

HERE COMES THE ELECTRIC CAR: DELVING INTO YOUNG CZECH CONSUMERS' MOTIVATIONS IN BUYING AN ELECTRIC CAR

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Abstract *Electromobility is a preferred way of car manufacturers to deal with environmental impact of their products. But is it also a preferred way of their customers? This paper gives insights on history of electromobility, EU market incentives, customers' approaches towards innovative products in automotive and plans for Clean mobility in the Czech Republic. Finally it presents motivational factors of buying electric cars amongst Prague University of Economics and Business students. A survey was conducted and data were collected with the use of a structured questionnaire.*

Keywords *electromobility, electric cars, motivators, automotive, Czech Republic*

1 INTRODUCTION

Electric vehicles (EV) have become an increasingly crucial segment of the automobile industry (Chan and Wong, 2004). They attest for long term maintenance of a healthier environment by the replacement of carbon emissions from the fuel-burning vehicles to clean energy (Anon, 2017). In this manner, they embody a quick call for change to our society as well as provide a choice to the responsible individual for thinking globally and acting as a world's citizen. However, despite the major benefits of using such vehicles have been stressed out openly for the general public, not everybody who has reached the legally required age to purchase a vehicle seems to undertake the leap towards this new technology.

Electromobility is defined as a transportation system that is driven by electricity. It includes vehicles such as electric cars, e-bikes, electric motorbikes, e-buses, and e-trucks. (Infineon Technologies AG, 2018) The common points among the aforementioned means of transport are that they are either partially or fully electric, have the option of accumulating and storing energy onboard, and receive energy from the electrical grid (Sandén, et al., 2013).

With the emergence of EV and them slowly becoming the epicenter of the technological debate, opposing views around adopting them have flourished. Considering the particular importance of automotive industry has in the economy of the Czech Republic, this paper focuses on exploring where the young local consumers stand on this topic. More precisely, it aims to explore what the motivators are when purchasing a car and what is holding back the conscious buyer from switching to electric. Therefore, the aim of this study is to analyze the market of electric vehicles in the Czech Republic and explore the attitude of University students towards electric cars. Additionally, we deem that the political environment has an

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important impact on the adoption of this technology. Accordingly, it will be enumerated what policies EU bodies as well as the Czech institutions have undertaken regarding this specific topic as well as the environmental and economic rationale behind them. Lastly, this paper will be concluded with a compilation of the main drivers of this market and some learning points which can form the basis of a guideline to be employed by the players in the automotive industry when shaping their supply offer.

2 LITERATURE REVIEW

2.1 The concept of electric cars

The concept of battery driven cars, as opposed to the most common beliefs, is not new. It dates as back as the beginning of the 19th century with the invention of the battery, which led to further development of the electric motor and thereafter that of the electric car. The success of the electric car was immediate because it was quiet, easy to use, safe to maneuver and did not release pollutants. With the well spread of electricity in 1910s, charging cars also became much easier and accessible. This innovative technology attracted attention of the big players in the industry (Matulka, 2014). Such examples of industry giants that showed specific interest are Ferdinand Porsche with the first prototype to ever be released by the car manufacturer Porsche, called P1 dating back to 1898, and Henry Ford, the owner of Ford automobile company, who, in close collaboration with Thomas Edison attempted to produce an electric car model for the world (Porsche Cars Great Britain Limited, 2014).

However, the lifespan of this technology during those years, despite it being groundbreaking and forward looking for the time, was relatively short as new developments arose. An important factor was coincidentally the development of Model T by Henry Ford, which significantly decreased the price of gasoline mobiles. Afterwards, the price at which you could obtain an electric car was extremely high. This demotivated individuals from purchasing such vehicles and overshadowed their benefits. Furthermore, improvements in the road infrastructure in the US and worldwide also brought the desire of wanting to explore and travel long distances to people. Regrettably, the electric car was not the most practical option to pursue this (Matulka, 2014).

With the advancement of the technology throughout the years there have been numerous attempts to reintegrate the electric vehicles into the market. At the verge of the new millennium these attempts intensified due to society becoming increasingly more aware of the environmental issues caused by fuel combustion vehicles. With the protection of the environment having taken the first spot on the agendas of international institutions and governmental bodies, so have entered the spotlight the incentives of encouraging usage of electric vehicles.

The imperative importance of using electric vehicles comes first and foremost from the amount of damaging fumes that are emitted into the environment by the ICT (Internal Combustion Engine) vehicles. Passenger automobiles are especially targeted in the incentives of decreasing emission due to the reasoning that they are responsible for producing 44% of transport greenhouse gas (GHG) emissions (Anon., 2017). Given the recent upheave of environmentally friendly policies, the term Green Mobility has emerged. As stated by Sodero, Garrison and Powley (2008), green mobility is a way of transportation which is sustainable, while also providing the benefit of safely meeting the basic needs of individuals and society by not exploiting the wellbeing of the environment and its people. Furthermore, it is claimed to be economical, smoothly operable, offering a spectrum of vehicle choices and providing dynamic changes in society. Additionally, its most valuable traits entail cutting down on the harmful fume emissions and wastes released, while using the renewable resources up to a limit instead of thoughtlessly exploiting the finite ones (Sodero, Garrison, and Powley, 2008).

2.2 The rise of electromobility in the European Union

The European Union has been actively undertaking incentives to promote the usage and spread of electric vehicles to its member states, making electric mobility a commonly used term. The motion taken in 2011

by the European Commission, called Green eMotion with an allocated fund of €41.8 million and the contribution of 42 partners, has played a major role in this process. The goal of this undertaking was to assist the market entry of electric vehicles, as well as share and cultivate expertise within the European region (European Commission, n.d.).

Such important measures have been undertaken as governmental bodies recognize the importance and influence of the automobile industry to the economy. Constituting 7% of the total GDP of the EU, the industry provides positive spillovers in other sectors through the maintenance of extensive supply chains and the provision of further business services (European Automobile Manufacturers Association, 2019).

According to the main findings of the European Topic Centre on Air Pollution, Transport, Noise, and Industrial Pollution (ETC/ATNI) for the EEA (2019), the countries which promote policies that employ the usage of no- and low-emitting vehicles, such as battery electric vehicles and plug-in hybrid vehicles have lower CO₂ emissions. Furthermore, in these action-taking countries, a decrease in other air pollutants such as NO_x and PM₁₀ has been observed. The development of long-term taxation policies also plays a major role in whether the consumer is bound to purchase an EV. It can motivate the consumer to invest, but also may be a source of discouragement. Such was the case for the drop in sales of PHEVs (plug-in hybrid electric vehicles) in the Netherlands in 2017 when taxation policies were slightly modified. On a macro-perspective ownership of electric cars leads to lesser dependence on gas and a decrease in costs of motor maintenance.

However, according to the same report (ETC/ATNI for the EEA, 2019), in some countries, such as Ireland, an important point that held back the success of the newly imposed EV friendly policies was the insufficiency of the charging points.

2.3 Adoption of innovation by customers

Despite the impact governmental incentives have on consumer behavior, it is questionable whether these measures are sufficient to normalize the usage of electric vehicles by the masses. Certainly, there are more incentives at play. Following the model of 'consumer decision process' developed by Dewey (1910), when facing the decision-making process of whether to acquire an electric vehicle, the consumer analyses the benefits and consequences of all the possible choices and chooses the most beneficial option. With the development of new technologies and the presence of many competitors in the car manufacturing market, numerous alternatives have to be assessed and compared with one another.

Further, Stern (2000), identified four factors shaping consumers' actions: attitudinal factors (these include values, beliefs and norms causing somebody to behave in an environmentally friendly manner), daily established habits, the surrounding environment and the present situation of an individual, such as financial situation. The first one has been the focus of attention when contextually analyzing green consumer behavior amongst population fragments. The theory of value-belief-norm (Stern, 2000) also takes importance in attitudinal factors by highlighting the importance that individual moral norms have amongst our deep values and ongoing behavior in means of arbitration.

A study conducted by Jansson (2011) regarding the consumer eco-innovation put alternative fuel vehicles (AFVs) into the main picture. The research showed that individual and social norms can be important factors when it comes to taking high-involvement decisions of purchasing a product. Jansson (2011) divided his pool of consumers into adopters and non-adopters. Adopters were people with higher individual and social norms, haughty, curious and open-minded about innovation. They also understood the benefits, plausibility and relevance of the AFVs better. The importance of eco-friendliness, alternative fuels and fuel efficiency was also graded higher by the adopters. Another contribution of this study was regarding the pursuit of novelty seeking, which takes up a significant part in the drive of a consumer when investing in a product advertised as environmentally friendly (Jansson, 2011).

The technology acceptance model developed by Davis (1989) helps shed some light on motivation of the adopters. The model entails the principles of 'perceived usefulness' and 'perceived ease of use' being defined as respectively 'the degree to which a person believes that using a particular system would enhance his or her job performance' and 'the degree to which a person believes that using a particular

system would be free of effort'. Furthermore, Pichlak (2016) demonstrated the importance of the innovation's 'ease of use' in the post-adoption stage.

2.4 Factors impeding the further adoption of electric cars

Previous research has tried to explore the various deal-breakers for the consumer regarding the purchasing of electric cars. Certain factors, such as setbacks in battery technology, high tariffs, limited road infrastructure and lack of charging stations are characterized as elements continuing to hold back the advancement of EVs in the market (Zhang et al., 2014).

Mileage (reach) of electric vehicles is a common cause for misconception for the consumer. Traditionally internal combustion engine (ICE) vehicles are classified as ideal for long distance driving and this was one of the reasons that made them so popular. Whereas electric vehicles are most commonly seen as inner city transportation means. Their mileage is directly proportional to the battery size and model of automobiles selected; therefore, people are often restricted in taking long journeys in them.

Battery is not only a limitation when it comes to mileage of a vehicle, it is also one of the most expensive spare part in an EV. Given studies from Habermacher(2011) and Althaus and Gauch (2010) states that about one in two vehicles would need a battery replacement during their use, deriving the lifespan of the battery of a 1,250kg vehicle to 100,000km (Del Duce, et al., 2016). Consequently, the higher cost of Lithium-ion batteries used in electric vehicles and its maintenance is what mainly causes the steep price difference among them and their internal combustion engine competitor.

Recycling of lithium batteries is an important topic that may come up as controversial and possibly damaging for the environment if it is avoided. Due to the old practices and the limited spread of lithium batteries, recycling has not been followed through regularly. Furthermore, the usage of these batteries has not met its full potential. Taking inspiration from circular economy practices, where waste is either disposed or managed, the same pattern has been suggested to be applied in the end-of-life Lithium-ion batteries(LIB) of electric vehicles (Richa et al., 2017). The obvious benefits, such as reduced eco-toxicity, of reuse and cascaded use of batteries have been currently disregarded. The most common practice being pushed toward the used batteries is that of landfill disposal bans (Richa et al., 2017).

An important takeaway from The International Council on Clean Transportation (ICCT) in the study "Effects of battery manufacturing on electric vehicle life-cycle greenhouse gas emissions" was regarding the amount of carbon intensity released while producing the battery pack (Hall, Dale; Lutsey, Nic (ICCT), 2018). Electricity consumed during the process is responsible for almost half of the emissions released in the manufacturing procedure. Therefore, it is crucial to make use of renewable energy sources and more systematic power plants. By 2030, a decrease of 30% in carbon intensity of electricity is expected coming from fossil fuel-based markets (International Energy Agency, 2015).

According to Nordelof, the main form of environmental harm coming from battery driven vehicles is the source of electricity being used to charge them. With coal being one of the main sources of it, this can cause its portion of environmental damage (Hawkins et al. 2012). Indirectly, by boosting electric vehicles and intending their spread, we are replacing low-carbon with high-carbon and allowing dissolved emissions instead of concentrated pollution. In case that the source would be provided by a form of clean energy, much lower harm could be attributed to electric vehicles (Zhang et al., 2014).

It can be understood that the lack of charging stations imposes a drawback on sales of EV. However, governments are continuously approving policies promoting infrastructure building. Currently, in the US two such projects are active, i.e "Charge Point" and "EV Project". Additionally, a bill aiming at an economic incentive provides refunds for installing charging facilities. Similarly, the British government has released a charging station grant worth £30 million and plans to expand charging points in London (Jia, 2007). Additionally, electric companies have had a major influence in making these charging stations possible. For example, in Italy, the Enel electric power company controls the majority of the sector for charging infrastructure.

2.5 The Automotive market in the Czech Republic

The market environment in the Czech Republic is highly influenced by the policies of international organizations. Being a solid participant in the European scene, Czech Republic does adapt to the latest developments in policy making and decision-making trends, while there is a strong presence of multinational companies in the automotive sector.

The presence of a powerful car manufacturing industry has the predisposition of putting Czech Republic into a new spotlight for the years to come. A subsidiary of Volkswagen Group such as Skoda could be quite promising in the field of electromobility through its many models. Such an example was Škoda Citigo-e iV which was the most popular electric car model for Czech Republic with 634 units sold. Surpassing also the two well-known brands Tesla (280 vehicles sold) and Hyundai (237 vehicles sold) (ČTK, 2020). The attempts to satisfy the electric-savvy customers still continue. Early in the month of September a new model Škoda Enyaq was introduced and the most optimistic projections according to Jiří Maláček, Head of Czech representation of Skoda in Mladá Boleslav, reaching around 2,000 cars of Enyaq model sold in 2021 (Dvořák, 2020). Taking the above-mentioned numbers into consideration, we do notice that supporting local and regional brands is very important in the Czech culture and engraved in the society (Chalupova et al., 2015).

The National Action Plan for Clean Mobility, or in Czech "Národní akční plán čisté mobility", is the most important stand taken by the Czech government back in 20 November 2015, which falls under the directive 2014/94/EU of 22 October from the European Parliament and Council regarding the adaptation of infrastructure regarding alternative fuel vehicles. This obliged the member countries to develop respective charging and refilling stations to match this demand. These requirements had a timespan from year 2020 to 2030 of being fulfilled (Ministerstvo Průmyslu a Obchodu, 2015). The plan was valid from year 2015 to 2018, until its further ramification in 2017. The vision of the document is to lower the negative impacts on the environment through lowering emissions and reducing the dependence on fuel-driven engines.

The document puts an emphasis on the Development of Electromobility and includes steps such as: alleviating or softening formalities in order to build an infrastructure; supporting and boosting demand, i.e. via tax reductions regarding to electric vehicles; local incentives for potential customers, such as free parking; and refining conditions (legislations) for the effective continuation of businesses in a field related to electromobility.

In addition, the plan is divided into four periods of realization with specific targets:

- 2015-2020: reaching 150 to 200 km per one charging; coverage of cities with more than 100,000 inhabitants with appropriate charging infrastructure; a total amount of 6,000 battery electric vehicles and 11,000 plug-in hybrid electric vehicle; total of 1,300 charging stations;
- 2021-2025: average coverage of 200 km per one charge; presence of charging infrastructure even in towns with 10,000 citizens; presence of 25,000 registered electric vehicles at the end of year 2025;
- 2026-2030: aimed further development of the charging infrastructure and setting tariffs for charging of electric vehicles; presence of 44,000 registered electric vehicles at the end of year 2030;
- 2030: charging infrastructure to be as developed and standard like the current gas stations; total integration of electromobility into the life of citizens; yearly sales to reach around 50,000 electric vehicles; total number of registered electric vehicles around 400,000.

The two key players in the development of the charging infrastructure in the Czech Republic are CEZ Group, covering ČEZ Electromobility and further expansions, and Škoda Auto. Both bringing innovations and providing an enhancement in the technology used so far at the charging stations. Regarding CEZ, they have chosen Driivs, an Israeli based EV charging software said to support more than 120 kinds of EV

chargers, encompasses also: billing option, roaming interoperability; and vehicle-to-grid facilitation (Manthey, 2019).

Skoda has also provided innovative options, such as usage of flywheel kinetic technology. Part of the agenda of the car manufacturer is to install further 7000 charging stations in the premises of its sites in Mladá Boleslav, Kvasiny and Vrchlabí by 2025. This does not count the already established 300 charging stations being created for testing purposes in the headquarters of the company. This would be an investment of about 32 million Czech crowns and will primarily be available to Skoda's employees (Randall, 2019).

3 METHODOLOGY

In order to address the research's objectives a survey was conducted with the use of a structured questionnaire. The structured questionnaire explored the general environmental concerns, the factors that affect the purchasing of electric cars and the willingness of participants to purchase an electric car in the future.

The questionnaire was designed by using established scales previously used in relevant studies (see Al Mamun et al., 2018) and the majority of scales were 7-point Likert-type scales. A pretest took place with 5 participants that helped refine the research instrument (i.e. the questionnaire). A sample frame with the available contact information of 530 students of the Prague University of Economics and Business was created. In total, 131 filled questionnaires were collected online with 107 being usable after taking account the missing data issue. Therefore, the final sample consisted of 107 Czech University students (response rate was 20,2%). The data collection took place in Spring 2020. Following, the sample description and the main findings are presented.

4 MAIN FINDINGS

The final sample of 107 Czech students consisted of 51% male and 49% female students. 53% of students were 18-22 years old, 46% were 23-27 years old and 1% above the age of 27. The vast majority (81% of participants) were undergraduate and the 8% Master's level students.

A four-item, 7-point Likert scale (from strongly disagree to strongly agree) was used to measure the construct of "Environmental Concern". Environmental concern is defined as the evaluation of a person's attitude towards behaviors that have consequences for the environment (Kai and Haokai, 2016 cited in Al Mamun et al., 2018). According to the results, the mean for the construct of "Environmental Concern" is 5.84 when a 7-point Likert scale is used. This finding indicates that the participants have quite high levels of general environmental concerns.

Next, for further insights, each item is presented in detail. The item "I believe that major social changes are necessary in order to protect the natural environment" had 5.52 mean and 7 mode demonstrating that participants are positive towards social changes that can be beneficial for the environment. The item "I believe that humans must live in harmony with nature in order to survive" had 6.06 mean and 6 mode and the item "I think environmental problems are very important to address" had a mean of 5.79 and mode 7. Finally, the item "I think we should care more about environmental problems" with mean 5.96 and 7 mode showcases the participants' concerns towards the environment and their belief that more attention needs to be paid to environmental problems.

Furthermore, a four-item, 7-point Likert scale (from strongly disagree to strongly agree) was employed in order to measure the construct of "Normative Beliefs". Normative beliefs represent the social pressure that significantly influences a person's behavioral intentions (Ajzen, 1991 cited in Al Mamun et al., 2018). According to results, the mean for the construct of "Normative Beliefs" is 4.18 when a 7-point Likert scale is used. This finding indicates that the influence of family and friends (when it comes to practicing environmentally friendly behavior and purchasing environmentally friendly products) on participants is rather moderate. However, results showed that approximately 45% of the participants believe that their friends think that they should purchase environmentally friendly products while 27% of the students that

took part in the survey believe that their family thinks that they should purchase environmentally friendly products, showing that the role of friends in Czech Republic is quite important when becoming a green consumer.

In addition, results showed that 50.5% of the survey's participants intend to buy a car the next five years, 15.2% are neutral and 34.5% do not intend to buy a car. Also, 45.2% of participants think that they will have resources to purchase an electric car in the next five years, 16.1% are neutral and 38.8% do not agree with that. However, when exploring the willingness to purchase an electric car the next five years, the mean is 4.10 and the mode is 4 in a 7-point Likert scale. More specifically, 38.8% of participants claim that they have the willingness to purchase an electric car in the next five years, 30.1% of participants are neutral and 31.2% do not have the willingness to purchase an electric car in the next five years.

Following, a 7-point Likert scale (from not important at all to extremely important) consisting of 16 items was used to measure the importance of various factors influencing the decision to buy an electric car in the next five years. Table 1 presents the ranking of those motivational factors based on the mean estimation.

Table 1: Ranking of Motivational Factors Based on the Mean (based on 7-point Likert scale)

Ranking	Motivational Factors	Mean
1.	"A lot more charging points where I park"	6.18
2.	"Real world range needs to be more than 250 km on a single charge"	6.15
3.	"Hundreds of rapid chargers along strategic roads"	6.01
4.	"Uniform method of accessing public charging points"	5.55
5.	"More choice of electric cars"	5.38
6.	"New-built homes with allocated parking having charging points installed"	5.28
7.	"Electric car's price the same as petrol car's price"	5.09
8.	"Electric car's price the same as diesel car's price"	4.98
9.	"Electric cars allowed to have free parking in major cities"	4.72
10.	"Electric car's price lower than petrol car's price"	4.70
11.	"Petrol's price to increase"	4.69
12.	"Electric car's price lower than diesel car's price"	4.61
13.	"Diesel's price to increase"	4.58
14.	"Penalties for driving petrol/ diesel cars become too high"	4.41
15.	"Introduction of congestion charges in major cities"	4.38
16.	"Electric cars allowed to use bus lanes"	3.50

For the factor "A lot more charging points where I park" the mean is 6.18 and the mode is 7. For 95.7% of participants this factor is important for them in order to buy an electric car in the next five years. The factor "Real world range needs to be more than 250 km on a single charge" has 6.15 mean and 7 mode. According to results, for 89.2% of participants this factor is important for them in order to purchase an electric car. In addition, the factor "Hundreds of rapid chargers along strategic roads" has 6.01 mean and 7 mode. For 91.4% of participants this factor that has to do with infrastructure is important. The importance of accessible chargers is demonstrated in the analysis of the factor "Uniform method of accessing public charging points" as well: it has 5.55 mean and 6 mode. The findings indicate that for 81.7% of participants this factor is important in order to buy an electric car in the next five years.

Also, the factor "More choice of electric cars" is of high importance as it has 5.38 mean and 6 mode. In fact, for 76.4% of participants this factor is important. The analysis also showed that the item "New-built homes with allocated parking having charging points installed" has 5.28 mean and 7 mode. For 72.1% of participants this factor is important in order to purchase an electric car. Finally, another interesting finding is that for 61.4% of participants the factor of "Electric cars allowed to have free parking in major cities" is important in order to buy an electric car in the next five years.

5 CONCLUSIONS

Although the technology of electric vehicles has been known for a century, it is only recently that they have become the preferred way of dealing with environmental restrictions and incentivized by the EU or local governments. Our research amongst university students showed that even though they have quite high environmental concern about their purchasing decisions in this segment and that they would favor an environmentally friendly car (over a third of respondents are willing to purchase an electric car in the next five years), their decision will be limited by the infrastructure for such vehicles (charging points where they park and on strategic roads) and the characteristics of such vehicles (real world range on a single charge). These findings support the National Action Plan for Clean Mobility's aim to mainly support building infrastructure, without which the customer will not be as willing to purchase an electric vehicle.

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