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A Study on the Impact of Perceived Benefits on Customer Preference for Electric Vehicles#

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Abstract

Indian roads are currently dominated by petrol and diesel cars and bikes with only one percent of the vehicles in India being Electric Vehicles (EVs). India is not self-sufficient and it imports crude oil from other countries, which is a huge burden on the country's balance of payments. India is making efforts to adapt to the EV trend and various automobile manufacturers are taking advantage of the situation by producing and marketing EV vehicles. However, the Indian customer's mindset is not favourable for the promotion of EV's. Hence, an attempt has been made to identify the various aspects that influence or prevent consumers from switching from carbon-fuelled vehicles to electric vehicles. The primary data collected through a well-structured questionnaire has been analysed using Percentage Analysis and Chi-Square analysis. The study found that awareness level is not a significant factor, although awareness was considered a major factor in consumers' preference for buying electric vehicles in earlier literature. Statistically significant results indicate that changes in 'fuel price', 'environmental consciousness' and 'same price as petrol/diesel' significantly influence consumers' buying preferences for an electric vehicle.

Keywords: Customer Perception, EV Infrastructure, Perceived Benefits, Renewable Energy

1. Introduction

A new mobility era is emerging in India propelled by net zero commitment amid growing concerns about climate change. At present, the road transport segment contributes about 123 million tonnes of carbon emissions. Increases in carbon fuel prices as well as increased carbon footprints in this world have caused major problems for consumers as well as the environment in various forms. The growing demand for fossil fuels, industrialization, civilization, global warming, and the depletion of fossil fuels is driving the whole world to adopt different means to power themselves. Hence, switching to an electric fuel vehicle seems to be a better sustainable option to save the environment and money, but only with the condition that such electricity is produced through clean energy forms.

Developed countries like the USA have long since migrated to electric vehicles as is seen in the article published way back in 1997 titled "Electric vehicles as

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a new power source for electric utilities". The author states that electric vehicles will add value as useful power resources, as they will serve as electric utilities (Kempton and Letendre, 1997). This is true in the case of electric vehicles fuelled by liquid, gaseous, or solid fuels or by batteries. In developed countries, vehicle purchase subsidy was recommended to be offered as an incentive more than 25 years ago (Kempton and Letendre, 1997).

Despite the delay, India is now committed to improving people's quality of life and furthering the government of India's initiative in ushering in a green mobility future. India has said that it will reduce its carbon footprint by half by the year 2030. Our nation is marching ahead with the adoption of electric vehicles to decrease the carbon footprint and build a sustainable transportation system. India's expertise in renewable energy is contributing to the creation of India's robust mobility ecosystem with its pioneering grid-to-plug EV charging system and a grid eMotion flash that offers a robust charging infrastructure for large-scale EV fleets. The major market leader's innovative flash charging technology 'grid eMotion flash' is further powering e-buses and reducing carbon emissions to enhance environmental sustainability through social innovation.

The extensive use of EV's is perceived as the solution to combat the scarcity of fossil fuels and to solve the environmental problems caused by customers' insistence on the usage of carbon-fuelled vehicles. (Almeida, *et al.,* 2013). India, along with various other countries has taken a pledge to reduce its carbon footprint and carbon emission to safeguard this planet earth from increasing temperatures. In almost all of the developed countries, governments are consistently supporting and adopting new policies for the promotion of sustainable and environment-friendly mobility through the use of electric vehicles (Sanguesa, *et al.,* 2021).

The Indian car market has delivered full EVs, hybrid EVs and fuel cell EVs in the last ten years. These EVs provide a variety of solutions to customers in terms of product differentiation and variety. However, the Indian customer's mindset is not favourable for the promotion of EV's. In this study, an attempt has been made to identify the factors affecting the perception of Indian customers and their preferences as they relate to their electric vehicle buying decisions.

This research aims to study the impact of costs and perceived benefits on the demand for electric vehicles. It entails an analysis of the various aspects that influence or hinder consumers to switch from carbon-fuelled vehicles to electric vehicles and determines the level of awareness about electric vehicles and the EV industry. The various aspects that the government and private players should work on so as to make this EV revolution a major game changer are also discussed. The study works on the general hypothesis that there is a lack of awareness about EVs in India and customers underestimate the costs and perceived benefits of electric vehicles preventing them from making a purchase. This study also examines the credibility of marketing claims made by EV companies with regard to their electric vehicles' performance efficiency.

2. Review of Literature

The arguments in favour of EVs broadly include economies of cost of running and maintenance and environmental sustainability against the high cost of acquisition of the electric vehicle. This section examines the literature on the technical and marketing aspects of EVs, their maintenance and their role in renewable energy solutions.

2.1 Customer Perception of EVs in India

Rout, *et al.,* (2020) found in their study that in Orissa's capital city Bhubaneswar, the awareness regarding Hybrid Electric Vehicles (HEV) was much less than desired among vehicle owners. They found that the number of users of E-four wheelers was minimal. The number of two-wheelers was also insignificant. Thus, they concluded that a lack of awareness was the main reason customers did not prefer electric vehicles. If awareness improves, the customer's attitude towards the purchase of HEV will also improve.

Ashok (2019) found that it is vital to provide the consumer with adequate information so that he is aware of the intricacies and implications of the new technology and perceives it as adding more value than the existing technology in order for the new technology to be accepted and adopted by customers. EVs and HEVs have their advantages, prospects and obstacles, and it is necessary to create a feeling of comfort in the mind of the customer so as to make him/her acquire the product.

Sharma (2020) found that the car producers and the Indian government must make larger investments to increase community acceptability of the vehicle by building more infrastructure, developing larger battery packs, and laying more emphasis on technology that can inspire customer confidence. The government should work hard to increase awareness of EVs and affect potential customers' attitudes in a positive way.

2.2 Existing EV-Related Surveys

Since 2010, there has been a tremendous increase in research and development and new technologies used in the production, marketing and sales of electric vehicles in India. Various safety concerns have been addressed and customisation of the vehicles for Indian roads has also received priority. This has increased the number of automobile companies making electric vehicles as part of their product portfolio. Among the research studies published recently, some analyse the general aspects including the evolution and introduction of electric vehicles in various countries, classification based on their design and engine characteristics and their impact on the electrical infrastructure. The following is a compilation of literature relating to the marketing of EVs:

2.2.1 Evolution of EV

Yong, *et al.,* (2015) evaluate the evolution and introduction of EVs from the nineteenth century until the present. In addition, they categorize the vehicles according to their powertrain settings and analyse the impact of charging electric vehicles on the electric grid. Transitioning transportation infrastructure to a fully electric model is an urgent requirement. However, it is extremely demanding on the available electrical grid. Richardson (2013) concludes that the required capacity, efficiency and productivity of the electric grid can be produced by EVs. In addition, he reviews the environmental impact, the costs and the economic impact of electric vehicles. Comparing costs, he argued that the cost of driving an EV that incurs charging costs is much less when compared to a similar-sized vehicle that runs on petrol for the same distance. Habib, *et al.,* (2015) also depict the variety of charging methods used for electric vehicles and analyse the way in which they impact the power distribution systems. The authors do an evaluation of the two different types of charging methods, namely, coordinated and non-coordinated, in addition to delayed loading and intelligently planning the charging. They conclude by stating the economic benefits of the technology of EVs, namely the vehicle-to-grid (V2G) technology.

2.2.2 Use of Renewable Energy

Harmful air pollution caused by exhaust emissions is drastically reduced with the choice of driving an EV. The use of renewable energy sources like wind power, solar power and biomass and how they have been incorporated into this field is another area of research on EVs. As a boost to increase sales, automobile companies and EV charging stations in the US are designing new pilot programs and services. In this rollout, commercial and residential customers are allowed to use common sources of renewable energy for the electricity needs of their EVs. By syncing daytime charging with peak solar output and nighttime charging with wind energy, more renewable energy sources are integrated into the grid. In addition, solar panels are installed at charging stations.

Liu, *et al.,* (2015) collated a broad perspective on electric vehicles and renewable energy sources, including solar and wind power. Their study is purposively classified into three categories: (i) those that deal with the interaction between reducing energy costs by the use of renewable energy sources for EVs; (ii) projects that are specifically aimed at reducing emissions; and (iii) proposals improving energy efficiency.

Another cause for concern is that the lithium-ion batteries used in the production and operation of hybrid cars create more emissions when compared to conventional fossil-fuelled cars. One-third of the harmful carbon dioxide emissions from hybrid cars emissions occur from the energy used in the production process of the vehicle. This indicates that in the promotion of EVs and their hybrid counterparts, there is still a long way to go before we can clearly state that EVs are not hazardous to the environment.

Hawkins, *et al.,* (2012) surveyed the existing literature about the environmental impact of Battery Electric Vehicles (BEVs) and Hybrid Electric Vehicles (HEVs) during their life spans through 51 environmental evaluations. Their work considered all aspects right from the production, transmission and distribution of electricity and harmful greenhouse gas emissions. They also studied the production of electric vehicles and their batteries and evaluated their efficiency, taking into account their life span. They state that although EVs appear to demonstrate decreases in global warming potentials (GWP) compared to conventional internal combustion EVs, high-efficiency ICEVs and grid-independent hybrid electric vehicles perform better than EVs using coal-fired electricity.

Plug-in Hybrid Electric Vehicles (PHEVs) use batteries to power an electric motor and another fuel, such as gasoline to power an internal combustion engine. It is seen here that hybrid vehicles are much better in terms of performance when compared to EVs. Thus, the relative merits of one type of EV can hardly be measured to be of any value as they have not done away with fossil fuels altogether. Rahman, *et al.,* (2016) assessed that PHEVs can be deployed more widely through efficient control and management of charging infrastructure and daytime charging stations. They studied the daily usage of PHEVs and stated that the appropriate distribution of charging stations can lead to a broader positioning of PHEVs.

2.2.3 Unidirectional and Bidirectional Charging

A comparative analysis of the optimization of charging in unidirectional and bidirectional models using a composite EV load model is another aspect that has been researched in the case of EVs. In doing this, Manmohan (2020) suggested measures to minimize the impact of high saturation of EVs on the grid and the EV charging cost. Real-time data is exchanged by the aggregator at every step between the vehicle and the grid such that the EV's charging schedule is optimized through the bidirectional communication infrastructure. The aggregator gets the updated, necessary information as soon as the EV is connected to the charging station. The aggregator then sends a signal command to the charging stations to charge or discharge the EVs that are connected based on this information. The aggregator's decision is influenced by the regulation reference and regulation price announced by the Transmission System Operator (TSO) and the Distribution System Operator (DSO).

An overall perspective of the updated economic model that fits into EVs is provided by Shuai, *et al.,* (2016). This perspective takes into account the unidirectional and bidirectional flows of energy wherein the EVs themselves have the capacity to provide power and energy to the electric grid. To enable this, the authors analyse various charging facilities available for EVs and the commercialization of different methods for the two types, unidirectional and bidirectional energy charging. In conclusion, they evaluate the extent to which these EVs can be used feasibly as storage for the energy generated from renewable sources.

Das, *et al.,* (2020) suggest various solutions for problems related to the charging infrastructure of PHEVs and BEVs that have been employed before. They also assess the effectiveness of varied charging systems in diverse environments such as malls, apartment buildings and domestic garages. This is because the massive EV disposition will have negative consequences on the existing power grid. Some other studies review other pertinent issues and the potential opportunities that EV integration with the smart grid can bring. Yong, *et al.,* (2015) studies the impact of EV distribution from the point of view of vehicle-to-grid technology, especially for minimizing renewable energy intermittency. In yet another study Mahmud, *et al.,* (2018) discuss all of the aspects related to EV charging, energy transfer, and grid integration with deployed energy resources in the

Internet of Energy (IoE). More recently, Das, *et al.,* (2020) present an evaluation of how future connected EVs and autonomous driving would affect EV charging and grid integration.

2.2.4 Battery Management

Other relevant EV charging issues are those that pertain to the management of the battery like battery health and lifetime estimations since they are vital factors in increasing the battery lifetime. Liu, *et al.,* (2019) review how recent advancements in big data analytics have paved the way for data-driven battery health estimation. To do this, they categorise them in terms of cost-effectiveness and feasibility and pinpoint their advantages and limitations. Liu, *et al.,* (2019) continue their study and propose the Gaussian Process Regression (GPR), which is based on a machine learning-enabled system to predict the ageing of lithium-ion batteries. Other approaches explore advanced techniques to diagnose faults since battery faults can potentially cause performance degradation.

Most of the studies that deal with EVs have focused on: (i) the impact of EV charging on electric demand; (ii) the use of renewable energy sources in the charging process; and (iii) the proposal of new methods for optimizing the charge of electric vehicles, including grid solutions. Not much research has been done on the customers' perception of the costs and benefits associated with the purchase and maintenance of an EV. This paper examines the marketing aspects of electric vehicles in the context of what benefits have been offered to customers as incentives to purchase an EV in India in terms of subsidies, GST rate reductions, and income tax deductions. An attempt has been made to evaluate the awareness levels of customers regarding the benefits of EVs and how that has impacted their preference for EVs.

In the present situation, where the world is facing a major threat from global warming, climate change, and human-induced natural calamities, electric vehicles are a boon to society. Fossil fuel vehicles emit lots of harmful gases that are deadly to the environment and do not contribute to sustainable development. Moreover, in developed countries, EV owners have been able to capitalize on the benefits of saving money on gas. They are environment-friendly as they do not emit pollutants. Not only do they perform better, but their maintenance cost is also lower due to an efficient electric motor. The only downside to this is the higher cost of acquisition of EVs when compared to internal combustion engine vehicles. The EV revolution offers a solution to the conservation of natural resources. However, the mindset of automobile users has not adapted to this new concept. This study is an attempt to find out the perceived benefits of electric vehicles from the point of view of automobile users. An attempt has been made to analyse their willingness to migrate from carbon-fuelled combustion engines to electric-fuelled vehicles.

3. Scope of the Study

This study is restricted to customer preferences towards electric cars driven only for domestic use. It does not cover other types such as electric two-wheelers or heavy vehicles nor does it include any discussion on cars for commercial purposes. Future researchers could further investigate considering other factors like geography, population, commercial vehicles, etc.

4. Research Methodology

The study uses a quantitative approach to measure, evaluate, and analyse consumer perceptions of switching from carbon-fuel vehicles to electric vehicles. This research is predominantly based on primary data. Secondary data from past publications, journals, and websites has been used to substantiate the research findings.

The primary data for this study was collected through a well-structured questionnaire. The survey was conducted to understand various aspects of the individual sample unit's perceptions, opinions and understanding of EVs. A sample of 250 individuals was selected through the purposive convenience sampling technique. The sample was representative of a diverse population so as to get a conclusive review of the EVs. The respondents include Indians residing in India as well as NRI's residing in the UAE.

Secondary data was collected from external sources like websites and journals to review the existing literature on electric vehicles. Percentage analysis and Chi-Square analysis techniques were used to determine the statistical significance of the findings.

5. Data Analysis and Interpretation

The data collected from a sample of 250 individuals were selected through purposive convenience sampling techniques. The data was subject to statistical analysis and the analysis and findings are as follows:

Table 1 depicts that 86% of the respondents surveyed attributed their lack of knowledge about EVs to their disinterest in preferring an EV.

Table 2 discloses that 86% of the respondents surveyed stated that the only reason that they would prefer an EV is the rising cost of petrol and diesel.

Table 3 discloses that 70% of the respondents surveyed stated that their buying preference would be affected by the fact that they would get an income tax benefit.

Table 1. Testing relevance between buying preferences with insufficient knowledge of EVs

Buying Preference	Know more			Total
	1	2	3	
Yes	156	32	27	215
No	23	6	6	35
Total	179	38	33	250

Source: Primary Data

Table 2. Testing relevance between buying preference with fuel price

Buying Preference	Fuel price			Total
	1	2	3	
Yes	78	55	82	215
No	9	11	15	35
Total	87	66	97	250

Source: Primary Data

Table 3. Testing relevance between buying preference with income tax benefit

Buying Preference	Income Tax Benefit		Total
	1	2	
Yes	64	151	215
No	7	28	35
Total	71	179	250

Source: Primary Data

Table 4 discloses that 78% of the respondents surveyed stated that the main reason for buying an EV is because they do have an environmental concern.

Table 5 shows that 72% of the respondents opined that lower GST would be a factor that would affect their buying preferences for EVs.

Table 4. Testing relevance between buying preference with environmental consciousness

Buying Preference	Environmental consciousness			
	1	2	3	Total
Yes	168	2	45	215
No	25	3	7	35
Total	193	5	52	250

Source: Primary Data

Table 5. Testing relevance between buying preference with lower GST

Buying Preference	Lower GST		
	1	2	Total
Yes	61	154	215
No	8	27	35
Total	69	181	250

Source: Primary Data

Table 6. Testing relevance between buying preference with lower registration cost and road tax

Buying Preference	Lower registration costs and Road Tax		Total
	1	2	
Yes	168	47	215
No	27	8	35
Total	195	55	250

Source: Primary Data

Table 7. Testing relevance between buying preference with lower insurance premium

Buying Preference	Lower Insurance Premium		Total
	1	2	
Yes	150	65	215
No	25	10	35
Total	175	75	250

Source: Primary Data

Table 6 shows that 78% of the respondents strongly opined that lower registration costs and road tax would be a factor that would affect their buying preferences for EVs.

Table 7 shows that 70% of the respondents opined that lower insurance premiums would be a factor that would affect their buying preferences for EVs.

Table 8 shows that 77% of the respondents opined that lower maintenance costs would be a factor that would affect their buying preferences for EVs.

Table 9 shows that 60% of the respondents opined that the availability of financial support and subsidies would be a factor that would affect their buying preferences for EVs.

Table 10 shows the level of trust that the respondents had in the safety and sustainability of EVs. The majority of the respondents' trust level was relatively high.

Table 8. Testing relevance between buying preference with lower maintenance

Buying Preference	Lower Maintenance		Total
	1	2	
Yes	165	50	215
No	30	5	35
Total	195	55	250

Source: Primary Data

Table 9. Testing relevance between buying preference with high financial assistance

Buying Preference	High Financial Assistance		Total
	1	2	
Yes	128	87	215
No	23	12	35
Total	151	99	250

Source: Primary Data

Table 10. Testing relevance between buying preference with trust level

Buying Preference	Trust Level (1 depicting a low level of trust and 5 the highest level)					Total
	1	2	3	4	5	
Yes	5	16	55	57	82	215
No	0	1	13	6	15	35
Total	5	17	68	63	97	250

Source: Primary Data

Table 11. Testing relevance between buying preference with same price as its petrol diesel

Buying Preference	Same price as its petrol/diesel			Total
	1	2	3	
Yes	**166**	**15**	**34**	**215**
No	22	3	10	35
Total	188	18	44	250

Source: Primary Data

Table 11 shows that 77% of the respondents opined that they would buy an EV if it was offered to them at a lower price than a combustion vehicle.

5.1 Testing of Hypothesis

H_1: Buying preference for an electric vehicle is significantly associated with buyers' knowledge about the vehicle, fuel price, environmental consciousness, income tax benefit, lower GST, lower registration cost, lower road tax, lower insurance premium, lower maintenance, high financial assistance, high trust level and the same price as its petrol and diesel counterparts.

Table 12 illustrates the results of the Pearson Chi-Square test depicting the association of buying preference for electric vehicles and various factors influencing buying preferences such as buyers' knowledge about an electric vehicle, fuel price, environmental consciousness, income tax benefit, lower GST, lower registration cost, and lower road tax, lower insurance premium, lower maintenance, high

Table 12. Representing testing of hypothesis using Pearson Chi-Square test

Variables	Pearson Chi-Square	df	Asymp. Sig. (2-sided)
Know more	0.777	2	0.678
Fuel price	1.528	2	0.046
Environmental consciousness	8.975	2	0.011
Income Tax Benefit	1.412	1	0.235
Lower GST	0.458	1	0.498
Lower registration cost Road Tax	0.017	1	0.895
Lower Insurance Premium	0.04	1	0.842
Lower Maintenance	1.411	1	0.235
High Financial Assistance	0.481	1	0.488
Trust Level	4.445	4	0.349
Same price as its petrol diesel	3.714	2	0.045

Source: Primary Data

financial assistance, trust level and the same price as its petrol and diesel counterparts.

Firstly, Table 12 depicts that buying preference for an electric vehicle is not significantly associated with buyers' knowledge about an electric vehicle, as we see that the Chi-Square value is 0.777 with a p-value above 0.05 (i.e., 0.678). It indicates that having knowledge about electric vehicles is not sufficient to influence their buying preference for an electric vehicle. Statistical findings indicate that there is no association between buying preference and knowing more or having more awareness about electric vehicles. Hence, we can strongly say that there is no significant association between buying preference and knowing more about electric vehicles.

This contradicts the findings of the study done by Rout, *et al.,* (2020) in Bhubaneshwar, in which they conclude that the demand for EVs is lower because of a lack of awareness. It is not the lack of awareness but the perception that is causing the customers to have a negative attitude towards the perceived benefits of EVs. This is also the case with regard to the tax benefits available for buying EVs. The lack of awareness of the same was not the reason for customers not preferring to buy EVs.

6. Results and Discussion

The study found that there was no significant association between trust level or assurance of the safety of EVs and preference for EVs. Hence, there is no significant association between buying preference and knowledge about electric vehicles. This contradicts the findings of the study by Ashok (2019) in Bangalore city which affirms that customers do not buy EVs because they are not aware of the safety aspects of the technology used in the manufacture process. It is vital to provide the consumer with adequate information so that he or she is aware of the intricacies and implications of the new technology, and perceives it as adding more value than the existing technology to make the shift to electric vehicles. EVs and HEVs have their advantages, prospects and obstacles, and it is necessary to create in the mind of the customer a feeling of comfort. However, this lack of awareness is not the main reason for the lack of preference for EVs.

Furthermore, Table 12 also depicts that buying preference for an electric vehicle is significantly associated with fuel price ($\chi^2 = 1.528$, df = 2, p = 0.046), environmental consciousness ($\chi^2 = 8.975$, df = 2, p = 0.011), and the same price as its petrol-diesel counterpart ($\chi^2 = 3.714$, df = 2, p = 0.045), as the p-value is less than 0.05 in all these cases. It indicates that changes in fuel price, environmental consciousness, and the same price as petrol and diesel significantly influence consumers buying preferences for the electric vehicle, where environmental consciousness is very vital for the buyer.

However, buying preference for an electric vehicle is not significantly associated with income tax benefit ($\chi^2 = 1.412$, df = 1, p = 0.235), lower GST ($\chi^2 = 0.458$, df = 1, p = 0.498), lower registration cost and road tax ($\chi^2 = 0.017$, df = 1, p = 0.895), lower insurance premium ($\chi^2 = 0.040$, df = 1, p = 0.842), lower maintenance ($\chi^2 = 1.411$, df = 1, p = 0.235), high financial assistance ($\chi^2 = 0.481$, df = 1, p = 0.488) and trust level ($\chi^2 = 4.445$, df = 4, p = 0.349). Hence, H_1 is partially accepted.

Another cause for concern is that the lithium-ion batteries used in the production and operation of hybrid cars create more emissions when compared to conventional fossil-fuelled cars. One-third of the harmful carbon dioxide emissions from hybrid cars occur from the energy used in the production process of the vehicle (Liu, *et al.,* 2019). Hence, there is still a long way to go before we can emphatically state that EVs are not hazardous to the environment.

Plug-in Hybrid Electric Vehicles (PHEVs) use batteries to power an electric motor and another fuel such as gasoline to power an internal combustion engine (Hawkins, *et al.,* 2012). It is seen here, that hybrid vehicles are much better in terms of performance when compared to EVs. Thus, the relative merits of one can hardly be measured to be of any value as they have not done away with fossil fuel altogether. The recent developments which have happened in the modern-day world like the war, COVID, the crippling

of the economies of various countries, inflation, etc., are harming the global fossil fuel price. This sudden and drastic increase in fossil fuel prices is having an adverse effect on the lives of people, and because of this, about 85.2% of people have expressed their intention to switch from carbon-fuelled vehicles to electric vehicles.

During the observation of the data, it was found that before 2019, people were less aware of EVs. Hence, their behaviour towards buying an EV was driven by their level of understanding of EVs and awareness about various factors that were directly or indirectly aiding EV sales. The study finds that 85.2% of the people (213 out of 250) are willing to buy an EV, but this purchase behaviour has nothing to do with various factors that were thought to be the driving force behind a purchase decision. Thus, the purchase decision is not influenced by or has nothing to do with the following:

- Wanting to know more about electric vehicles.
- Awareness about income tax benefits.
- Awareness about lower GST rate.
- Awareness about lower registration costs/road tax.
- Awareness about lower insurance premium.
- Awareness about lower maintenance.
- Awareness of high financial assistance.
- Trust level in the Indian EV industry.

At present, people's perceptions have changed and it is observed that customers purchasing preferences for EVs are heavily influenced by the increase in fossil fuel prices. The increase in fuel price has influenced people to think of EVs as an alternative to combustion engine vehicles.

7. Conclusion

The case for and against the use of EVs is still highly debatable. In a country like India, there are still major issues to be resolved in the use of EVs with regard to battery safety, the chances of vehicles bursting and the availability of charging points. Governments of different countries are favouring the use of EVs and depicting it as a way to protect the environment and promote sustainable development. However, a lot of research is still underway with regard to the technology used in the manufacture of EVs which still releases a large amount of carbon dioxide into the environment, the higher performance of hybrid vehicles when compared to EVs, and the lithium-ion batteries used. Some of the main concerns of customers who have already purchased EVs are safety with regard to the battery and the concept of range anxiety, or whether they will be able to find the needed battery charging points while on the road. Battery swap technology is still under development. Hence, the following suggestion would help the government create an EV revolution and resolve issues in the practical implementation of EV infrastructure.

The government should increase the provision for subsidies to people who purchase EVs. It should strengthen the combustion engine vehicle scrappage policy to fuel this EV revolution. The government as well as corporations should work together to create a network of charging stations across the country to reduce or eradicate range anxiety. In addition, they should also develop battery-swapping technology. As lithium-ion batteries used in EVs are harmful to the environment, the government and corporations, should work together to set up a research facility to find out the best way to dispose of or recycle these batteries.

Presently, the grids in India are not capable of handling this EV revolution, as they cannot handle a high load at once. This EV revolution would be a major success if and only if the energy generated to fuel this EV is produced from a clean energy source.

As the EV needs more technology integration, the government should resolve the issue of the shortage of semiconductor chips. Car manufacturers should find some ways to reduce the cost of manufacturing EVs and also bring out more variants to capture a diverse group of people. These suggestions would help the government and the country successfully build an EV infrastructure and contribute to the sustainable development of the economy.

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