plug-in electric vehicles are often cheaper to operate than gasoline vehicles.	Agree	Count	156	46	202	
		Expected Count	154,3	47,7	202,0	
	Disagree	Count	27	8	35	
		Expected Count	26,7	8,3	35,0	
	I am not sure	Count	66	23	89	
		Expected Count	68,0	21,0	89,0	
Total	Count	249	77	326		
	Expected Count	249,0	77,0	326,0		

<b>Chi-Square Tests</b>			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,335 <sup>a</sup>	2	,846
Likelihood Ratio	,331	2	,847
N of Valid Cases	326		

a. 0 cells (0,0%) have expected count less than 5. The minimum expected count is 8,27.

### **Symmetric Measures**

		Value	Approximate Significance
Nominal by Nominal	Phi	,032	,846
	Cramer's V	,032	,846
N of Valid Cases		326	