

Data Analyzing the Electric Vehicle Market in Asia and Prospects

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Abstract: The document discusses the rise of electric vehicles (EVs) in Asia, highlighting environmental concerns, market trends, and consumer behavior. It examines the impact of factors like emissions, energy consumption, government regulations, and technological advancements on the EV market. The study also considers the challenges and opportunities in developing EV infrastructure, consumer adoption patterns, and the role of government policies. It aims to provide a comprehensive analysis of the factors influencing the EV market in Asia, identifying key trends and prospects.

Keywords: Electric Vehicles, Asia Market Analysis, Consumer Behavior, Environmental Impact, Government Regulations, Technological Advancements EV Infrastructure, Market Trends, Future Prospects.

1. Introduction

The transportation sector has become one of the major emitters of carbon dioxide in Southeast Asia. The sector has also become one of the major consumers of the final energy in the region. The sector is mainly dependent upon petroleum energy, the sector utilized almost 125 million tons of oil in 2018[1]. Thus, it is important to shift toward a cleaner and more sustainable source of mobility. One option is to opt for electric vehicles and blend biofuel with them. These options are currently sought by many countries in the Asian region. Findings by AEO6 showed the impact of gas emissions resulting from the transmission.

2. Literature Review

The electrification of the transportation sector has been a go-to option to reduce the environmental risks and impacts of transportation. The major impacts have been emissions and air pollution. The adoption of electric vehicles can result in public health benefits in different urban areas[2]. Additionally, [3] suggested that emission reduction from the power generation sector should also be reduced. The Asian engagement with EVs has spread over many decades as the region has many developed countries such as China and Japan. Additionally, South Korea has also established itself as a leader within the industry. The development of the industry can be considered a strategic journey propelled by many factors such as environmental issues and geopolitical considerations. The initial phase of the Asian EV market can be traced to Japan in the 1970s. However, major automakers like Toyota started the mass production of hybrid vehicles in the 1990s. Customers did not respond very positively to these vehicles mainly because of concerns about their performance. Additionally, a lack of charging infrastructure was another major issue faced by the customers. Japan's entrance into the EV market was only the start of Asia's notable role in the global EV market. In the years to follow, countries like China and South Korea also joined the market.

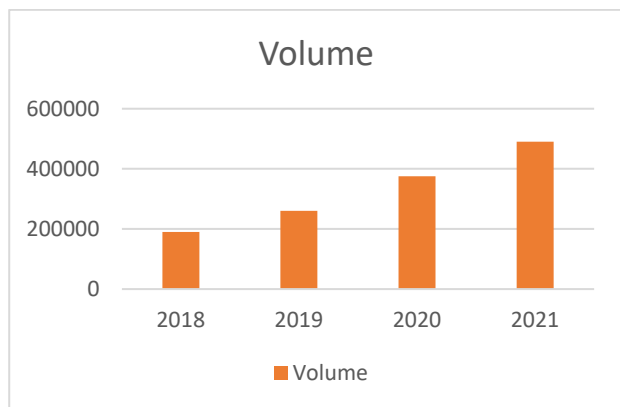
The total value of the Asia-Pacific vehicle market was \$ 229.39 billion in 2021 and it will reach \$ 777.62 billion in 2027. These figures show a CAGR of 19.1% during the

specified period. It is important to analyze the impact of the pandemic on the electric vehicle market as it affected almost all the other industries in the market. However, the market for electric vehicles has shown a considerable annual increase as people adopt more and more mild-hybrid electric vehicles across the globe [4]. A dramatic rise in electric vehicle sales has been observed in China despite the pandemic showing that the market will be active despite the pandemic. It is also important to note that people are demanding more fuel-efficient vehicles with lower emissions and higher performance. Additionally, stricter laws have been passed in many countries regarding vehicle emissions causing people to shift to electric vehicles. The governments have also been involved in the shift towards electric mobility [5]. Regulations have been designed and implemented by the governments to reduce the dependence on fossil fuels. Additionally, the governments have also increased spending on developing the EV charging infrastructure so that people can access them more easily. Other government initiatives include initiatives in the form of tax refunds and subsidies so that more people adopt Electric Vehicles. Investments in charging infrastructure can come either directly via the public charging stations or indirectly by subsidizing private charging stations. Another important element to be considered is the advancement of batteries [6]. The market for batteries is expanding because of the Internet of Things (IoT) and Artificial Intelligence (AI). Different organizations are investing huge resources to ensure that the best products are delivered to the customers as well as to support market expansion for them. Many countries are looking to increase mobility through electric vehicles, but they struggle to develop and maintain an ample charging infrastructure.

3. Trends In the Asian Ev Market

The increase in carbon emissions and climate change concerns pose the most serious challenges to the organizations. These challenges are faced by companies working in both developed and developing countries. However, these issues are more complex in Asia because the region contains both developed and developing countries. The transport sector is the major contributor to emitting

greenhouse gases [7]. From a global perspective, 24% of carbon dioxide emissions are caused by the transportation sector. Developing countries need to deploy technologies to minimize carbon emissions at a vast scale. However, these countries lack the intent and resources to do so successfully. Concerning a zero-carbon requirement, countries have to design and implement strategies for Alternative Fuel Vehicles (AFV). These vehicles will help in developing sustainable transportation in terms of energy. The most common types of electric vehicles include Hybrid Electric Vehicles (HEVs), Battery Electric Vehicles (BEVs), and plug-in electric vehicles (PHEVs). There has been a shift in customer preferences towards electric vehicles. Such development is also important in terms of developing charging stations[8]. An increase in the sale of electric vehicles will also increase the demand for charging stations. Improvements in the charging technology will also reduce the charging time for vehicles. Although fast-changing technology has been designed and adopted in many countries, there is huge room for improvement available. The electric vehicles offer a 30% lower emission of carbon as compared to the conventional engines. This benefit can be further increased by increasing the battery manufacturing facilities. Many Original Equipment Manufacturers (OEMs) are expanding by investing more in EV manufacturing. In February, Tesla planned to build its second EV manufacturing facility in China so that it could cover the increase in demand both inside and outside the country. The company wants to increase its production capacity to 1 million cars per year. The following graph shows the volume of EVs produced in the Asia Pacific market from 2018 to 2021.



The theory of planned behavior as presented by Ajzen states that buyer behavior is determined mainly by knowledge and experience. Buyers require more objective and trustworthy knowledge to improve their buying decisions. These buyers are mainly educated through advertisements and other forms of media coverage. Additionally, buyers have not tried to gain information about EVs except for the experienced users. However, as people increase their knowledge about EVs, they are more willing to pay a higher price for them. Thus, it can be concluded that awareness is a bigger factor than familiarity which is in turn important than knowledge. When considered through a purchasing funnel, knowledge leads to familiarity which in turn leads to awareness. HEV owners are more interested in purchasing electric vehicles. The interest seems to be based on experience and knowledge. Updating people about the benefits of EVs and incentivizing them is an important step in commercializing them.

The major psychological factor in EV adoption is the perception of economic benefits. Individuals perceive a product in terms of the economic benefits sought. When the price of gasoline rises, people tend to purchase more EVs for the sake of saving. The reason for this decision is that the maintenance costs of EVs are much lower. To be more precise, the energy costs incurred on the fueled vehicles are almost eight times higher than the EVs. Cheaper electricity and more expensive gasoline provide enough incentives for people to buy EVs.

A wide range of concerns are available in the literature about customer preferences and opinions about EVs. These include functionality issues related to EVs such as miles per charge. Psychometric factors can also be assessed to differentiate traditional car buyers from buyers of EVs. Functional barriers can be considered the main barriers to the adoption of EVs. Thus, these barriers can be considered intervening variables in the buying behavior of EVs.

Environmental factors also play a significant role in describing consumer behavior. These factors may include the efforts to buy ecologically safer products. People considered non-environmentalists are much less likely to buy EVs as compared to their counterparts. Environmental aspects will have a positive impact on the buyer of an EV before and after an EV has been used. Additionally, environmental concerns will also lead a person to buy a full EV. Although people consider EVs to be environment-friendly, they are also concerned about the negative impact of electricity charging and battery production. However, environmental factors are considered less important as compared to vehicle costs and performance. Sustainability is a minor issue when comparing EVs to traditional vehicles.

Governments play an important role in adopting any new technology by helping with research and educating consumers. Additionally, the government has an important responsibility to spread objective information about the issue and develop policies to help in the manufacturing and adoption of EVs. Some governments may also monetary incentives to people purchasing EVs. With the increase in charging infrastructure, there will be a higher level of EV acceptance. These policies cannot induce an increase in EV adoption unless people know explicitly about them. Financial incentives and subsidiaries may be considered temporary steps to enhance EV adoption. If buyers have lower confidence in EVs, then financial incentives may not be very successful in increasing adoption. However, if the incentives are offered to manufacturers, they will have a positive influence on the adoption of EVs. Lastly, the political state of affairs also influences the acceptance of new products.

Car characteristics also play an important role in influencing buyers to purchase a new vehicle. The purchase of EVs is influenced by a higher purchase price, limited mileage per charge, battery life and replacement costs, and time required to charge the vehicles.

4. Research Objectives

The main aim of this study is to find and elaborate on the factors that affect the buying behavior of EV consumers along with understanding the barriers in adopting EVs. The current analysis is aimed at understanding the barriers to EV adoption in the Asian market. The additional aim of the study is to identify the factors influencing the purchase behaviors of EVs.

5. Research Model

Various studies have highlighted the importance of knowledge, awareness, and knowledge of EVs when considering the adoption of EVs [9]. Some studies have found that psychological factors like the perception of economic benefits and functional characteristics of EVs play an important role in the process of buying an EV [10]. Many studies have been undertaken to understand the important characteristics related to EVs in purchase intentions and have compared conventional vehicles to EVs. The environmental aspects related to EVs have not been well-studied. Thus, the current study will focus on the environmental aspects of EVs.

Hypothesis 1: There is a positive impact of personal norms (PN) on people's intentions to buy EVs

It is important to assess if individuals are aware of their behaviors especially if these behaviors are environmentally friendly. In the case of environmentally friendly behaviors, awareness affects personal norms positively.

Hypothesis 2: Awareness about outcomes will have a positive impact on personal norms

Previous research has shown that being aware of the outcomes can help an individual identify the responsibility related to the vehicles. If the decision-makers are well aware of their responsibilities regarding the environment, they will be more committed to reducing environmental impact.

Hypothesis 3: Awareness about outcomes will have a positive impact on the ascription of responsibility.

Past studies have shown a positive relationship between the ascription of responsibility and personal norms [1]. If

individuals know the positive outcomes of not participating in environmentally friendly activities, they will be more responsible towards them and will show a higher commitment to follow those behaviors. Consumers using traditional vehicles and their responsibility towards society as a whole will result in a higher adoption rate of EVs.

6. Data Collection

This paper has applied the procedures of the non-probability sampling technique because of the total number of elements in the population. A purposive sampling technique has been used by carefully choosing the participants for the desired purpose. In purposive sampling, the researcher purposefully inducts the participants because they fulfill some specific requirements [11]. It is an extremely useful technique at the start of a study when participants have only a little knowledge of the subject. Since obtaining the list of all the individuals using the transportation was not possible, the study used non-probability purposive sampling to gather the data. The questionnaire was given only to individuals who had a driving license and were experienced in driving a vehicle. To identify the minimum feasible sample size, the study used the popular rule of thumb to square the number of constructs and add 50 or 100 to it to find the minimum number of samples. The sample size for this study came out to be 150. The sample was big enough to examine model parameters. The data was collected using internet sources including social media. 129 questionnaires were received out of which 10 were eliminated because of incomplete data.

Variables	Frequency	Percentage
Gender		
Male	88	73.95
Female	31	26.05
Age		
less than 35	30	25.21
B/w 35 and 45	69	57.98
greater than 45	20	16.81
Education level		
Senior high school	17	14.28
Undergraduate	87	73.11
postgraduate	15	12.61

7. Hypothesis Testing

The multiple correlation coefficients (R²) show the extent to which an independent variable describes the change in the dependent variable. The values of R-squared were 0.47, 0.37, 0.62, and 0.86 for the ascription of responsibility, personal norm, attitude, and intention of adoption. Since these values are more than the suggested minimum of 0.25, a significant proportion of the model variance has been explained by these variables. More specifically, 78% of the variation in the dependent variable is explained by the independent variables. The first hypothesis has been proven with β -value = 0.195 and $p < 0.001$. The next two hypotheses are also supported with $\beta = 0.206$ and p -value < 0.001 .

8. Discussion

The main purpose of the research was to investigate the factors affecting consumers' intentions to use EVs in Asia. Social and psychological factors play a central role in the

decision to switch to technology [12]. Thus, the integration of NAM and TPB was used in the study to propose and analyze a more detailed framework. The model showed that Personal Norms (PN) had a positive impact on the adoption of EVs. Past research has also supported that personal norms can significantly predict environment-friendly behaviors. People who are highly concerned about social issues will be more tilted towards EVs. Having a deeper understanding of energy-efficient devices is also important for participation in EVs. The results show that AC and AR have a positive and significant relationship with Personal Norms.

9. Conclusion

The current study was aimed at developing a research model including the factors affecting customers' intention to adopt EVs. The model was developed using two theories or models named NAM and TPB while other factors were also added to the analysis from the past research. NAM was included in the model as a pro-social incentive. A

questionnaire was prepared for collecting data and all three hypotheses were supported by the data analysis. The major limitation of the study was that behavioral intention may not be fully representative of the actual behavior. Future studies can use behavioral models other than NAM and TPB. Other limitations may include the fact that the study was completed in Asia.

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