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**FACTORS INFLUENCING ELECTRIC VEHICLE ADOPTION: A
CONCEPTUAL PAPER**

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Abstract

Due to carbon emissions, the new global economic period has been hampered. Since there are millions of petroleum-based vehicles on the road every day, the transportation industry is the primary contributor to carbon emissions. Since the past ten years, electrification of transportation has been one of the primary study fields. The market share of traditional internal combustion engine vehicles is being replaced by electric vehicles (EV). Data were collected through literature searches (journals, articles, thesis, and websites) on electric vehicle adoption. This study found that there are four consistent factors towards Electric vehicles (EV) adoption that have been consistently studied by previous researchers which are (1) environmental concerns, (2) government policy, (3) government incentives, and (4) charging infrastructures. Therefore, the aim of this study was to explore and clarify the driving forces behind EV adoption. This review study has management ramifications and identifies future EV research and practise paths that may assist governments and the auto industry in raising the share of EV adoption.

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Keywords: Electric vehicle, environmental concerns, government policy, government incentives, charging infrastructure

1. Introduction

It is widely acknowledged that the two main problems of the new millennium are climate change and carbon emissions. According to the Intergovernmental Panel on Climate Change Report (2022), the primary cause of climate change is the increasing concentration of greenhouse gases such as CO₂ and N₂O. This phenomenon has a deleterious effect on the natural ecosystem that exists on Earth. In the meantime, the International Energy Agency predicts that by the year 2030, emissions from the transportation sector will account for half of the total greenhouse gas emissions (International Energy Agency, 2018). According to Manisalidis et al. (2020) an increasing reliance on motor vehicles is a factor in a number of environmental issues, such as air pollution, traffic congestion, and carbon dioxide emissions. These issues are caused by a variety of factors, including pollution in the air and emissions of carbon dioxide. One of the primary contributors is the rise in the number of automobiles, which has reached over one billion worldwide and consumes approximately sixty million barrels of oil per day, which is equivalent to almost seventy percent of the world's total oil production. Therefore, replacing traditional automobiles with ones powered by other sources of energy may be viewed as a potentially fruitful alternative (Tu & Yang, 2019).

Electric vehicles (EVs) are able to connect to the power grid, which allows for a significant reduction in, or entire elimination of, the need for traditional fuels like gasoline or diesel within the vehicle itself. The revolution of electric vehicles, which is being driven by the necessity to decarbonize personal transportation in order to meet global targets for reductions in greenhouse gas emissions and improve air quality in urban centres, is about to bring about a significant shift in the automotive industry. This shift will take place as a result of the necessity to decarbonize personal transportation. Fuel cell electric cars, battery electric vehicles, hybrid electric vehicles, plug-in hybrid electric vehicles, and range-extended electric vehicles are the major categories that electric vehicles (EVs) can be placed into (Adnan et al., 2018; Zhang et al., 2018). EV have the potential to become an important technology for reducing emissions of greenhouse gases, as well as local air pollution and the noise caused by vehicles (Requia et al., 2018; Wu & Zhang, 2017).

Malaysia is making strides toward achieving its goal of low carbon emission in accordance with the Low Carbon Mobility Blueprint that the government has devised for the years 2021-2030 (New Straits Times, 2021). According to its Tan Sri Shamsul Bahar Mohd Nor, who serves as the CEO of the Malaysian Green Technology and Climate Change Corporation (MGTC), the organization's plans call for the establishment of 10,000 charging stations for electric cars (EVs) around the country (Moh, 2021). According to Datuk Seri Dr. Wee Ka Siong, Malaysia's Transportation Minister, electric vehicle (EV) development and production have received special attention from the government, which welcomes high-value international investments into Malaysia as a critical platform to introduce EV manufacturing to the ASEAN. EV development and production have received special attention from the government (Matthew, 2022). In addition, the ministry is improving the incentive package to promote the use of EVs, which includes road tax exemption, income tax relief for the purchase of EVs, as well as income tax relief for the installation of EV charging facilities, according to Minister of International Trade and Industry Datuk Seri Mohamed Azmin Ali (Malaysian Investment Development Authority, 2021). As a result, this study's objective was to investigate and identify the factors influencing consumer acceptability of EVs based on earlier research.

2. Literature Review

Based on previous literatures, there are four main factors of EV adoption as discussed below:

2.1. Environmental concerns

Schuitema and Bergstad (2018), define the word "environmental concern" as the thought and awareness of environmental issues. Although Hawkins et al. (2013), have noted certain environmental problems in the production phase of EV, research suggests that EV are less damaging than Internal Combustion Vehicles (ICVs) or conventional vehicles (Ke et al., 2017). EV adoption is seen as a pro-environmental behaviour since EV eco-innovations can minimise negative environmental effects by reducing energy use and exhaust emissions (He & Zhan, 2018). Above all, it was suggested that an important component in consumers' adoption of EVs was their knowledge of environmental concerns (Adnan et al., 2018).

2.2. Government policy

Governments can make rules that make it easier for people to use a new technology. Policy approaches can be based on laws, the market, or giving people information (Dovers & Hussey, 2013). Many countries and regions, like China, Sweden, Norway, and others, have used different policy tools, like financial and non-financial incentives, to speed up the spread of electric vehicles (EVs) (Hardman et al., 2017; Kester et al., 2018; Wee et al., 2018). From all of these, market-building policies may lead to more sales of electric vehicles (Vergis et al., 2014). As a necessary market co-condition, a good recharger network would have a lot of charge spots that are spread out, well-kept, easy to get to, and well-marked. To build such a network and make EVs more popular, policy instruments would need to be carefully put into place.

2.3. Government incentive

Money-based incentives are an important way to close the price gap between electric vehicles and regular cars. They have direct ties to consumers, the business world, and the infrastructure. Incentives to buy EVs are a big part of getting people to use them. Every country has taken the step of giving subsidies to help private and public charging infrastructure get set up. Another popular policy is to help people buy things by giving them discounts. Modelling done by Sierzchula et al. (2014) showed that the rates of electric vehicle adoption in 30 different countries were related to financial incentives, charging infrastructure, and local vehicle production. The number of charging stations per head of population was found to be the single most important factor in the relationship between these three factors. Therefore, government incentives can be useful in persuading individuals to purchase electric vehicles and overcoming their reluctance to the high pricing of these vehicles (Mock & Yang, 2014). Nevertheless, the manner in which the incentive is provided is as significant as the value it carries. According to the findings of recent studies, immediate tax reductions have a greater impact on consumer behaviour than deferred income tax credits. This shows that customers place a high value on instant gratification and simplicity of use (Gallagher & Muehlegger, 2011).

Diamond (2009) showed that upfront payments work better, but that these kinds of payments could act as subsidies for car dealers if they aren't factored into their pricing plans.

2.4. Charging infrastructure

As the market for electric vehicles (EVs) grows, there are more EV charging stations, which are used to connect EVs to the grid (EVGI). The charging stations that were put in place can be divided into two types: residential and non-residential. They can be used for both slow charging (level 1 and level 2) and fast charging. There are many things that can affect the economics of EV public charging infrastructures, and each thing can have a different effect. Zhang et al. (2018) mentioned that the economics of EV charging infrastructures can be split into two groups: direct factors and indirect factors. As Yu et al. (2022) looked into the EV standards used in the United States. They showed that charging infrastructure and government subsidies and incentives are both important parts of standardisation. Aside from that, Haidar and Rojas (2022) looked at the charging infrastructure in France to support the deployment of EVs and said that policy support is one of the most important factors for EV adoption to be successful.

3. Method

This study examined secondary data such as journals, website, articles and report on the factors of adoption of EV. The literature analysis discussed on the factors that influence consumers towards EV adoption.

4. Findings

Various studies have been carried out across countries on factors towards EV adoption. Thus, the purpose of this study was to discuss the factors influencing consumer's adoption of electric vehicles. In their study, Soltani-Sobh et al. (2017) reported that EV adoption in United States was mainly factored by electricity price and government incentives. Meanwhile, Beck et al. (2017) identified the factors influencing Australians towards EV adoption namely, the driving range, government incentives, and concerns towards environments. Wang et al. (2017) indicated that government policy and environmental concerns were the factors that influence consumers towards EV adoption.

Wang et al. (2019) highlighted that the successful factors of EV adoption in China were through government policy. However, Yu et al. (2022) contended that the factors of EV adoption in China and Korea were charging infrastructure and government incentives, which were also mentioned by Chu et al. (2019) who also found other factors such as environmental concerns, subsidies, cost, and user satisfactions.

Jaiswal et al. (2021) found that the main factor of EV adoption in India was the provision of financial incentives by government, and this finding was supported by Ali and Naushad (2022) who also mentioned other factors such as charging infrastructure, social reinforcement, environmental concerns and cost that contributed to successful EV adoptions. Chen et al. (2020) pointed out that the factors of EV adoptions across Denmark, Finland, Iceland, Norway, and Sweden were: (1) Experience, (2) Fuel Economy, (3) Financial Saving, (4) Environmental Concerns, and (5) Vehicle-To-Grid Capability.

In Malaysia, Adnan et al. (2018), Asadi et al. (2022) and Jamil and Aminuddin (2019) reported comparable findings on the factors of EV adoptions: environmental concerns, and safety and cost of EV. In addition, Daud et al. (2021) indicated that government policy also plays a role towards EV adoption. Accordingly, the factors derived from the literature review findings, are as summarised in Table 1 below.

Table 1. Factors on electric vehicle adoption

Authors/Year	Country	Variables/Dimension
Asadi et al. (2022)	Malaysia	Environmental concerns
Ali and Naushad (2022)	India	Financial Incentives Charging infrastructure Social reinforcement Environmental concern Cost
Yu et al. (2022)	China	Charging infrastructure Subsidies Government incentives
Daud et al. (2021)	India	Government policy
Jaiswal et al. (2021)	Malaysia	Financial Incentives
Chen et al. (2020)	Denmark, Finland, Iceland, Norway, and Sweden	Experience Fuel economy Financial Saving Environmental Vehicle – to-grid capability
Chu et al. (2019)	China, Korea	Environmental Cost Government incentives Usage satisfaction Operation cost Charging infrastructure
Jamil and Aminuddin (2019)	Malaysia	Safety Cost Environmental
Wang et al. (2019)	China	Government policy
Egnér & Trosvik (2018)	Sweden	Charging infrastructure Policy
Adnan et al. (2018)	Malaysia	Environmental concern
Wang et al. (2017)	China	Government policy Environmental
Beck et al. (2017)	Australia	Driving range Government incentives Environmental
Soltani-Sobh et al. (2017)	United State	Electricity Price Government incentives

From the table above, it can be concluded that there were various factors examined by previous researchers on EV adoption. However, four factors have been consistently studied by previous researchers,

namely: (1) environmental concerns, (2) government policy, (3) government incentives, and (4) charging infrastructures. Therefore, it can be concluded that the main factors that contribute to EV adoption by the consumers based on 5-year literature are environmental concern, government policy, government incentives, and charging infrastructure.

5. Discussion and Conclusions

The purpose of this study was to determine the factors that consumers consider important when deciding whether or not to purchase an electric vehicle (EV). Despite the fact that it began its EV activities in 2016, Malaysia is falling behind its surrounding countries in terms of the most recent progress made toward the adoption of electric vehicles (EVs). While Malaysia is in the process of amending its policy to encourage more use of electric vehicles (EVs), the nations that are Malaysia's neighbours are continually adopting drastic simultaneous steps in various sectors including manufacturing, regulation, incentives, and public awareness. Despite its modest pace, Malaysia has the potential to learn from and use as a model the adoption of electric vehicles (EV) by other countries, which would allow for adaptation and improvisation (Veza et al., 2022). Thus, as discussed in the findings above, four factors were identified as important factors contributing towards EV adoption which are: (1) environmental concerns, (2) government policy, (3) government incentives, and (4) charging infrastructures. Table 2 below is the summary of factors towards EV adoption.

Table 2. Summary of Factors on Electric Vehicles Adoption

Authors/Factors	Environmental Concerns	Government Policy	Government Incentives	Charging Infrastructure
Asadi et al. (2022)	√			
Ali and Naushad (2022)	√		√	√
Yu et al. (2022)			√	√
Daud et al. (2021)		√		
Jaiswal et al. (2021)			√	
Chen et al. (2020)	√			
Chu et al. (2019)	√		√	√
Jamil and Aminuddin (2019)	√			
Wang et al. (2019)		√		
Egnér & Trosvik (2018)		√		√
Adnan et al. (2018)	√			
Wang et al. (2017)	√	√		
Beck et al. (2017)	√		√	
Soltani-Sobh et al. (2017)			√	

There are some practical implications that can be generate from this present study. Firstly, this study provides clear insight on factors that consumer considered when adopting EV which can help marketer and government as well in order to help accelerate EV adoption among Malaysian consumers. For example, this present study reveals that government actually plays very significant roles in EV adoptions among public. Therefore, policy makers can implement policy and regulations that focus on environmental

awareness from EV usage. Apart from that, this present study highlights that government incentives as one of the key factors that contributes to EV adoption. Therefore, government should provide relevant incentives and subsidies to public in order to increase EV adoption in Malaysia. Last but not least, what Malaysian government can do is install more public EV charging infrastructures across Malaysia since one the concerns in adopting EV is the charging infrastructures especially in rural areas where the charging infrastructure is hardly to be found (Baumgarte et al., 2021; Schulz & Rode, 2022). In addition, as for EV marketer, they should communicate and advertise more on how EV usage could keep the environment safe by reducing the pollution and greenhouse gas emission.

6. Limitations and Future Studies

This study is a literature study focusing on the factors towards EV adoption. Thus, it lacks generalizability. Future study should be focusing on dividing the factors into the internal and external factors so that the distinction of the factors towards EV adoption will be clearer.

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