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Chapter 1. Introduction

Government of India is pushing for a quicker uptake of electric vehicles to tackle the deadly air pollution in its cities and lower carbon emissions from fossil fuels. It aspires for at least 33% of all vehicles on the road to be electric by 2014.

Utilizing electric cars (EVs) more frequently could help address problems including global warming, pollution, & oil reliance. EV market penetration is still relatively low even though many governments have adopted aggressive marketing campaigns. This paper provides an indepth analysis of consumer preference surveys for EV in order to

better inform policy-makers and offer suggestions for future research. We compare the economic and psychological approaches to this problem before using an EV-based conceptual framework to organise our review.

We also provide a brief

summary of the modelling techniques applied in the selected studies. An analysis of consumer choice projections for financial, technological, infrastructural, and policy attributes is then given. Then, the effects of the many categories of socioeconomic characteristics, psychological variables, mobility conditions, social influence, etc. that influence consumer preferences are classified and explained.



Figure 1: Green Energy Scope

India wants to move to a more energy-efficient road transport system. Launched in 2013, the National Electric Mobility Mission Plan (NEMMP) 2020 sought to pave the way for a switch from fossil fuel-based mobility to one driven by electricity. By 2020, the mission's ambitious goal was to have 6-7 million electric vehicles on the road nationwide. The impact of the Government of India's following initiatives and programmes, which were mostly implemented through the FAME programmes, has been little in terms of helping to meet the NEMMP's objectives. Since the FAME program's inception in April 2015, little under 2.7 lakh electric cars, including over 1.7 lakh electric two-wheelers, have been sold as of June 2019.

1. Moving to clean mobility

- According to air quality indicators for India, it is no longer safe to breathe in many Indian cities. One of the reasons for this is pollution from automobiles.
- The automotive industry needs to switch to solutions that minimise or do not emit greenhouse gas emissions in order to address aspects of global warming.
- The requirement to lessen reliance on an economy based on fossil fuels. India imported 112 billion dollars' worth—or almost 7, 00,000 crore rupees —of crude oil in 2014–15. In contrast, the budget for 2017–18 allotted 48,000 crore rupees for the Mahatma Gandhi National Rural Employment Guarantee Scheme.
- India has the potential to lead the world in providing scalable, cost-effective clean mobility solutions.
- Residents of numerous Indian cities experience the effects of noise pollution. Some Indian cities have some of the worst noise pollution levels. By

adopting electric vehicles, noise pollution levels in cities could be.

2. Government of India Initiatives

The Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) programme was launched by the government and offers financial incentives for buying electric vehicles. To improve the nation's charging infrastructure, the government is issuing tenders. The 2017 Electric Vehicle and Energy Storage Policy was adopted by Karnataka.

The car is covered by the Indian government's FAME-India (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles) programme, which offers incentives for buying electric and hybrid cars. For scooters and motorcycles, these advantages range from

Rs. 1,800 to Rs. 29,000, and for vehicles, they are Rs. 1.38 Lac. The National Electric Mobility Mission Plan of the Indian government includes FAME as a component.

The government has revealed a two-pronged strategy that targets both customers and producers. It gives consumers \$1.4 billion in subsidies while increasing import taxes to promote the development of these vehicles by domestic companies. Public transport electrification is the main objective of the government's subsidies, which are largely provided for two-wheelers, three-wheelers and buses. Additionally, this plan allots \$140 million for the development of charging infrastructure, which ought to help the Indian EV sector expand. On December 14th, the government also released a document providing requirements and suggestions for EV Charging infrastructure. Along with the specifications for the charging infrastructure, the regulations demanded that a charging station be present every 25 km along a road or highway.

The Delhi government is one state government

that is actively working to promote the use of electric vehicles in India. Recently, the Delhi Government approved the usage of 1000 Electric

buses in Delhi's public transportation system. The Uttarakhand government unveiled a new programme in 2018 to support EV production and encourage their use. The programme would give businesses loans between Rs 10 crore and Rs 50 crore to manufacture EVs and the infrastructure necessary for charging them. The programme also waives motor tax for the first lakh electric vehicle buyers for a period of five years. By proposing to remove EVs from road tax and provide a 15% subsidy to the first lakh EVs registered in the state, the Maharashtra government is aiming to increase

EV adoption in the state. The Maharashtra government is attempting to encourage EV adoption in the state by proposing to exclude EVs from paying road tax and to offer a 15% subsidy to the first lakh EVs registered in the state. In order to build the necessary infrastructure, the government suggested offering the first 250 stations established in Maharashtra a maximum subsidy of Rs. 1 million (about \$15,549) per charging station.

10,000 Electric Vehicles are being purchased by Energy Efficiency Services Limited (EESL) from reputable manufacturers for distribution to govt. departments on a rental basis and a direct purchase basis. Due to EESL's tender for 10,000 electric vehicles, the price of EVs has significantly dropped.

Chapter 2 E Vehicle Industry

In order to address the concerns of national energy security, vehicular pollution, and the expansion of local manufacturing capabilities, India presented the "National Electric Mobility Mission Plan 2020" in 2013. The Government of India has plans to transition significantly to electric vehicles by

2030, reaffirming its commitment to the Paris Agreement. Over the next two decades, ecommerce businesses, Indian automakers like Reva Electric Car Company, and Indian app-based transportation network companies like Ola are seeking to increase the use of electric vehicles.

Industry Profile

India's 2030 Vision on Electric Vehicle

The Government of India and the Indian Automotive Industry have jointly finalised the Automotive Mission Plan (AMP). According to the AMP 2026 vision, by 2026, India's automotive industry will rank among the top three globally in terms of engineering, manufacturing, and exporting vehicles and components. It will also provide safe, effective, and environmentally friendly conditions for affordable human and commercial transportation that are on par with international standards, contributing more than 12% of India's GDP and creating 65 million new jobs.

Due to intense market competition, India's auto sector has grown to be among the biggest in the world. According to the 2016 Automotive Mission Plan Review Report, the car industry's turnover is

7.1%. The National Mission on Electric Mobility was approved by the Indian government in 2011, and the National Electric Mobility Mission Plan (NEMMP) 2020 was subsequently unveiled in 2013. FAME - India (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India) is a programme developed by the Department of Heavy Industry as part of the mission. It will go into effect on April 1, 2015, and

its goal is to support the growth of the hybrid/electric vehicle market and manufacturing

eco-
system.

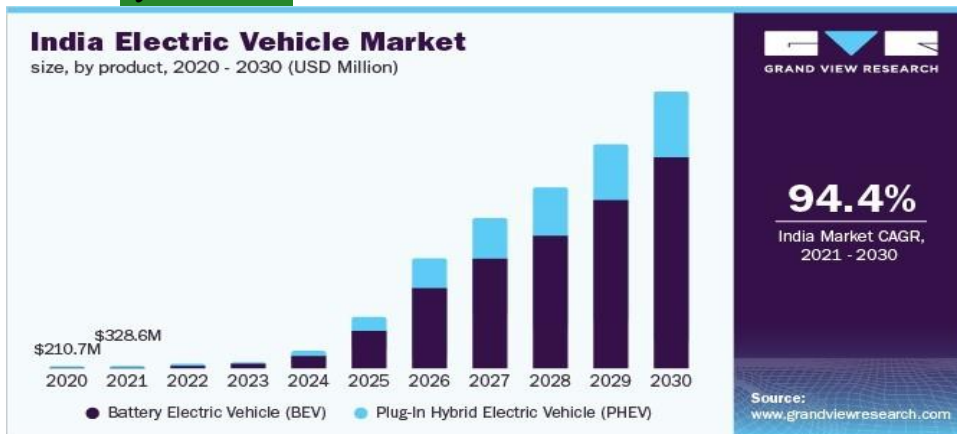


Figure 2: Indian Electric Vehicle Market

The total programme is expected to be implemented over a six-year period, through 2020, with the goal of assisting the market's growth for hybrid and electric vehicles and the industry's

transition to self-sufficiency. Technology Development, Demand Creation, Pilot Projects, and Charging Infrastructure are the four main aspects of the programme.

According to the Ministry of Road Transport & Highways' regulation No. GSR 643(E) dated 19.08.2015, all four-wheeled vehicles constructed on or after the first of April 2017 must comply with the Bharat Stage IV mass emission criteria. By 2020, India will upgrade its Bharat Stage (BS) IV emission standards to BS VI.

Instead of using gas or diesel, electric cars use

alternative fuel. Hybrid and electric vehicles are becoming more and more popular in the nation, and more manufacturers are focusing on this specialised market with the sole purpose of reducing gasoline import costs and vehicle operating expenses. The switch to electric vehicles has the potential to save the country \$100 billion in fossil fuels every year, preventing the dependence

on imported petroleum goods and reducing city

pollution by 80–90 %.

- The NDA government wants India to have 100% electrified vehicles by 2030.
- India spent Rs 4.7 lakh crores on crude oil imports in 2016–17. Electric vehicles will aid in cost reduction.
- According to current government plans, every car sold in India starting in 2030 will be electric.
- By 2030, India wants to have only electric cars on the road. By 2020, seven million electric and hybrid vehicles are the goal set by the National Electric Mobility Mission Plan (NEMMP).

Electric cars have zero tailpipe emissions, which reduces smog in urban areas. The Indian government has gained pace with its Faster use and Manufacturing of (Hybrid &) Electric cars efforts, which both promote and, in certain situations, require the use of electric cars (EV), with a target of 30% EV penetration by 2030. The strategy fosters the development of technologies and charging facilities in urban areas while fostering incentives for EV demand. It is estimated that if these objectives are met by 2030, they will prevent up to 474 million tonnes of oil equivalent (Mtoe) and 846 million tonnes of net CO₂ emissions during the course of their lifetime.

To promote the creation and use of EVs and charging infrastructure, a number of fiscal demand incentives, such as income tax rebates of up to INR150,000 (\$2,100) for customers on interest paid on loans to acquire EVs, have been enacted. To enhance lithium-ion cell battery production while reducing costs, a customs duty exemption will be put into place.

90% of Indian automobile owners, if the required infrastructure is in place, are expected to switch to EVs, according to a May 2019 Economic

Times survey. Although only 1% of all vehicles sold in India at the moment are electric, electric two-wheelers make up 95% of those sales.

Players in the automobile sector, as well as providers of batteries, charging infrastructure, and mobility services, have taken a variety of steps to speed up industrial activity. Companies are developing and testing goods that are appropriate for the Indian market, with a particular emphasis on two- and three-wheelers. An initiative called "Mission: Electric" by the Indian taxi business Ola aims to add 10,000 electric rickshaws and auto rickshaws to its fleet. Mahindra and Mahindra, a car manufacturer, would invest INR18 billion in EV production over the next three years in order to increase its four-wheeler production. In order to improve their public transport networks, other manufacturers are forming collaborations with governments. The government's aim is still unwaveringly supported by some of the producers

of light-weight cars, such as Hero MotoCorp, Bajaj Auto, and TVS, but they are now recommending a more careful, precise, and practical roadmap for

the adoption of EVs. The automotive industry would need to spend an estimated INR 70 billion to comply with the government's new Bharat

Standard-VI emission laws, and with the requirement to replace traditional internal combustion engines within the following five years, businesses are already feeling the financial pinch. Battery producers like Amara Raja are actively working to improve their research and development capabilities in order to create battery packs for electric vehicles. Electric charging stations will be widely dispersed throughout cities thanks to ambitious plans by Indian Oil, National Thermal Power Corporation, and Tata Power.

State governments and municipal transport bodies are essential for scaling up the deployment of EVs.

Ten states and union territories have released draught or final policies that are in line with the economic and demographic circumstances of each region to supplement this central government initiative.

Different strategies have been used. For instance, Delhi's strategy focuses on the parts of electric vehicles that have achieved parity in terms of life cycle and total cost of ownership with internal combustion engine (ICE) vehicles, given the city's air pollution problems and role as a high-employment hub. Additionally, it hopes to generate employment for battery changers.

Karnataka, on the other hand, aspires to develop into an EV manufacturing hub and invest in research and development for battery manufacture thanks to technology hubs like Bengaluru. Kerala is concentrating on employing energy-efficient equipment, electric trains, and electric buses. Awarded for its comprehensive strategy, Tamil Nadu has designated parking places for EV in commercial buildings and established an EV venture capital fund in addition to offering tax exemptions for production and land subsidies. Each state takes a unique strategy to address its particular environmental problems.

2.1 Market Scenario

Over the forecast period, the Indian electric vehicle market is anticipated to expand at a CAGR of 30%.

The technology, power source, vehicle type, and powertrain categories used to categorise the electric vehicle market in India. The three technology-based subsectors of the Indian electric vehicle market are hybrid electric cars, plug-in hybrid electric vehicles, and battery electric vehicles. Based on the power source—stored energy, on-board electric, and generator—the Indian electric vehicle industry is split into three categories. The two-wheeler, passenger car, commercial vehicle, and other vehicle segments make up the Indian market for electric vehicles. In India, the majority of electric vehicle sales are made up of series hybrid, parallel hybrid, and combination hybrid models.

Electric vehicles will play a significant role in reaching India's goal of reducing overall oil import costs and city pollution levels. Increased crude oil prices and strong government support are what are driving India's demand for electric vehicles. By 2030, the Indian government will outlaw petrol and diesel vehicles

In other words, only electric automobiles will be sold starting in 2030 and no petrol or diesel vehicles will be permitted on the road. The government's prohibition on petrol and diesel vehicles is a strong supporter of green, electric technology and has the potential to transform the transportation sector forever. A potential market for electric vehicles in India is created by government initiatives such as FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) and NEMMP (National Electric Mobility Mission Plan) 2020. Electric vehicle

adoption is aided by lower battery prices and lower maintenance and operating costs.

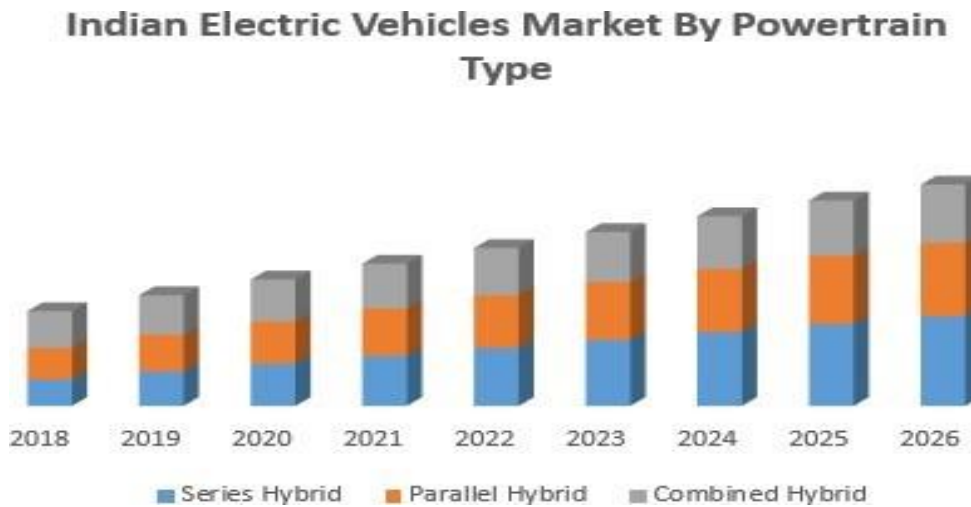


Figure 3: Penetration of EV

In 2017, the two-wheeler vehicle sector dominated the Indian market for electric vehicles. High CAGR growth is projected for passenger autos. High sales will result from the government's proposal to outlaw diesel and petrol passenger cars. By 2026, it is anticipated that this passenger

car segment would account for 70% of sales of electric vehicles in India.

The Indian market for electric vehicles is predicted to be dominated by the stored electricity category,

which is expected to command an estimated 84.4% market revenue share in 2017. The federal government has suggested that the state and federal governments build a "minimum skeleton network" of charging infrastructure across the

nation.

Every 25 kilometres on the highways that connect metro areas, two sets of charging stations are suggested, one on each side of the route. As a result, the market for stored electricity power sources will grow, encouraging the usage of EVs and creating enough demand to draw businesses to build charging stations.

Automakers have begun to make significant efforts to electrify or introduce electric automobiles.

⁴⁹Hyundai has stated that electric vehicle sales will begin in India in 2019. The introduction of Maruti Suzuki's first electric vehicle in India is scheduled for 2020.

Plans exist for international automakers like Audi, Mercedes, and Porsche to introduce their electric automobiles to India.

Toyota Motor Corporation, Honda Motor Co., Ltd., Bayerische Motoren Werke AG, Avon Cycles Ltd, Lohia Auto Industries, Electrotherm (Indian) Ltd, Yamaha Golf-Car Company, Club Car, LLC, Speedways Electric, Maini Material Movement Pvt. Ltd., Auto Power, Carrieall Car Private Limited, Ampere Vehicles Pvt. Ltd., and Tunwal E-Vehicle Indian Pvt.



Figure 4: EV Manufacturers

The research also aids in understanding Indian Electric Vehicles Market, by geography for automotive dynamics, structure, and size by segmenting the market and projecting the Indian Electric Vehicles Market, by geography, for automotive size. There is a clear depiction of competition analysis of key rivals by type, price, financial status, product portfolio, growth plans, and regional presence in the Indian Vehicles Market for the Electric automotive investor's guide report

It is inevitable that electric car use will increase, both globally and in India. Although many manufacturers have released EVs, there are a number of issues that need to be resolved, and a

govt. involvement is one of the likely methods to do so.

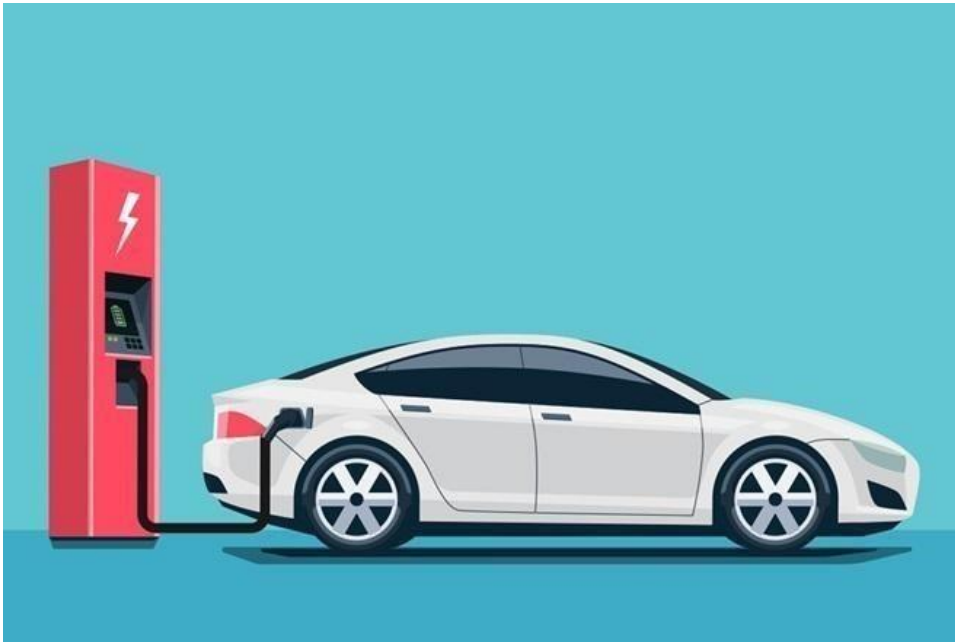


Figure 5: EV Car

A revolution in the vehicle business is set to occur worldwide. The four technology-driven trends of electrification, shared mobility, connectivity, and autonomous driving are causing a significant upheaval in the automotive industry. Markets and revenue sources, mobility patterns, and new chances for competition and cooperation will all be affected by these changes.

2.2 India -Emerging EV ambition

These impact of the global disruption have already started to be seen in the Indian automotive sector. The relevance of and potential influence on car OEMs and auto component makers from the electrification trend, one of the four emerging trends, cannot be overstated. India has ambitious aspirations for the technologies and newlyemerging electric vehicles in the nation. This has

issued its ten-year ultimatums. India has high hopes for reaching a significant degree of e-mobility adoption by 2030.

For this technology to be supported, a thorough policy must be created. An eco-system strategy would enable India's transition to electric mobility.

In some ways, the FAME I and FAME-II regulations on "Faster Adoption and

Manufacturing of Hybrid and Electric Vehicles" have helped to successfully establish a young but developing market. However, it seems that the government is focussing on supply-side initiatives, like the manufacturing of crucial EV technology components.

Challenges and Barriers to going electric

- > The development of the EV business in India will take some time even though there are no obvious signals of electrification. This isn't because of the government of India's lofty objectives and subsequent actions; rather, it's because the auto sector expects India to follow the same low-carbon regulations as other significant global auto markets like China, the US, and Japan.
- > The main issues have been range anxiety (kilometres on a single charge), a lack of infrastructure for charging, and a number of other things. Among them are:

➤ Incentives

- Electric vehicles (EVs) are a very small niche market that are all highly expensive and still reliant on incentives. This is valid in industrialised nations with a critical mass of EVs on the road, such as the US and China. Adoption in India will be significantly impacted by government incentives as well.
- A counterargument contends that while demand incentives may be advantageous in the short run, they won't be as effective in five to six years, when it is anticipated that battery prices would decline and ICE vehicle costs will increase as a result of more stringent emission standards. By that time, EVs will already have an advantageous operating cost that makes them profitable even without subsidies.

➤ Cost of the battery

- Currently, the battery and power electronics account for about two thirds of the cost of an EV. The most popular battery types today are lithium-ion (LiON) and nickelmetal hydride (NiMH) batteries. There are a lot of factors, including as demandsupply imbalances, unprofitable low volume production, etc., that contribute to the high cost of EV manufacture. The ex-showroom price of an

EV is affected by the battery, power electronics, and motors, which can now cost up to six or seven times as much than an IC

- Therefore, it is clear that the advantages of localization can only be realised in the long run and with sufficient EV penetration and volume.

> High Cost

The high cost of EVs at the moment is the largest barrier for consumers wishing to go electric. The roughly threefold price of an EV is too great of an entry hurdle for a buyer who is hesitant to select a hybrid over the same ICE-only car. According to industry opinion, the price differential between ICE automobiles and similarly situated EVs cannot be greater than 1.2x to 1.3x.

However, because of the increased cost of technology distributed over a lower price range, lower-end cars will typically be more expensive. Unfortunately, consumers in the lower price range are also more sensitive to price. Additionally, the cost-of-ownership issue will have an impact on EVs' long-term viability.

> Challenges from the Grid side

Most often, discussions about electric vehicles (EVs) focus solely on India's lack of a charging infrastructure, who will be held accountable, and when this will change. The quantity of electricity produced by antiquated coal-fired thermal power plants has also been raised, and it has been suggested that EVs may only be relocating pollution from urban areas to the suburbs where these plants are located. What about the additional challenges the grid might face when EVs start to gain traction and additionally, how much does it cost to charge EVs at public charging stations.

2.3 The way forward for e-mobility in India

Besides the end-users or customers, three key stakeholders could play an integral role in India's transition towards EVs.

- The government: It may encourage the adoption of EVs and concentrate on creating a supporting ecosystem by outlining the restrictions on emissions and fuel economy, establishing ambitions, strategic intent and direction, and exploring incentives and subsidies.
- The companies that provide power, fuel, and charging infrastructure: By laying a solid foundation of support, developing innovative business models (such as leasing batteries, swapping infrastructure, and deploying fast chargers), making (fast) charging infrastructure economically viable, and ensuring a steady power supply and grid stability, they can promote EV adoption.
- The automotive industry can lead the EV disruption in India by altering the product and component mix, bringing EV components and vehicles to life, developing the necessary talent pool and skill set, enhancing the performance of batteries and electric vehicles, and gaining scale.

Because of the worrisome amount of pollution and the fact that renewable energy sources and transmission are the sole option, e-mobility in India will no longer be a luxury but rather a necessity for survival. In light of the fact that EVs are ultimately unavoidable, it is preferable to plan and organise how the advances will take place as opposed to trying to avoid the transition.

Unquestionably, the time has come for a comprehensive policy on upcoming transport, with a focus on zero-emission transport. However, such a scheme should also consider the sector's financial soundness, tax revenue, and the millions of jobs it provides. In the future, the use of electric vehicles will only increase, advance, and spread.

2.4 Main Players of Indian Electric Vehicles Market:

Toyota Kirloskar Motor Pvt. Ltd., Mahindra Electric Mobility Limited, Tata Motors Limited, Volvo India Private Limited, BMW AG, Kinetic Green Energy & Power Solutions Ltd., Lohia Auto Industries, Avon Cycles Ltd., Okinawa Autotech Pvt. Ltd., and Hero Electric Vehicles Pvt. Ltd. are a few of the major businesses active in the Indian electric vehicle market.

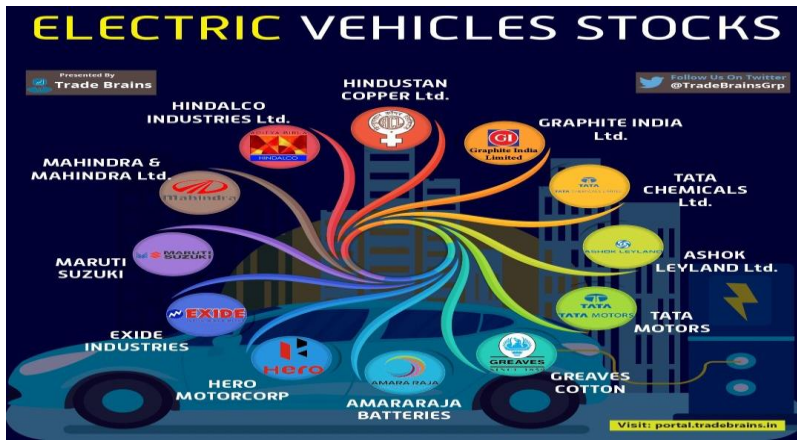


Figure 6: EV Market Players

□

2.5 Government Initiatives

The Ministry of Power increased funding for the infrastructure for charging. Installing EV charging stations wouldn't call for a licence. The government encouraged the use of electric vehicles by requesting that ministries and other government organisations add EVs to their fleet of vehicles.

FAME II Scheme

- Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles (FAME) India scheme or FAME II
- Aims to promote electric mobility by incentivizing electric vehicles. Focuses on increasing the number of EVs on road by encouraging the electrification of vehicles in the commercial and public domain.
- This scheme will be implemented for the period of three years with effect from 1st April 2019. The total outlay of the scheme is Rs 10,000 Crores.
- This scheme is the expanded version of the FAME 1 India which was launched on 1st April, 2015 with an outlay of Rs. 895 Crores.
- The emphasis of this scheme is on electrification of the public transportation which includes shared transport.
- For electric buses, demand incentives on operational expenditure will be delivered through State/city transport corporation (STUs).
- 3W and 4W segment incentives will be applicable mainly to vehicles used for public transport or those who are registered for commercial purposes.
- In e-2Ws segment, the focus will be on the private vehicles.
- Let us tell you that through this scheme, it is planned to support 10 Lakhs e-2W, 5 Lakhs e-3W, 55000 4Ws and 7000 Buses.
- The incentives will be offered by the Government for electric buses, three-wheelers and four-wheelers to be used for commercial purposes.
- In the scheme Plug-in hybrid vehicles with sizeable lithium-ion battery and electric motor will also be included.

Chapter 3: Research Methodology

Statement of the problem

“Perception of Customers on Electric Vehicles in India”

Need for the study

- To identify the market growth trends of electric vehicle market.
 - To identify the mind set of Indian customer segment
- Objective Of the study**
- To identify the perception of Indian Customer towards EV.
 - To identify the govt policies and schemes to encourage the development & use of electric vehicles.

The Indian Prime Minister unveiled the National Electric Mobility Mission Plan (NEMMP) on January 9th, 2013 with the objectives of improving

national energy security, reducing adverse environmental effects (including CO₂ from road transport vehicles), and expanding domestic manufacturing capabilities for electric vehicles.

Sales of 6-7 million new electric vehicles are anticipated under the Mission Plan, saving 2.2 to 2.5 million tonnes of liquid fuel in the process (Government of India, 2012).

Future scenarios for electric vehicle transportation in India are examined in this paper, with a focus on the function of EVs. There are five chapters in the report. The report's context and scope are established in Chapter 1, which serves as an introduction. The history of the Indian electric car sector is covered in Chapter 2. A summary of the research technique used to assess the EV market is provided in Chapter 3. Chapter 4 will offer the conclusions, recommendations, and discoveries.

Research Methodology:

Research methodology is the process of gathering data and statistics to identify the answers to particular questions with the use of technologically advanced software ways of gathering and decoding statistics.

Research Design

The entire research is carried based on Descriptive research layout and Hypothesis Testing.

Descriptive Research Design

- □ It includes a variety of surveys and factfinding inquiries. This is a sufficient interpretation of a reality-finding investigation. It is a good form of evaluation and is more detailed than a visual examination.
- Because it concentrates on particular aspects of the subject under investigation. As a result, the method of evaluation chosen for this project was descriptive analysis. The most effective method for analysing the Indian electric vehicle market is now descriptive research. **Data Collection Method**

- Secondary sources are employed as the data source for analysis. The information from many studies and online sources is used to analyse and assess the potential of the Indian electric vehicle market.
- Principal Research: The main information was gathered through mailing a questioner.

Sources of Data

- **Secondary data source:**

The company's brochure and website are used to gather information about the company's history, its products and services, and its important personnel. Secondary research is also used to gather information on government regulations that support the production and marketing of electric vehicles as well as future predictions for their sales. **Hypothesis Testing:**

A statistical technique known as hypothesis testing is used to draw conclusions about a population from a sample of data. It entails developing a hypothesis, usually in the form of a null hypothesis and an alternative hypothesis, then gathering data to test the hypothesis. The alternative hypothesis denotes the likelihood of a substantial difference or effect, whereas the null hypothesis denotes the status quo or the conviction that there is no significant difference or effect.

Following a statistical analysis of the data, a test statistic will be computed to evaluate how

divergent the sample result is from what the null hypothesis would predict. The test statistic is

compared to the critical value, which is determined based on the level of significance chosen for the test. If the test statistic is higher than the critical value, suggesting that there is evidence of a

significant difference or effect, the null hypothesis is rejected in favour of the alternative hypothesis. If the test

statistic is smaller than the critical value, suggesting that there is no evidence of a substantial difference or impact, the null hypothesis is not rejected.

It is significant to emphasise that, based on the given data, hypothesis testing can only offer support for or opposition to the null hypothesis, not show that it is true. Additionally, it is crucial to select the proper level of significance because doing so will reduce the likelihood of Type II error (failing to reject a false null hypothesis) and increase the likelihood of Type I error (rejecting a true null hypothesis).

Basis on the nature of the hypothesis being tested and the type of data being analysed, there are various methods of hypothesis testing. These typical forms of hypothesis testing are listed below:

One-sample t-test: This test is used to determine whether the mean of a single sample is significantly different from a known or hypothesized value.

Two-sample t-test: This test is used to determine whether the means of two independent samples are significantly different from each other.

Paired t-test: This test is used to determine whether the means of two dependent samples are significantly different from each other.

One-way ANOVA: This test is used to determine whether there are significant differences in means among two or more independent groups.

Two-way ANOVA: This test is used to determine whether there are significant differences in means among two or more groups, while controlling for the effects of two or more independent variables.

Chi-square test: This test is used to determine whether there is a significant association between two categorical variables.

Pearson correlation test: This test is used to determine whether there is a significant linear relationship between two continuous variables.

Simple linear regression: This test is used to determine whether there is a significant linear relationship between a dependent variable and one independent variable.

3.1 Analysis and Interpretation of Data To understand the perception of Indian Customers towards the Electric Vehicles, I have floated a questionnaire.

Below are the questions and their analysis on the basis of responses.

1. **Age of the responders.**

Total 96 responds on the questionnaire, the distribution of them according to the age are the following.

From the above table we can observe that maximum responders are of age range 20-25.

2. **Profession of the Responders.**

To understand the profession of the responders, this question is put in the questionnaire and it is observed from the graph that most of the responders are students after that Private Sector employee, Public Sector and unemployed. The distribution according to the profession are the following:

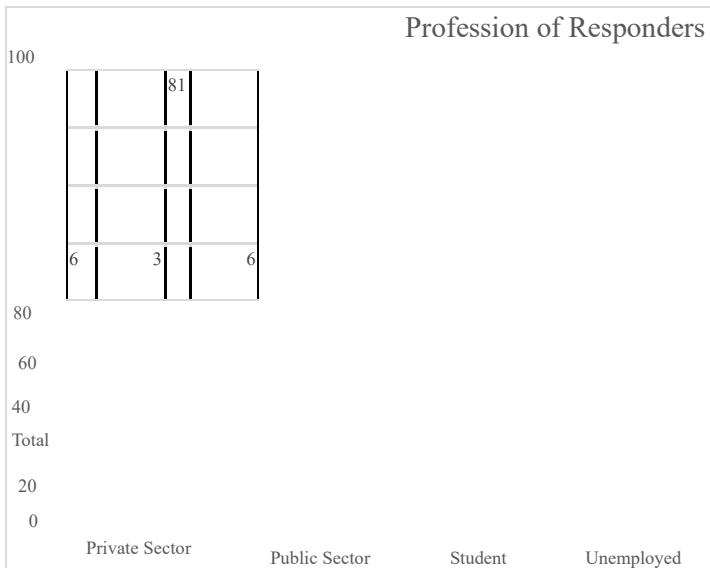


Figure 8: Profession of Respondents

3. Family Annual Income Distribution:

It has been observed that most of the responders are having the family annual income of range 5-10 LPA and 10-15 LPA.

Out of total 96 responders 22 responders are having annual family income in range of 10-15 LPA and 23 Responders are having income 5-10 LPA.

4. Home Region and Home State The region wise distribution of the responders are given in the following chart.

As we can see that about 62 from 96 are of North India and it counts about 66% of the total responders.

5. **Have you ever considered purchasing an electric vehicle**

The response on the above mentioned question is tremendous as out of 96 responses 63 are considering the purchase of EV vehicles in future. This accounts about 67% of the responses.

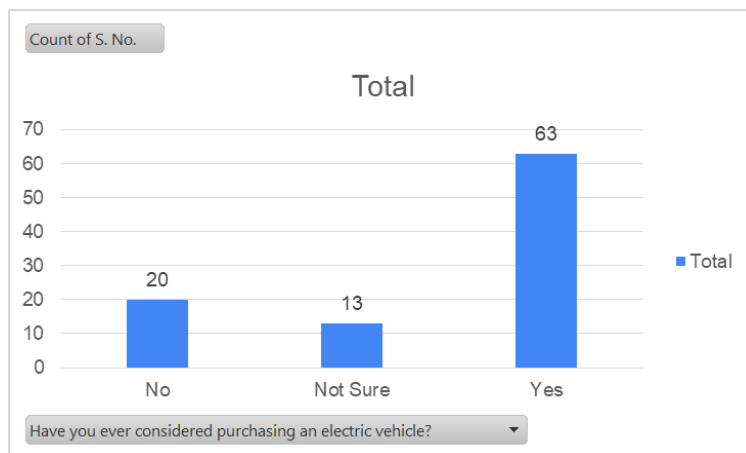


Figure 11: Purchasing Car in Future

The above observations shows that people are having a perception of buying Electric Vehicle in Future.

6. **What is your primary reason for considering an electric vehicle**

The reasons are basically divided into 4 categories which are as follows:

- Lower operating costs
- Environmental concerns
- Better performance
- Government incentives

The responses for the same are the following:

Figure 12: Reason Responses

The observation says that 42 out of 96 wants to consider it for low operating cost and 39 are thinking of environmental condition and wants to buy EV for this reason also.

7. Biggest barrier to the growth of electric vehicles in your state

We asked the responders about the biggest barrier for the growth of EV in their state. The response to the

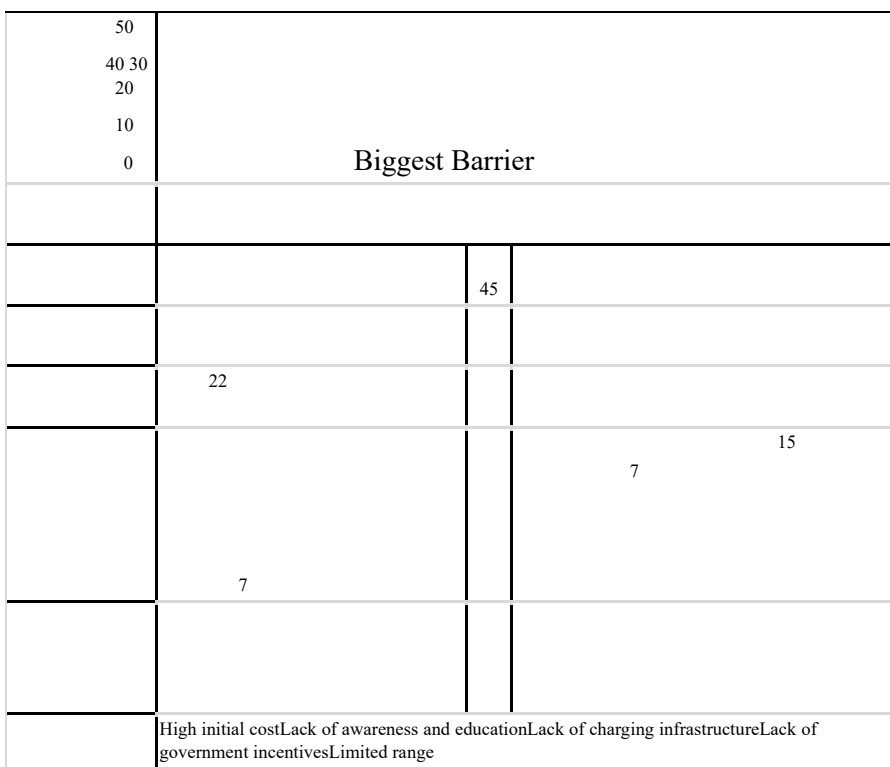


Figure 13: Biggest Barrier

Out of the 96 responders 45 thinks that there is a lack of charging Infrastructure in the state. This will suggest that government should take initiatives to provide the basic charging facilities for the customers

8. Steps do you think the government should

take to promote the growth of electric vehicles in your state

We have categorised the government should take to promote the growth of electric vehicles in your state

- Increased investment in charging infrastructure
- Better public transportation options
- Tax breaks for companies investing in electric vehicles
- More incentives for electric vehicle purchases

By observing the graph we can see that people wants charging stations to be set up by government to promote electric vehicles in the state.

9. Perception of Indian Customers on Electrical Vehicles

This questions is generally to know about the perception of Indian Customers on Electrical Vehicles as the responses are divided into five categories.

- Neutral
- Somewhat Negative
- Somewhat Positive
- Very Negative
- Very Positive

By observing the graph we can find 59% are somewhat positive perceptions and 30% are very positive towards the electric vehicles. The perception of the Indian customer's increases with time as EV is growing.

10. Brand Name

This factor play a very important role while choosing vehicle by the customers. As EV is a new type of vehicles coming in the market so to understand the perception of customers this is very important.

From the above graph we can observe that about 43% finds it very important factor as brand Name while purchasing the Electric Vehicle.

3.2 Chi-square test:

A substantial relationship between two categorical variables is detected using this test.

Here, we'll use a Chi-square test to identify any significant correlations or associations between the two sets of category data. We can only do the Chisquare test because our data is categorical.

Here, in order to determine the relationship between the variables, we shall test the null hypothesis or an alternative hypothesis.

H0 (Null Hypothesis): The null hypothesis is a claim that holds that there is no meaningful link or difference between two variables. In other words, it symbolises the status quo, the conviction that nothing has changed, or the lack of an impact.

If there isn't enough data to refute the null hypothesis, it is presumed to be false when doing a hypothesis test. Depending on the level of significance selected, which is commonly set at 0.05 or 0.01, the amount of evidence needed to reject the null hypothesis will vary.

H1 (Alternative Hypothesis): An assertion that suggests the likelihood of a substantial difference or relationship between two variables is known as the alternative hypothesis. In other words, it argues that something has changed or that there is an effect and is the opposite of the null hypothesis.

1. Relation between Age of the responder and consideration of purchasing an electric vehicle

We performed the chi square test to find the relationship between the age and the consideration of purchasing an electric vehicle.

The observation for the same are the following:

Table 1: Hypothesis of Age and Buying Behaviour

Observed				
	Count of Have you ever considered purchasing an electric vehicle?			
Row Labels	No	Yes	Grand Total	
20-25	19	42		61
25-30	11	17		28
30-35	1	2		3
40-45	2	2		4
Grand Total	33	63		96
Expected				

		Count of Have you ever considered purchasing an electric vehicle?			
Row Labels	No	Yes	Grand Total		
20-25	20.96875	40.03125		61	
25-30	9.625	18.375		28	
30-35	1.03125	1.96875		3	
40-45	1.375	2.625		4	
Grand Total	33	63		96	
P VALUE	0.797542058				
ALPHA	0.05				

Result: We can draw the conclusion that there is no meaningful correlation between the respondent's age and their contemplation of buying an electric vehicle based on the provided observation and projected count.

We cannot rule out the null hypothesis because the p-value of 0.7975 is higher than the specified alpha threshold of 0.05. Therefore, we can conclude that there is no statistically significant difference in the proportion of people across various age groups who have thought about buying an electric vehicle.

2. Income of Responder and consideration of purchasing an electric vehicle

We performed the chi square test to find the relationship between the Income of Responder and the consideration of purchasing an electric vehicle. The observation for the same are the following:

Table 2: Income and Buying Behaviour

Observed			
Count of Have you ever considered purchasing an electric vehicle?			
Row Labels	No	Yes	Grand Total
0 - 1 Lakh	13	8	21
1- 5 Lakh	4	8	12

10-15 Lakh	2	20	22
5- 10 Lakh	10	13	23
More than 15 Lakh	4	14	18
Grand Total	33	63	96
Expected			
Count of Have you ever considered purchasing an electric vehicle?			
Row Labels	No	Yes	Grand Total
0 - 1 Lakh	7.21875	13.78125	21
1- 5 Lakh	4.125	7.875	12
10-15 Lakh	7.5625	14.4375	22
5- 10 Lakh	7.90625	15.09375	23
More than 15 Lakh	6.1875	11.8125	18
Grand Total	33	63	96
P VALUE	0.004083451		
ALPHA	0.05		

Result: From the Chi square test we can see that the P- Value is very less than the Alpha value thus means that Null hypothesis (H0) is rejected and Alternative hypothesis is accepted. This simply means that Alternative Hypothesis (H1) is accepted, indicating that there is a strong correlation between the respondent's income and the likelihood that they will consider buying an EV in the future. According to the findings of the chi square test, there seems to be a strong correlation between the respondent's income and whether or not they are thinking about buying an electric vehicle. The observed data are statistically significant and not the result of chance because the p-value of 0.004 is less than the alpha threshold of 0.05. Additionally indicating the existence of a link between these factors is the fact that the expected counts for each category are different from the observed counts.

3. Government Initiatives and consideration of purchasing an electric vehicle

We performed the chi square test to find the relationship between the Government Initiatives

and the consideration of purchasing an electric vehicle. The observation for the same are the following:

Table 3: Government Policies and Buying Behaviour

Count of	Have you ever considered purchasing an electric vehicle?			
GOVT INTV	No	Yes	Grand Total	
No	30	51	81	
Yes	3	12	15	
Grand Total	33	63	96	
Count of	Have you ever considered purchasing an electric vehicle?			
GOVT INTV	No	Yes	Grand Total	
No	27.84375	53.15625	81	
Yes	5.15625	9.84375	15	
Grand Total	33	63	96	
P VALUE	0.201914076			
ALPHA	0.05			

Result: According to the chi-square test, as the p-value (0.201914076) is higher than the alpha value (0.05), there is no correlation between government actions and contemplation of

buying an electric vehicle. As a result, the null hypothesis—which states that there is no correlation between the two variables—is not ruled out.

Chapter 4 Recommendations:

1. Government Incentives: Finding smart

incentives for electric vehicles will be a key aspect in the market's growth. This will accelerate while lowering the primary customer barrier of the cost of electric automobiles. The incentive may be an electric vehicle subsidy programme bridging the difference in price between conventional and electric vehicles with comparable performance levels.

2. **Charging Infrastructure:** The growth of the EV market will coincide with the development of the charging infrastructure.

The development of grid-connected charging stations with moderate tariffs, encouragement of standalone renewable (solar/wind) charging stations, addition of a facility for charging at petrol stations and bus stops, state transportation charging stations and allowing the development of private renewable charging stations can all serve as sources of motivation.

3. **Awareness:** Government marketing and increased public knowledge of EV's advantages can both have a big impact on development. It can be done with the aid of widespread advertising using banners and hoardings at airports, bus stations, movie theatres, government buildings, and other public locations. It can also be done by using print media, such as newspapers, magazines, and periodicals, as well as digital media, radio, and the internet. It can also be done by using TV shows and expert talks.

4. **Collaboration with Industry and Academia:** The development of new technology and ideas in the electric vehicle sector can be facilitated by government cooperation with business and academics. Grants for research, the establishment of centres of excellence and incubators for start-up businesses, and the planning of joint ventures between the public and private sectors can all help achieve this.

5. **Public Transport:** Promotion of electric buses and other public transport vehicles can

reduce the dependence on personal vehicles and enhance the sustainability of the

transportation sector.

The government can provide subsidies and incentives for the adoption of electric buses and other public transport vehicles, and also establish policies for the conversion of existing public transport fleets to electric.

CONCLUSION

Customers in India are willing to learn more about alternatives like electric and hybrid vehicles. But one of the biggest obstacles to their acceptance continues to be their expensive price. Government subsidies and incentives are therefore viewed as essential to promote the adoption of these new technologies.

Indian consumers are receptive to the notion of adapting their current cars to become plug-in hybrid electric cars. This enables customers to take advantage of electric car benefits without having to purchase an entirely new vehicle.

Due to unclear policies and their execution, a dearth of EPT manufacturers, and other factors, the development of sustainable transportation in India is anticipated to go slowly overall. However, there is potential for significant future growth in the

market for eco-friendly vehicles with the correct incentives and awareness raising.

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