MARKETING AND PROMOTION OF ELECTRIC VEHICLES WITH SPECIAL REFERENCE TO DEVELOPING CHARGING INFRASTRUCTURE

A PROJECT REPORT

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MASTER OF BUSINESS ADMINISTRATION

Submitted by

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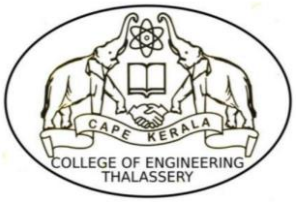

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DECLARATION

I, VISHNU S MANGALATH hereby declare that the project work entitled "**MARKETING AND PROMOTION OF ELECTRIC VEHICLES WITH SPECIAL REFERENCE TO DEVELOPING CHARGING INFRASTRUCTURE**" has been prepared by me and submitted to Cochin University of Science and Technology, in partial fulfilment of requirements for the award of Master of Business Administration, is a record of original work done by me under the supervision of **Mr. JITHIN K V** Assistant Professor in the Department of Management Science, Govt. College of Engineering Thalassery. I also declare that this project report has not been submitted by me fully or partly for the award of any Degree, Diploma, Title or Recognition before.

Place: VISHNU S MANGALATH

Date:

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VISHNU S MANGALATH

TABLE OF CONTENT

LIST OF TABLES

LIST OF CHARTS

Executive Summary

Electric vehicles are the future of Indian transportation. The government is taking the initiative to introduce policies to impart electric vehicles in the Indian customer segment slowly. The government aims to fully electrify the Indian transport system by 2030.

In the light of above context, this project on "Marketing and Promotion of Electric vehicles concerning Developing Charging Infrastructure in India" aims at providing an insight into the India's existing electric vehicle market and future of electric vehicle market. This project talks about the sales of electric vehicles in India in the years of 2018, 2019, and projected sales for years of 2020, 2021, 2022, 2023. It also has an insight at what rate the India's electric vehicles market is growing to expand itself year after year to reach its goal of mission clean mobility in India.

We also take look into the policies and incentives taken by the India government to encourage the sales of electric vehicles and subsides provide to the Indian customers for the purchase of electric vehicle.

The data collected from the sales of the Electric Vehicles are used to find trends of the future sales of the electric vehicle. Later these trends are represented in the form of graphs and then interpreted for simple but detailed analysis of the representation of the graph.

Findings are made from the analysis of the sales of electric vehicle and the policies introduced by the government to implement and encourage the manufacturing and sales of electric vehicles in India. Out of the findings found during the project period there are a few suggestions made to increase the sales of the electric vehicles in India.

In the end we can say that the electric vehicles will take over the transport system of India by the end of 2030, which is inevitable. The customers or people of India have to accept the

electric vehicle model as their daily part of their transport system, which is being promoted by the government now and soon to be made compulsory.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

India's government is pushing for a faster adoption of electric vehicles -- hoping at least 15% of all vehicles on the road will be electric in five years starting 2018 -- to deal with the deadly air pollution in its cities and curb carbon emissions from fossil fuels.

Widespread adoption of electric vehicles (EVs) may contribute to the alleviation of problems such as environmental pollution, global warming, and oil dependency. However, the current market penetration of EVs is relatively low in despite of many governments implementing strong promotion policies. This paper presents a comprehensive review of studies on consumer preferences for EVs, aiming to better inform policy-makers and give direction to further research. First, we compare the economic and psychological approaches towards this topic, followed by a conceptual framework of EV preferences which is then implemented to organise our review. We also briefly review the modelling techniques applied in the selected studies. Estimates of consumer preferences for financial, technical, infrastructure, and policy attributes are then reviewed. A categorisation of influential factors for consumer preferences into groups such as socio-economic variables, psychological factors, mobility conditions, social influence, etc. is then made and their effects are elaborated.

This research aims to examine the Marketing and Promotion of Electric vehicles concerning Developing Charging Infrastructure in India. Furthermore, it explores consumers' and owners' attitudes towards sales and promotion and their buying decision, and analyses the effectiveness of strategies by the brands. The Audience will benefit from knowledge about the underlying effect of advertising and be able to distinguish information needed for making buying decisions from promotion strategies.

The automobile industry is a big industry that has an impact on the country's economy. The automobile market is fiercely competitive. Manufactures like Jeep India, Maruti Suzuki, KIA,

Hyundai, Mahindra, and TATA exports car from India to markets like Europe, South Africa, Australia, Japan, etc. e. Sales promotion strategies play a significant role in marketing and help increase sales of EVs.

In Europe and America, more and more EVs are sold as a result of sales promotion strategies including advertising. However, additional reasons and motivations to buy EVs apart from advertising should also be investigated. This study consolidates consumers‟‟ or car buyers‟‟ attitude toward EVs and their sales promotion strategies and promoting infrastructure of EVs. The findings will benefit advertisers in terms of crafting the sale promotion plan that best respond to consumers' needs. Consumers as an audience of advertisers will be able to analyse technology and advertising effectively.

Promotion is the major component of a company's total marketing mix along with product planning, pricing, and distribution. When planning the total promotional program in a company, management must ordinarily make use of the campaign concept. "A campaign is a coordinated series of promotional efforts built around a single theme or idea and designed to reach a predetermined goal". The term "campaign" is often in connection with the advertising and it seems more appropriate to apply the concept of a campaign first to the entire promotional program. Then the total promotional campaign can be subdivided into its advertising, personal selling, and sales promotion components. For sale promotion of EV, company should concentrate on step-by-step process and future in developing EV infrastructure.

1.2 BACKGROUND OF THE STUDY

India is committed to reducing emission intensity up to 33-35% from the 2005 level by 2030 and set the target of 40% non-fossil-based electricity generation in the energy mix. This requires radical measures to scale up the share of renewable energy (RE) besides the

ongoing program of 175 GW RE by 2022. The new targets for RE by 2030 could be in the order of 350 to 500 GW.

Road EVs includes a large range of vehicles from electric two-wheelers, three-wheelers (rickshaws), cars and electric buses. In addition, plug-in electric vehicles can be classified into two types: battery electric vehicles (BEVs), and plug-in hybrid electric vehicles (PHEVs). BEVs have an electric motor in place of combustion engine and use electricity from the grid stored in batteries. Plug-in hybrid electric vehicles (PHEV) use batteries to power an electric motor and liquid fuel such as gasoline or diesel to power an internal combustion engine or other propulsion source. EVs can go beyond the above-mentioned technology-based classification, and can be classified on the basis of their attributes such as

(i) charging time,

(ii) driving range

(iii) the maximum load it can carry.

Of these attributes, he two most important characteristics of an electric vehicle of concern to the consumer are: -

1. Driving range (i.e., the maximum distance an EV can run when fully charged)
2. Charging time of batteries (i.e., the time required to fully charge the battery) and Charging time depends on the input power characteristics (i.e., input voltage and current), battery type, and battery capacity.
3. Charging infrastructure and availability of charging points.

India endeavours to be on a path of energy transition in the road transport sector. The National Electric Mobility Mission Plan (NEMMP) 2020, launched in 2013, aimed at paving the way for a shift from fossil fuel-based mobility to an electric powered one. The

mission set an ambitious target of 6–7 million electric vehicles in the country by 2020. The impact of subsequent schemes and initiatives by the Government of India, mostly channelled through the FAME schemes, has been limited in achieving the targets of NEMMP. As of June, 2019, just about 2.7 lakh electric vehicles have been sold under the FAME scheme since its implementation in April, 2015 including about 1.7 lakh electric two-wheelers. The government has announced that the country would shift to an entirely electric public transport along with 30% electric private vehicles by 2030, lending a further push towards the goal of electrification (Sasi, 2019). Recent data collated by SMEV1 indicates that 54,800 electric two-wheelers and 1200 electric four-wheelers were sold in 2017–18. In terms of the total cars and two-wheeler sales, these figures translate into a miniscule proportion. Electric two-wheelers constituted an insignificant, 0.002%, in the entire two-wheeler sales in 2017–18. Similarly, electric cars formed a mere 0.0003% of the total car sales in India for the same financial year (FY). Considering the total market sales in FY 2016–17 was only 39,000 (electric two-wheelers and four wheelers), India has certainly shown a progress towards electric vehicle adoption, but a slow one (SMEV, 2017). The sluggish growth as compared to the vision Society of Manufacturers of Electric Vehicles; India numbers clearly indicates the presence of unforeseen challenges impeding the targeted electrification. There is a need to acknowledge that a quick transition, howsoever well-desired, might be challenging to achieve in the absence of a clear policy, limited understanding about technological challenges, infrastructural deficiencies, and lack of consumer acceptance and awareness in the Indian market. Quick technological transitions may also have negative externalities on the job markets. To enable faster adoption of electric vehicles, it is imperative to develop an understanding of these challenges. Against this background, TERI in association with the Society for Development Studies (SDS) proposes to undertake a research study and aims to bridge the

vital gap between the expectations of the consumers and the industry actors vis-à-vis government policies, initiatives, and actions.

Reasons for the shift to clean mobility

- Air quality indices related to India indicate that the air in many cities of India is no longer healthy. Automobile related pollution has been one of the causes for this.
- Aspects related to global warming needs a shift to automobile solutions that reduce / do not produce greenhouse gas emissions.
- The need to reduce dependency on a fossil-fuel based economy. India's crude oil imports for 2014-15 was 112 billion dollars (approximately 7,00,000 crore rupees). For comparison, the allocation for the Mahatma Gandhi National Rural Employment Guarantee Scheme, in budget 2017-18, is 48,000 crore rupees.
- India can become a global provider for clean mobility solutions and processes that are affordable and scalable.
- People living in some Indian cities are being affected by noise pollution. Some of the Indian cities have the worst noise pollution levels in the world. Electric vehicles may contribute to a reduction in noise pollution levels in the cities.
- Energy efficiency and emission reduction has improved in automobiles. Yet, the growth in total number of vehicles on road, and the resulting total pollution and total energy consumption removed all gains made by betterment in energy efficiency and emission reduction by automobiles. Energy efficiency measures and pollution control measures did not keep pace with the sales growth in vehicles. The total number of vehicles registered in India has been 5.4 million, 11 million, 33 million, 40 million and 210 million in the years 1981, 1986, 1996, 2000 and 2015. This indicates a 3500+ percentage growth in the total number of vehicles between 1981 and 2015. The total

number of vehicles sold in India increased between 1,54,81,381 in 2010-11 and 2,04,69,385 in 2015-16 indicating a 30+ percentage growth in this five-year period.

Initiatives of Government of India

The Government started Faster Adoption and Manufacturing of Hybrid and Electric vehicles (FAME) scheme which provides incentives for purchasing electric vehicles. Government is releasing tenders to increase charging infrastructure in the country. Karnataka approved Electric Vehicle and Energy Storage Policy 2017.

The vehicle is covered under Government of India's FAME-India (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles) scheme that offers incentives to the electric and hybrid vehicles ranging from Rs.1,800 to Rs.29,000 for scooters and motorcycles and Rs.1.38 Lac for cars. FAME is a part of National Electric Mobility Mission Plan by Government of India.

Recently, the Government released a two-pronged strategy aimed at both buyers and manufacturers, in which it offers $1.4 billion in subsidies to buyers while imposing a hike on import tariffs to increase manufacturing of these vehicles by domestic companies. The Government is mainly focusing to electrify public transportation as the subsidies, mainly available for two-wheelers, three-wheelers, and buses. This policy also earmarks $140 million to develop charging infrastructure which should further help the development of the EV industry in India. On 14 December 2018, the government also released a document which outlines the standard and guidelines for EV Charging infrastructure. Beyond the specifications of the charging infrastructure, the guidelines also required a charging station to be present every 25 km along a road/highway.

Some state governments like the Delhi government are playing a major role to increase the use of EV’s in India. The Delhi Government recently approved 1000 Electric buses to be

used in Delhi's public transport system. In 2018, the Uttarakhand Government introduced a new scheme to help the manufacturing and promote the use of EV's as well. The scheme would provide companies with loans ranging between Rs 10 crore and Rs 50 crore to build EV's and charging infrastructure. The scheme also doesn't charge motor tax for first lakh customers of EV's for five years. The Maharashtra Government is focusing on increasing EV use in the state by proposing to exempt EV's from road tax and providing a 15% subsidy to the first lakh EV's registered in the state. To improve suitable infrastructure, the government proposed to provide a maximum subsidy of Rs. 1 million (~$15,549) per charging station to the first 250 stations that are set up in Maharashtra. Energy Efficiency Services Limited (EESL) is procuring 10,000 nos. of Electric Vehicles from reputed manufacturers for distribution to Government Departments on rental model and upfront sale model. EESL's tender of 10,000 nos. of EV's has reduced the cost of EV's substantially.

1.3 STATEMENT OF PROBLEM

Sales promotions targeted at the consumer are called consumer sales promotions. Sales promotions targeted at retailers and wholesale are called trade sales promotions. Sales promotion includes several communication activities that attempt to provide added value or incentives to consumers, wholesalers, retailers, or other related organizations/ businesses to stimulate immediate sales. These effects can attempt to stimulate product interest, trial or purchase. These effects can attempt to stimulate product interest/ curiosity, trial or purchase.

This study investigates the problem of Promotion and Challenges faced by the EV market and Developing Charging Infrastructure. Compared to some combustion engine vehicle models EVS have higher sales figures, still, people don't prefer them. Current owners or consumers have secondary vehicles and the majority use them for city drives. Neither Companies nor Governments are ready to take action toward Charging Infrastructure for promoting EVs.

1.4 OBJECTIVE OF THE STUDY

- To study the Developing Charging Infrastructure in India.
- To study consumer behaviour toward EV
- To study on consumer preference for purchasing EVs.
- To study the Future and Promotion of Electric vehicles.
- To study Government promotion and subsidies.

1.5 SCOPE OF THE STUDY

- The study helps to know the effective method to reach and convince the consumer.
- Developing charging infrastructure effectively and easy to access and implement.
- To develop a smart-connect application for effective mobility interconnecting the charging station.

1.6 RESEARCH METHODOLOGY

Research methodology is the specific procedures or techniques, that are used to identify, select, process, and analyse information about a topic**.** In a research paper, the methodology section allows the reader to critically evaluate a study's overall validity and reliability

1.6.1 Research Design

Research design is a comprehensive plan of the series of operation that research intends to carry out to accomplish the research objectives.

1.6.2 Source of data Main source of data are

- Primary data
- Secondary data

Primary Data

Primary data are those data, which are obtained for the first time by the investigator himself. In order words, by primary data we mean those data, which are originally, i.e., those in which little or no grouping has been made, the instance being recorded or itemized encountered. The source of primary data used in my project is the questionnaire. Primary are the raw data like raw material. Primary data are according to object of investigation and used without correction. The collection of primary data requires large sum, energy and time. Precautions are not necessary in the use of the primary data.

Secondary Data

Secondary data means data that are already available i.e.; they refer to the data, which have already been collected and analysed by someone else. When the researcher utilizes secondary data, then he has to look in to various sources from where he can obtain them. In this cause he/she is certainly not confronted with the problems that are usually associated with the collection of original data. Secondary data may be published or unpublished data. Secondary data collection methods consist of

- Various publications of central, state, local, foreign government, or international bodies and their subsidiary organization.
- Written records of primary source can be said as secondary source.
- Books, magazines, and reports
- Reports, research, and publications of various associations connected with business or findings in textbooks, magazines, and newspapers are considered secondary sources.

Data is taken from YouTube Reviews, vlogs, blogs, sits like Team BHP, Online Magazine like Autocar India

1.6.3 Sampling

Sampling Technique

The researcher has used a simple random sampling technique for the conduct of the study, whereby which each element of the sample being has an equal probability of selection. This minimizes bias and simplifies the analysis of results.

Sample Size

The sample size used for the study is 125 respondents from the customers. The respondents were from Kannur area.

1.6.4 Tools and techniques

The various tools used for collecting the data are as follows:

Questionnaire

Questionnaires refer to forms filled in by respondents alone. Questionnaires were handed to the respondents in field and asked them to fill it. This method can be adopted for the entire population or sampled sectors.

Interviews

In interviews information is obtained through inquiry and recorded by enumerators. Structured interviews are performed by using survey forms. The interviewer in one-to-one conversation collects detailed personal information from individuals using oral questions.

1.6.5 ANALYTICAL TOOLS USED:

- Pie chart
- Bar diagram
- Simple percentage method

1.6.6 SIMPLE PERCENTAGE METHOD

The normal data collected are converted into simple percentage. This is the earliest and the best method to analyse a given data. The percentage wise distribution of the data gives an idea of which factor is more and which is less.

$$\text{Percentage} = \frac{\text{Number of Respondents}}{\text{Total number of Respondent}} * 100$$

1.7 PERIOD OF THE STUDY

The study was conducted over a period of 150+ days.

1.8CHAPTER SCHEME

Chapter -1	-	Introduction
Chapter-2	-	Review of related Literature
Chapter-3	-	Profile of the Industry
Chapter-4	-	Data analysis and interpretation
Chapter-5	-	Findings, Recommendations and Conclusions

1.9 LIMITATIONS OF THE STUDY

- The respondent answer may be biased.
- Time was the main constraint of the study.
- The number of respondents is limited to hundred. it may not be universally acceptable
- Duration for the research was limited.
- Some respondents were reluctant to express their opinion

CHAPTER-2

REVIEW OF LITERATURE

2.1 REVIEW OF LITERATURE

In marketing, promotion refers to any type of marketing communication used to inform target audiences of the relative merits of a product, service, brand, or issue, most of the time persuasive in nature. It helps marketers to create a distinctive place in customers' minds, it can be either a cognitive or emotional route. Promotion has become an integral part of publicizing a product, organization, or venture to increase sales or public awareness. schemes of both manufacturers and retailers of durable as well as non-durable consumer goods. It consumes a very significant portion of the promotional expenses of marketers. In some developed countries allocation of promotion budget to sales, and promotion has far exceeded spending on advertisement. Brand managers are now relying heavily on promotion because its impact on sales is more direct, immediate, and quantifiable as compared to an advertisement. Marketers use both price and non-price promotions either independently or in association with each other. Price promotions allow buyers to make some savings of money whereas non-price promotions like premium add value to the offer. Point-of-Purchase promotions like feature advertisements and displays lead to impulse buying. The dynamic nature of sales promotion has inspired many researchers to turn their attention to studying the various issues related to this element of the promotion mix. Many studies have been conducted on the planning, implementation, and evaluation aspect of promotion worldwide. These studies are reviewed and presented briefly under suitable heads like Studies on Consumer Promotion, Studies on Sales Force Promotion, Studies on Trade Promotion, and Other Studies on Promotion.

Janardan Prasad Kesari, Yash Sharma, Chahat Goel (May, 2019) in their study of Opportunities and Scope for Electric Vehicles in India. Electric vehicles have seen unprecedented growth over the previous decade around the world. In this paper, they first discuss the scope and opportunities of Electric Vehicles in India. They defined about various policies and frameworks in place by the Government of India. Then, we study the various case

studies from around the world on adopting Electric Vehicles. We finally conclude with how India could implement and benefit from these strategies at the local as well as national level.

Shailendra Kumar, S.K. Choudhary, Chethan K N (June, 2018) reported that E-Vehicles are poised to cause a major disruption in the automobile as well as the energy industry across the globe. This disruption is propelled by the powerful purpose of creating a greener, safer and sustainable planet. Over 194 participating countries in the historical Paris climate agreement enforced in 2016 pledged to limit the average increase in global temperature to less than 2 degrees Celsius in this century. The USA, China, and India combined account for a staggering 50% of the world's Green House Gases (GHGs) emissions. The transport sector of these major economies forms the bulk of the emission of GHGs. The USA and China have already promoted the replacement of fossil fuel-powered vehicles with e-vehicles and as of 2016 have the highest stock of e-vehicles in the world; however, India is lagging behind its counterparts. Out of the 20 most polluted cities in the world, 15 cities are in India. India has pledged to cut down its share of GHGs emissions significantly to limit the average increase in global temperature. As a result of this, the Indian government has set a target of 100% e-mobility by 2030. India embarked upon its e-vehicle journey in November 2017 by the deployment of 100 e-vehicle units and the installation of four charging stations in a city. This paper is aimed to examine the commercial viability of the pilot project and identify the initial roadblocks and its rectifications to scale up on a pan-India basis. To achieve this, the pilot project was studied in detail, and interviews and surveys were conducted among all the stakeholders in April-May 2018. While it was found that it is a win-win proposition for stakeholders, major roadblocks in scaling up were found to be - bureaucratic hassles in the setting up of charging stations, high initial investment, and waiting time for drivers. The paper also uniquely identifies the charging pattern of commercial electric vehicles at a particular charging station.

Andrés Arias-Londoño, Oscar Danilo Montoya Giraldo, Luis Fernando Grisales-Noreña (June, 2020) reported on the power supply and infrastructure needed for developing charging stations to meet the demand. In the last decade, the deployment of electric vehicles (EVs) has been largely promoted. This development has increased challenges in the power systems in the context of planning and operation due to the massive amount of recharge needed for EVs. Furthermore, EVs may also offer new opportunities and can be used to support the grid to provide auxiliary services. In this regard, and considering the research around EVs and power grids, this paper presents a chronological background review of EVs and their interactions with power systems, particularly electric distribution networks, considering publications from the IEEE Xplore database. The review is extended from 1973 to 2019 and is developed via systematic classification using key categories that describe the types of interactions between EVs and power grids. These interactions are in the framework of the power quality, study of scenarios, electricity markets, demand response, demand management, power system stability, Vehicle-to-Grid (V2G) concept, and optimal location of battery swap and charging stations.

Dominic Savio Abraham, Rajesh Verma (August 2021) reported on Electric Vehicles Charging Stations' Architectures, Criteria, Power Converters, and Control Strategies in Microgrids that the usage of electric vehicles (EV) has been increasing over the last few years due to a rise in fossil fuel prices and the rate of increasing carbon dioxide (CO2) emissions. EV-charging stations are powered by existing utility power grid systems, increasing the stress on the utility grid and the load demand at the distribution side. DC grid-based EV charging is more efficient than AC distribution because of its higher reliability, power conversion efficiency, simple interfacing with renewable energy sources (RESs), and integration of energy storage units (ESU). RES-generated power storage in local ESU is an alternative solution for managing the utility grid demand. In addition, to maintain the EV charging demand at the microgrid levels, energy management and control strategies must carefully power the EV

battery charging unit. In addition, charging stations require dedicated converter topologies, control strategies, and need to follow set levels and standards. Based on EV, ESU, and RES accessibility, different types of microgrid architecture and control strategies are used to ensure optimum operation at the EV-charging point. Based on the above said merits, this review paper presents different RES-connected architecture and control strategies used in EV-charging stations. It highlights the importance of different charging station architectures with current power converter topologies proposed in the literature. In addition, a comparison of microgrid-based charging station architecture with its energy management, control strategies, and charging converter controls are also presented. The different levels and types of charging stations used for EV charging, in addition to controls and connectors used, are also discussed. An experiment-based energy management strategy was developed to control power flow among the available sources and charging terminals for the effective utilization of generated renewable power. The main motive of the EMS and its control is to maximize the usage of RES consumption. This review also provides the challenges and opportunities in EV-charging, and parameters in selecting appropriate charging stations.

Satyendra Pratap Singh (March 2021) explained in present scenario, air pollution has become a serious concern for the India. According to recent global report, many cities in the India are most polluted cities. Major sectors contributing to the air pollution are industrial sector and transport sector. Among this 51% of air pollution is caused by the industrial sector and 27% by the transport sector. Air pollution contributes to the premature deaths of 2 million Indians every year. In order to minimize the air pollution, Electric Vehicle (EV) can act as blessing in lowering the GHG emission. Electric Vehicles offer numerous advantages such as decreasing the pollution level and reduction in oil import bills etc. Although there is considerable number of threats in establishing the Electric Vehicles in India. This paper

provides the brief literature review on the Electric Vehicles and compiles the advantages and threats in promoting EVs in India.

Hemant Raj Singh (May, 2022) stated the electric vehicle market is growing all over the world. Electric vehicles are the solution to being independent and free from imported energy sources. To make the system sustainable, the adoption of electric vehicles is one of the options. According to a literature survey, electric vehicle charging has various issues like high impact on the grid, voltage, current, etc. Since the fast-charging stations have such high charging loads, there is a rise in peak load demand as well as decreased reserve margins, voltage instability, and reliability issues. In this way, the impact of smart charging stations on the distribution sector will be studied and analysed. Different ways to make the load curve smoother and the solution thereof have been discussed in this paper

Janardan Prasad Kesari (May, 2019) Electric vehicles have seen unprecedented growth over the previous decade around the world. In this paper, we first discuss the scope and opportunities of Electric Vehicles in India. We also discuss various policies and frameworks in place by the Government of India. Then, we study the various case studies from around the world on adopting Electric Vehicles. We finally conclude with how India could implement and benefit from these strategies at the local as well as national level.

Adil Amin, Wajahat Tareen,Muhammad Usman (DEC 2020) This study summarizes a critical review on EVs' optimal charging and scheduling under dynamic pricing schemes. A detailed comparison of these schemes, namely, Real Time Pricing (RTP), Time of Use (ToU), Critical Peak Pricing (CPP), and Peak Time Rebates (PTR), is presented. Globally, the intention is to reduce the carbon emissions (CO2) has motivated the extensive practice of Electric Vehicles (EVs). The uncoordinated charging and uncontrolled integration however of EVs to the distribution network deteriorates the system performance in terms of power quality

issues. Therefore, the EVs' charging activity can be coordinated by dynamic electricity pricing, which can influence the charging activities of the EVs customers by offering flexible pricing at different demands. Recently, with developments in technology and control schemes, the RTP scheme offers more promise compared to the other types of tariff because of the greater flexibility for EVs' customers to adjust their demands. It however involves higher degree of billing instability, which may influence the customer's confidence. In addition, the RTP scheme needs a robust intelligent automation system to improve the customer's feedback to time varying prices. In addition, the review covers the main optimization methods employed in a dynamic pricing environment to achieve objectives such as power loss and electricity cost minimization, peak load reduction, voltage regulation, distribution infrastructure overloading minimization, etc.

Nur Ayeesha Qisteena Muzir, Md. Rayid Hasan Mojumder, Md. Hasanuzzaman (JULY 2022) Electric vehicles (EVs) in Malaysia are gaining more attention and interest from the public. However, the electric vehicle's exposure, awareness, and sales are still low compared to other countries. In this review, the challenges associated with implementing the electric vehicle culture in Malaysia are thoroughly reviewed, including the obstacles that the Malaysian government, policymakers, EV manufacturers, and EV users face in terms of EV cost, travel demand, charging station availability, impact on the power grid, and battery capacity. Then, all the identified challenges have been addressed by considering the user behavior, travel demand, socio-economical culture of Malaysia, current policies taken by the government of Malaysia, and the psychological outlook of Malaysians towards EV adoption. Moreover, potential suggestions have been proposed that the government of Malaysia may adopt during policy planning and when seeking to provide incentives to the users. Finally, a concrete conclusion has been drawn by disseminating the vision about the future of EVs in Malaysia. The proposed review of the technologies, challenges, prospects, and potential solutions associated with EV

adoption in Malaysia can provide a base for proper strategic policy and help policymakers frame strategies to achieve the targets. This review could help achieve sustainable EV transport, and the successful implementation of Malaysian National Automotive Plan 2020, with the goal of adopting next-generation green vehicles.

Hanna Marxen, Valerie Graf-Drasch, Raviteja Chemudupaty (JUNE 2022) Electric vehicles (EVs) are an important cornerstone to achieve transport decarbonization. Still, simultaneous charging of EVs when home charging increases peak demand, especially during evenings. Smart charging allows optimal distribution of load, thus preventing peak loads. Nevertheless, this incorporates certain risks for the EV user, e.g., unavailability of EVs for unplanned events. This might lead to a lack of user acceptance. This paper focuses on specific incentives and nudges, motivating users to adopt smart charging. We conducted an integrative literature review, bringing together literature from different areas. Possible incentives and nudges are monetary incentives, feedback, gamification, or smart charging as a default-setting. We conducted three focus groups with 13 EV users in Luxembourg to get first insights into which of those incentives and nudges they prefer. Preliminary results indicate that incentives and nudges should be individualized. In the future, we would use these first insights to develop a large-scale survey.

Mohammad Amir,Ahteshamul Haque(JUNE 2022) states In stochastic power systems, electric vehicle (EV) fast charging stations (FCS) are rapidly being installed, while adversely impacts the distribution network. Due to this, the improper offline charging control policies for EVs may increase the voltage fluctuation and instability. To analyse these aspects, this paper investigates the problems associated with offline (dis)charging control for effective utilization of battery storage and grid power through different modes of operations. Further, the need to develop real-time charging control is identified to mitigate the adverse impacts of FCS on the distribution network. Hence, an online controller using reinforcement learning (RL) is designed

to distinguish the uncertainties in real-time and to schedule the (dis)charging of an EV against the uncertainties based on travelling pattern. The RL based online controller uses deep neural network (DNN), where the agents are programmed to control the bi-directional power flow (V2G/G2V). The effectiveness of the RL rewards controller is fulfilled by the different charging states of the battery. The performance of online (dis)charging controllers that utilize DNN to act at its optimal power flow set of points for all sessions are examined in the details. Finally, the effectiveness of online RL controller and hardware results have been realized using real time hardware-in-the loop simulator.

Sheik Mohammed Sulthan, Imthias Ahamed (JUNE 2022) In recent times, transportation electrification has been recognized as one of the key solutions to accelerate global GHG emission reductions. As the electric vehicle industry grows faster, plug-in electric vehicles (PEV) are expected to be the most dominant load in the utility sector in less than a decade. Regular charging of the battery energy storage system (BESS) is a mandate for the continued operation of the vehicle, and the PEVs are connected to the utility to charge. Since PEVs are mobility loads, predicting the interconnection of these mobility loads in the utility network for recharging is a major challenge. The intermittent connection of mobility loads to the grid for charging leads to an unpredictable increase in electricity demand and other grid-related issues. Optimal scheduling of PEV charging would conquer the grid-related issues and provide financial benefits to the users. In this paper, an intelligent charge scheduling technique of PEV charging for both residential and commercial charging stations using the heuristic algorithm is proposed and discussed. The primary objective of the algorithm is to achieve the minimization of PEV charging costs by implementing an interrupted charging schedule. The proposed algorithm is tested by conducting exhaustive simulation studies under several conditions for PEVs with different power ratings for residential and commercial charging scenarios. The time-of-use pricing (ToUP) system is adopted as a tariff system in this paper. A detailed comparison

of the unscheduled algorithm, the modified placement algorithm (MPA) and proposed heuristic technique-based charge scheduling is carried out through simulation studies. A detailed cost analysis for charging the PEVs with the selected charge scheduling techniques for various conditions is conducted and cost minimization by implementing the proposed charging scheme is validated.

Zongfei Wang (MARCH 2022) Electric vehicles (EVs) are considered to be a crucial and proactive player in the future for transport electrification, energy transition, and emission reduction, as promoted by policy-makers, relevant industries, and the academia. EV charging would account for a non-negligible share in the future electricity demand. The integration of EV brings both challenges and opportunities to the electricity system, mainly from their charging profiles. When EV charging behaviours are uncontrolled, their potentially high charging rate and synchronous charging patterns may result in the bottleneck of the grid capacity and the shortage of generation ramping capacity. However, the promising load shifting potential of EVs can alleviate these problems and even bring additional flexibilities to the demand side for further applications, such as peak shaving and the integration of renewable energy. To grasp these opportunities, novel controlled charging strategies should be developed to help integrate electric vehicles into energy systems. However, corresponding methods in current literature often have customized assumptions or settings so that they might not be practically or widely applied. Furthermore, the attention of literature is more paid to explaining the results of the methods or making consequent policy recommendations, but not sufficiently paid to demonstrating the methods themselves. The lack of the latter might undermine the credibility of the work and hinder readers' understanding. Therefore, this thesis serves as a methodological framework in response to the fundamental and universal challenges in developing charging strategies for integrating EV into energy systems. The discussions aim to raise readers' awareness of the essential but often unnoticed concerns in model development

and hopefully would enlighten future researchers into this topic. Specifically, this cumulative thesis comprises four papers and analyses the research topic from two perspectives. With Paper A and Paper B, the micro perspective of the thesis is more applied and focuses on the successful implementation of charging scheduling solutions for each EV individually. Paper A proposes a two-stage scenario-based stochastic linear programming model to schedule EV charging behaviours and considers the uncertainties from future EVs. The model is calculated in a rolling window fashion with updated parameters. Scenario generation for future EVs is simulated by inhomogeneous Markov chains, and scenario reduction is achieved by a fast forward selection method to reduce the computational burden. The objective function is formulated as variance minimization so that the model can be flexibly implemented for various applications. Paper B applies the model proposed in Paper A to investigate how the generation of a wind turbine could be correlated with the EV controlled charging demand. An empirical controlled charging strategy is designed for comparison where EVs would charge as much as possible when wind generation is sufficient or would postpone charging otherwise. Although these two controlled charging strategies perform similarly in terms of wind energy utilization, the solutions from the proposed model could additionally alleviate the volatility of wind energy generation by matching the EV charging curve to the electricity generation profile. With Paper C and Paper D, the macro perspective of the thesis is more explorative and investigates how EVs as a whole would contribute to energy transition or emission reduction. Paper C investigates the greenhouse gas emissions of EVs under different charging strategies in Europe in 2050. Methodologically, the paper proposes an EV module that enables different EV controlled charging strategies to be endogenously determined by energy system models. The paper concludes that EVs would contribute to a 36% emission reduction on the European level even under an uncontrolled charging strategy. Unidirectional and bidirectional controlled charging strategies could further reduce emissions by 4% and 11%, respectively, compared with the

original level. As a follow-up study of Paper C, Paper D develops, demonstrates, improves, and compares three different types of EV aggregation methods for integrating an EV module into energy system models. The analysis and demonstration of these methods are achieved by having a simplified energy system model as a testbed and the results from the individual EV modelling method as the benchmark. As different EV aggregation methods share the same data set as for the individual EV modelling method, the disturbance from parameters is minimized, and the influence from mathematical formulations is highlighted. These EV aggregation methods are compared from multiple aspects**.**

Niklas Wulff, Felix Steck, Hans Christian Gils (MARCH 2020) Battery electric vehicles (BEV) provide an opportunity to balance supply and demand in future power systems with high shares of fluctuating renewable energy. Compared to other storage systems such as pumped-storage hydroelectricity, electric vehicle energy demand is highly dependent on charging and connection choices of vehicle users. We present a model framework of a utility-based stock and flow model, a utility-based microsimulation of charging decisions, and an energy system model including respective interfaces to assess how the representation of battery electric vehicle charging affects energy system optimization results. We then apply the framework to a scenario study for controlled charging of nine million electric vehicles in Germany in 2030. Assuming a respective fleet power demand of 27 TWh, we analyse the difference between power-system-based and vehicle user-based charging decisions in two respective scenarios. Our results show that taking into account vehicle users' charging and connection decisions significantly decreases the load shifting potential of controlled charging. The analysis of marginal values of equations and variables of the optimization problem yields valuable insights on the importance of specific constraints and optimization variables. Assumptions on fleet battery availability and a detailed representation of fast charging are found to have a strong impact on wind curtailment, renewable energy feed-in, and required gas

power plant flexibility. A representation of fleet connection to the grid in high temporal detail is less important. Peak load can be reduced by 5% and 3% in both scenarios, respectively. Shifted load is robust across sensitivity analyses while other model results such as curtailment are more sensitive to factors such as underlying data years. Analysing the importance of increased BEV fleet battery availability for power systems with different weather and electricity demand characteristics should be further scrutinized.

Yijun Gai, An Wang, Lucas G Pereira(JUNE 2019) To estimate greenhouse gas (GHG) emission reductions of electric vehicles (EVs) deployment, it is important to account for emissions from electricity generation. Since such emissions change according to temporal patterns of electricity generation and EV charging, this study operationalizes the concept of marginal emission factors (MEFs) and uses person-level travel activity data to simulate charging scenarios. Our study is set in the Greater Toronto and Hamilton Area in Ontario, Canada. After generating hourly MEFs using a multiple linear regression model, we estimated GHG emissions for EV charging at two EV penetration rates, 5% and 30%, and five charging scenarios: home, work and shopping, night, downtown vs suburb, and an optimal low emission charging scenario, matching charging time with the lowest available MEF. We observed that vehicle electrification substantially reduces GHG emissions, even when using MEFs that are up to seven times higher than average electricity emission factors. With Ontario's 2017 electricity generation mix, EVs achieve over 80% lower fuel cycle emissions compared with equivalent sets of gasoline vehicles. At 5% penetration, night charging nearly matches low emission charging, but night charging emissions increase with 30% EV penetration, suggesting a need for policy that can smooth out charging demand after midnight.

Kaile Zhou, Lexin Cheng(December 2020) The uncoordinated charging of large amounts of electric vehicles (EVs) can lead to a substantial surge of peak loads, which will further influence the operation of power system. Therefore, this study proposed a coordinated charging scheduling method for EVs in microgrid to shift load demand from peak period to valley period. In the proposed method, the charging mode of EVs was selected based on a charging urgency indicator, which can reflect different charging demand. Then, a coordinated charging scheduling optimization model was established to minimize the overall peak-valley load difference. Various constraints were considered for slow-charging EVs, fast-charging EVs, and microgrid operation. Furthermore, Monte Carlo Simulation (MCS) was used to simulate the randomness of EVs. The results have shed light on both the charging modes selection for EV owners and peak shaving and valley filling for microgrid operation. As a result, this model can support more friendly power supply-demand interaction to accommodate the increasing penetration of EVs and the rapid development of flexible microgrid.

Francisco Manríquez, Enzo Sauma(March 2020) This study analyzes the impacts of the massive electrification of vehicles on the power system expansion planning and operation for the year 2030. For this purpose, a long-term generation and transmission expansion co-optimization model is used, which captures the hourly operational dynamics of the system by means of the use of representative days. This is relevant since smart charging schemes for Electric Vehicles (EVs) are available, and their benefits are intertwined with the hourly available generation (especially solar), the level of demand, and the transmission capacity. Private and public EVs' demand is considered through five main scenarios, which differ in the number of EVs and the charging strategies used (i.e., upon-arrival charging or smart charging). The analysis is illustrated using the Chilean power grid. The numerical results show that a massive penetration of EVs in the Chilean power generation system will heavily encourage solar power capacity investments. Furthermore, smart charging allows for an additional

increase in the solar power installed, leading (in the Chilean case) to an extra 2.4% increase in solar power generation and an additional 2.5% decrease in fossil fuel-based generation, which was commonly used to offer flexibility to the system. These effects are diminished if a high-enough level of solar power is not feasible. In addition, some sensitivity analyses are made in order to identify the specific influences of some of the model parameters.

MARKETING

Marketing deals with identifying and meeting human and social needs. Simply marketing means `meeting needs profitably'. Marketing management is the art and science of choosing target market and getting keeping and growing customers through creating, delivering and communicating the value of goods and services. Swinyard (1997) is of the view that US retailers have been more responsive to market shifts now which resulted in mergers and consolidation, franchise options, joint ventures, vertical integration, increase in financial power, information technology explosion etc. The results highlight that the reason for the retail market shift is the law of natural selection- adapt to the environment or die. Retailers that continually understand and meet the expectations of shoppers will succeed.

Nashwan Mohammed Abdullah Saif , Wang Aimin (JANUARY 2016) Marketing strategy represents a key element of success for organizations. Executing an effective marketing strategy is just as important as conceptualizing and creating it. Through marketing strategy implementation firms employ scarce resources through marketing capabilities in order to attain the set goals and targets. In order to illustrate the value of marketing strategy and the process of implementation a detailed literature review was performed. A total of (Number of Studies Depending on the References Count, After Employee Deletion) studies on the topic of marketing strategy have been examined. The meta-analysis uncovers two distinct but related

features to marketing strategy content: marketing strategy decisions and marketing strategy decision implementation. The literature also suggests there is a relationship of marketing strategy, and marketing mix elements on organizational performance, and emphasizes a further need to perform conceptual and empirical studies. The originality and value of the review lies in the fact that marketing strategy has been analysed both in terms of its outcomes and as a process that does not yield satisfactory results without effective implementation.

Levy et al (2004) said pricing optimization is currently one of the hottest topics in the retail industry. This study explores how retailers typically make pricing decisions using time-honoured heuristics and attempt to infer the optimal decision. The study also provides examples of the more sophisticated competitive pricing techniques that are currently being tested and the effect of advertising, competition, and substitute products on price.

Brennan and Lundsten (2000) analysed the impact of large discount stores on US towns, the reason for shopping and retailer strategy, and found that customers shop at discounters for low prices and a large variety and specialty stores for the unique items they cannot find elsewhere.

Gopal (2006), According to him the consumer shopping behaviour during leisure is largely driven by the recreational infrastructure as a competitive strategy of retailers. This also helps in developing store loyalty, innovative concern and perceived customer values whereby individuals experience enjoyment from shopping. According to India retail report (2009), healthy investment climate, retail.

Customer segments, growing shopping centres', malls, supermarkets and departmental stores are the major factors that have earned India the top spot among the favoured retail destinations

PROMOTION

Tang (2014) this paper aims to investigate an optimal promotional strategy of intra-category cross-selling on culinary products for the fiercely competitive, fast-moving consumer goods (FMCG) industry. (Trivedi, 2003) Research conducted over the last decade, on the influence of brand inertia or variety seeking on promotional response, has yielded mixed results. Variety seekers are more price sensitive by one set of researchers, while another stream of work finds them to be less sensitive.

B.Jones (1994) Presents a communications relationship model for setting promotional goals. The model divides promotional objectives into short, mid- and long-range goals and helps present advertising and related promotional tools as an ongoing process. Its focus is primarily on how advertising and related communications engineer situations and the importance of gearing advertisements that maximize subsequent advertisements′ effectiveness.

Park (2004) Promotional support, as a push strategy, that manufacturers use to encourage retailers to carry their products needs retailers' cooperation. This study investigates the effects of retailers' fashion and price orientations on manufacturers' offerings of and retailers' cooperation with promotional support. Twenty-one promotional support items applicable to the apparel retailing were studied. Questionnaires completed by 137 US apparel retail buyers via a modified national mail survey were analyzed.

Soares (2017) Marketing strategies can be used to leverage business in the service sector, specifically in veterinary medicine; among other benefits, it can make a difference in satisfaction and consequent customer loyalty.

Chapter 3

INDUSTRIAL PROFILE

India unveiled the 'National Electric Mobility Mission Plan 2020' in 2013 to address the issues of National energy security, vehicular pollution and growth of domestic manufacturing capabilities. Reiterating its commitment to the Paris Agreement, the Government of India has plans to make a major shift to electric vehicles by 2030. E-commerce companies, Indian car manufacturers like Reva Electric Car Company, and Indian app-based transportation network companies like Ola are working on making electric cars more common over the next two decades.

Industry Profile

India's 2030 Vision on Electric Vehicle

Automotive Mission Plan (AMP) has been finalised jointly by Government of India and Indian Automotive Industry. The vision of AMP 2026 is, by 2026, the Indian Automotive industry will be among the top three of the worlds in engineering, manufacture and export of vehicles and components, and will encompass safe, efficient and environment friendly conditions for affordable mobility of people and transportation of goods in India comparable with global standards growing in value to over 12% of India's GDP and generating an additional 65 million jobs.

India's auto industry has become one of the largest in the world due to the competitive environment in the market. The turnover of the auto industry is equivalent to 7.1% as per the Review Report of Automotive Mission Plan 2016. Government of India approved the National Mission on Electric Mobility in 2011 and subsequently National Electric Mobility Mission Plan (NEMMP) 2020 was unveiled in 2013. As part of the mission, Department of Heavy Industry has formulated a scheme namely FAME – India (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India) for implementation with effect from 1st April 2015,

with the objective to support hybrid/electric vehicles market development and Manufacturing eco-system.

The overall scheme is proposed to be implemented over a period of 6 years, till 2020, wherein it is intended to support the hybrid/electric vehicles market development and its manufacturing eco-system to achieve self-sustenance at the end of the stipulated period. The scheme has 4 focus areas i.e., Technology Development, Demand Creation, Pilot Projects and Charging Infrastructure.

Ministry of Road Transport & Highways has issued notification No. GSR 643(E) dated 19.08.2015 vide which the mass emission standards for Bharat Stage IV shall come in to force all over the country in respect of four wheeled vehicles manufactured on or after the 1st April, 2017. India will jump from Bharat Stage (BS) IV emission norms to BS VI by 2020. Electric car uses alternate fuel electricity instead of petrol or diesel. There is a growing acceptance for hybrid and electric cars in the country and more and more manufacturers are entering this niche segment with an express objective of lowering the fuel import bill and running cost of vehicles. Conversion of vehicles to electric vehicles has a potential to save fossil fuels worth about $100 bn annually, which in turn would save the country precious foreign exchange, prevent the dependence on imported petroleum products and reduce the pollution in cities by 80-90%.

- By the year 2030, the NDA Government wants India to be 100%, electric vehicle nation.
- India spent Rs 4.7 Lakh Crores in 2016-17 in importing crude oil. Electric Vehicles will help lower the bill.
- Every car sold in India from 2030 will be electric, under new government plans.

- India aims to become a 100% electric vehicle nation by 2030. The National Electric Mobility Mission Plan (NEMMP) targets seven million electric and hybrid vehicles by 2020.

Electric vehicles promise zero tailpipe emissions and a reduction in air pollution in cities. The Indian government has created momentum through its Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles schemes that encourage, and in some segments mandates the adoption of electric vehicles (EV), with a goal of reaching 30% EV penetration by 2030. The scheme creates demand incentives for EV and urges the deployment of charging technologies and stations in urban centres. If these aims are realised by 2030, they will generate an estimated saving of up to 474 million of tonnes of oil equivalent (Mtoe) and 846 million tonnes of net CO2 emissions over their lifetime.

Various fiscal demand incentives have been put in place to spur the production and consumption of EVs and charging infrastructure - such as income tax rebates of up to INR150,000 ($2,100) for customers on interest paid on loans to buy EVs. To scale production of lithium-ion cell batteries, there will be an exemption from customs duties to bring down their cost.

Assuming the appropriate infrastructure is in place, 90% car owners in India are willing to switch to EVs, according to a survey by the Economic Times in May 2019. At present, however, EV market penetration is only 1% of total vehicle sales in India, and of that, 95% of sales are electric two-wheelers.

The automotive industry players and charging infrastructure, batteries and mobility service providers have taken various actions to ramp up industry action. Companies are designing and testing products suitable for the Indian market with a key focus on two-wheelers and three wheelers. Ola, an Indian taxi company, has launched “Mission: Electric” to integrate 10,000 e-

rickshaws and electric auto-rickshaws into its fleet. Car manufacturer Mahindra and Mahindra is investing INR18 billion over the next three years into EV production to ramp up its four-wheeler production. Other manufacturers are forging partnerships with states to augment their public transport systems. Some of the lightweight motor vehicles manufacturers such as Hero MotoCorp, Bajaj Auto and TVS remain unequivocally aligned with the government's vision; however, they are proposing a more cautious, clear and realistic roadmap towards the adoption of EVs. To meet the government's new Bharat Standard-VI emission regulations will cost the car industry an estimated INR70 billion - and with the mandate to replace conventional internal combustion engines within the next five years, companies are feeling the burn on their balance sheets. Battery manufacturers such as Amara Raja are taking concrete steps towards enhancing its research and development capabilities to develop battery packs for electric mobility. Indian Oil, National Thermal Power Corporation and Tata Power have big plans to proliferate electric charging stations throughout cities.

To scale the deployment of EVs, state government and local transport authorities are critical. To complement this central government thrust, 10 states and union territories have published draft or final policies aligned with the economic and demographic realities of each region.

Varied approaches have been taken. For example, given Delhi's air pollution issues and status as a high-employment hub, Delhi's policy targets the components of electric vehicles that have achieved parity in terms of life cycle and total cost of ownership with internal combustion engine (ICE) vehicles. It also aims to create jobs for battery swapping operators.

Karnataka, meanwhile, with technology hubs like Bengaluru, aims to become an EV manufacturing hub and to invest in research and development for battery manufacturing. Kerala is focusing on electric trains, electric buses, and on using energy-efficiency systems. Tamil Nadu, lauded for its comprehensive policy, has also created an EV venture capital fund

while providing tax exemptions for manufacturing and land subsidies, as well as allocated parking spaces for EV in commercial spaces. Every state has a different approach to solving its own environmental challenges.

Market Scenario

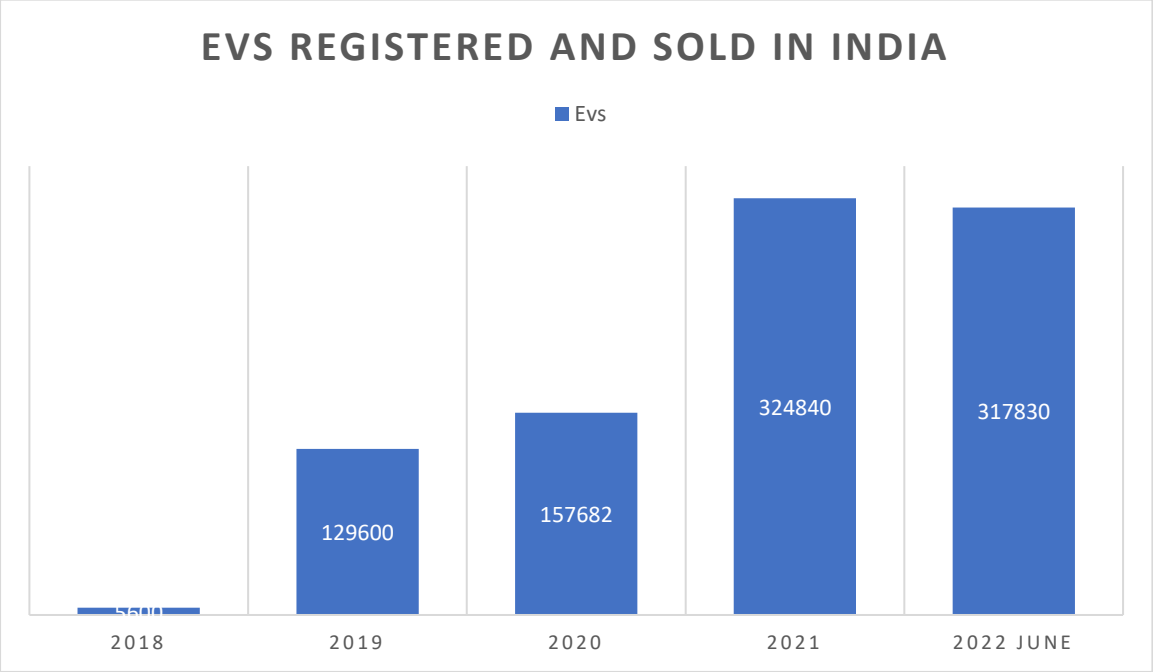
Indian Electric Vehicle Market is expected to grow at CAGR of 30 % over the forecast period.

Indian electric vehicle market is segmented by technology, by power source, by vehicle type and by powertrain. Based on technology, Indian electric vehicle market is segmented by hybrid electric vehicle, plug-in hybrid electric vehicle, battery electric vehicle. In terms of power source Indian electric vehicle market is bifurcated into stored electricity, on-board electric, generator. Two wheelers, passenger cars, commercial vehicles, others are vehicle type segments of Indian electric vehicle market. In terms of power train, Indian electric vehicle market is divided into series hybrid, parallel hybrid, combined hybrid.

Indian is aiming to reduce its overall oil import expense and pollution levels across cities, electric vehicles will play a remarkable role in achieving the target. Strong government support and hike in crude oil prices drives the electric vehicle market in Indian. Government of Indian will ban petrol and diesel cars by 2030.

This means that petrol/diesel cars won't be allowed on the road after 2030 only electric cars will be sold. Government's ban on petrol and diesel car is powerful endorsement of electric, green technology, and can change transportation industry forever. Government initiative for electric vehicles under FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) Indian and NEMMP (National Electric Mobility Mission Plan) 2020 creates potential

opportunity for electric vehicle in Indian. Low maintenance and operations costs of electric vehicles coupled with drop in battery price favours the E-Vehicle adoption.



Two-wheeler vehicle segment dominated the Indian electric vehicle market in 2017. Passenger cars is anticipated to grow at high CAGR. Government plan to ban diesel and petrol passenger cars will lead to high sale. Attributed to this passenger cars segment is expected to hold 70% of the Indian electric vehicles market share by 2026.

Stored electricity segment is anticipated to be the most lucrative segment in the Indian electric vehicles market and is estimated to dominate the Indian electric vehicles market with 84.4% market revenue share in 2017. Central government has proposed that the Union ministry of Power and state governments, create a ‘minimum skeleton network' of charging infrastructure throughout the country. Highways connecting metros, two sets of charging stations are proposed on either side of the road, every 25 km. This encourages the use of EVs and create enough demand to attract players to set up charging stations, thus creating a bigger market for stored electricity power sources in the forecast.

Automobile manufacturers have started working extensively toward electrifying or introducing electric vehicles. Hyundai has confirmed electric vehicle debut in Indian by 2019. Maruti Suzuki has also announced launching of its first electric vehicle in Indian by 2020. Global automakers like Audi, Mercedes and Porsche do have plans to bring their electric vehicles to Indian.

Mahindra & Mahindra Ltd., Maruthi Suzuki India Limited, Toyota Motor Corporation, AB Volvo, Tata Motors, Ashok Leyland, Hero Electric Vehicles Private Limited, 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. Ltd.

The objective of the report is to present a comprehensive analysis of the marketing and promotion of the Indian Electric Vehicles Market and the developing charging stations, by geography for automotive including all the stakeholders of the industry. The past and current status of the industry with forecasted Market size and trends are presented in the report with analysis of complicated data in simple language. The report covers all the aspects of industry with dedicated study of key players that includes Market leaders, followers and new entrants by region. PORTER, SVOR, PESTEL analysis with the potential impact of micro-economic factors by region on the Market have been presented in the report. External as well as internal factors that are supposed to affect the business positively or negatively have been analysed, which will give clear futuristic view of the industry to the decision makers.

The report also helps in understanding Indian Electric Vehicles Market, by geography for automotive dynamics, structure by analysing the Market segments, and project the Indian Electric Vehicles Market, by geography for automotive size. Clear representation of

competitive analysis of key players by type, price, financial position, product portfolio, growth strategies, and regional presence in the Indian Electric Vehicles Market, by geography for automotive the report investor's guide.

The rise of electric vehicles is inevitable around the world and India alike. While several manufacturers have rolled EVs, there are several challenges that need addressing and a government intervention is one of the plausible ways to go about it.

The global automotive industry is on the verge of disruption. Four technology-driven trends — electrification, shared mobility, connectivity, and autonomous driving—are leading the automotive industry to this disruption. These trends will shift markets and revenue pools, change mobility behaviour and build new avenues for competition and cooperation.

India Emerging EV ambition

The Indian automotive industry has started to experience these effects of the global disruption. Out of the four emerging trends, Electrification is of importance and might significantly impact auto OEMs and auto component manufacturers. India has big plans for the emerging Electric

Vehicles and its technologies in the country. It has announced (and later modified some) ultimatums for the next decade.

India has great expectations of achieving a high level of penetration in e-mobility by 2030. The reason is not very surprising; the alarming levels of pollution indices which keep on rising and the colossal dollars the country must pay for annual crude oil imports. In December 2017, New Delhi was in a state of red alert and came close to Beijing in terms of pollution toxicity, such are the pollution indices in India. If India successfully manages to achieve this target by 2030, it could save about 1 Giga Tonne of emissions.

E-mobility has arrived in India. In the Indian context, any discourse around Electric Vehicles cannot be disjointed from pollution and its impact, dependence on oil imports, dire need to have more renewable sources of energy. The automotive industry could benefit by viewing it not as a threat, but an opportunity. The good news is that policymakers are trying too seriously consider it and the social circle across the nation is making EV a buzzword.

However, till date, there has been very little penetration as EV today are undergoing a typical vicious cycle of high cost, low demand, low supply. This must translate into a virtuous cycle of low cost, high demand, high supply.

There is a need to create an integrated policy to nurture this technology. An eco-system approach is what will help achieve India's progress on electric mobility. The policy on 'Faster Adoption and Manufacturing of Hybrid and Electric vehicles' FAME I in 2015 and FAME-II in 2019 have in some ways been instrumental in successfully creating an initial but nascent market. However, there is an apparent shift in the focus of Government towards supply-side measures that include manufacturing of critical components of EV technology.

The real challenges and barriers to going electric.

Despite lack of specific pointers towards electrification, the EV Industry in India will still take another few years to evolve. This does not owe to the Indian Government's ambitions targets and their resultant steps but simply because the automobile industry believes that India too will follow the low-carbon footsteps that are being taken by global big car markets like China, US and Japan.

Every major car-maker existing and planning to enter our market is getting into the act. So, while some domestic players already have EV in their portfolio (though in very small numbers), other MNC OEMs are all testing and planning to launch their own EVs within the next few years. While each of these manufacturers understands the significance of the mass market prospects for EVs, they are hopeful that the policy push from the Government will translate into concrete steps that will eventually make EVs attractive even for buyers in the lower price segments.

But there are challenges. The primary concerns have been around range anxiety (kms on a single charge) and the lack of charging infrastructure and several other factors. Some of them are:

Incentives

EVs worldwide constitute a very small niche and are all loaded on the top of the premium price segment and remain dependent on incentives. This holds true in developed markets like China and the US where the number of EVs on the road are gaining critical mass. Adoption in India will also be heavily dependent on Government incentives.

However, there is an alternate view that while demand incentives can help in the short term but, in the next five-six years, with the expected reduction in battery prices and the simultaneous increase in cost of ICE (internal combustion engine) vehicles due to stringent

emission regulations could help EVs offer an inherent operating cost-benefit and make them sustainable even in the absence of incentives.

Cost of the battery

Currently, the cost of the battery and power electronics constitute almost two-thirds of the cost of an EV. The most widely used battery materials today are nickel-metal hydride (NiMH) and Lithium-Ion (LiON). Multiple factors like demand-supply gaps, uneconomically low volumes etc, lead to the high cost of manufacturing EVs. Today, an EV's battery, power electronics and motors can together cost as much as six to seven times that of an IC engine affecting the ex-showroom price.

New battery manufacturing capacities are coming up in India and the localisation push will help lower costs of EVs just like it does in the case of IC engine cars. Experts in cell manufacturing feel that the economic size of a battery manufacturing plant is upwards of 8 GWh. So, clearly, localisation benefits can be accrued only in the long term and with meaningful penetration and volumes for EVs.

Price multiple

The biggest hurdle for buyers looking to go electric is the current high price of EVs. For a buyer who is hesitant to choose a hybrid in favour of the equivalent ICE-only car, the nearly 3x price tag of an EV is too much of an entry barrier. The industry view is that the price multiple between ICE cars and similarly positioned EV can't be more than 1.2x to 1.3x.

But lower-end cars will tend to be more expensive because of the higher cost of technology spread over a lower price level. Unfortunately, price sensitivity is also higher amongst buyers in the lower price segment. And the cost-of-ownership issue will further affect long term viability of EVs.

Challenges from the Grid side

Most often, the EV discussion only veers around the non-existent charging infrastructure and about who will be responsible and when will this come up in India. Another point that gets raised is how much of the power generated comes from old, coal-fired thermal power plants and about how EVs may well be only displacing the pollution from the cities to the suburbs where these plants are located. But what about the other challenges that the grid may be faced with when EVs start becoming mainstream? And what about the price of charging EVs at private charging stations?

Even assuming that renewables and newer, cleaner sources of thermal or nuclear power come on stream within the next few years, there are other factors like the skyrocketing demand for electricity that will affect EVs. According to Brookings India, projections for 2030 show that even with a fair penetration of EVs (two, three and four-wheelers, and intra-city buses), the increase in demand for electricity is likely to be only about 100 TWh (Tera watt-hours) or about 4 per cent of the total power generation capacity. So, ramping up power generation should be possible to meet that growth in demand.

The EV space will also turn out to be like the proverbial ‘chicken and egg’ situation. But that was the case even with ICE vehicles, where the cars came first, and the roads came later. So, the charging infrastructure will take its time coming, as will the production capacities for batteries. But, in the meantime, the Government needs to also promote hybrids and plug-ins to create an enabling ecosystem for buyers of EVs and those who need to invest and profit from setting up the charging infrastructure.

As quite ostensible from the mentioned facts and figures, E-mobility is a distant dream for the Indian government. If India really wants the mission to be accomplished, it’s going to be a collective effort of every individual/ organization significant to the country.

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**: By defining the regulations on emissions and fuel efficiency, clarifying aspirations, strategic intent and direction, exploring incentives and subsidies, it can support EV adoption and focus on developing a supportive ecosystem.
- **The power, fuel, and charging infrastructure companies:** By laying down a foundation of support, innovating on business models (e.g., leasing of batteries, swapping infrastructure, deploying fast chargers), making the economics of (fast) charging infrastructure work, providing stable power supply and grid stability, they can enable easy and rapid charging and drive EV adoption.
- **The automotive industry:** By changing the product and component mix bringing EV components and vehicles to life, building the right talent pool and skill set, improving the performance of batteries and electric vehicles and building scale, the industry can drive the EV disruption in India.

In the new future, e-mobility in India would not be something of luxury but it would be something necessary for the survival because the pollution level is alarming, and the only solution is the green sources and transmission of energy. Hence, EVs are inevitable when it comes down to it, so it is better to plan and organize about how the developments are going to occur rather than dodging the change.

Undoubtedly, an integrated policy on future of mobility with a focus on zero-emission mobility is the call of the hour. However, such a policy should also consider financial health of the industry, revenue to the government and employment opportunities to millions and millions. The future of electric mobility is here and is here to stay, evolve and widen its reach.

Scope of the Indian Electric Vehicles Market

Indian Electric Vehicles Market by Technology Type

- Hybrid Electric Vehicle
- Plug-In Hybrid Electric Vehicle
- Battery Electric Vehicle

Indian Electric Vehicles Market by Power Source Type

- Stored Electricity
- On-Board Electric
- Generator

Indian Electric Vehicles Market by Vehicle Type

- Two Wheelers
- Passenger Cars
- Commercial Vehicles
- Others

Indian Electric Vehicles Market by Powertrain Type

- Series Hybrid
- Parallel Hybrid
- Combined Hybrid

Key Players analysed in Indian Electric Vehicles Market:

- Mahindra & Mahindra Ltd.
- Volvo India Pvt. Ltd
- Tata Motors

- Ather Energy Pvt. Ltd
- Ashok Leyland Ltd
- Hero Electric Vehicles Pvt. Ltd
- Bayerische Motoren Werke AG (BMW AG)
- Lohia Auto Industries
- Electrotherm (Indian) Ltd
- Yamaha Golf-Car Company
- Speedways Electric
- Maini Material Movement Pvt. Ltd.
- Auto Power
- Carrieall Car Private Limited
- Ampere Vehicles Pvt. Ltd.
- Tunwal E-Vehicle IND. Pvt. Ltd.
- BYD India Pvt. Ltd
- Toyota Kirloskar Motors Pvt. Ltd
- Lexus IND. Ltd
- MINI IND
- OLA Electric Mobility
- MG Motors IND
- Hyundai Motors IND
- KIA INDIA
- Jaguar Land Rover

Toyota Kirloskar Motors Pvt. Ltd, Lexus IND. Ltd is included because have models having mild-hybrid and hybrid technology. Due to a scam of mild hybrid technology, Maruti Suzuki was not included.

In order to perform the study, TechSci Research conducted primary as well as exhaustive secondary research. Initially, TechSci Research prepared an exhaustive list of electric vehicle manufacturers and companies operating in India. Subsequently, TechSci Research conducted primary research surveys, which included primary calls, email, etc., with the identified companies. While interviewing, the respondents were also asked about their major competitors. Through this technique, TechSci Research was able to include those companies which could not be identified due to the limitations of secondary research. TechSci Research analysed product offerings, regional network, and regional presence of all major companies operating across the country.

TechSci Research calculated the size for India electric vehicle market using a bottom-up technique, wherein the value service data for different vehicle types was recorded as well as forecast for future years. TechSci Research sourced these values from industry experts and company representatives, and externally validated through analysing historical data of respective companies to arrive at the overall market size. Multiple secondary sources such as directories, databases such as OICA, World Bank, company websites, company annual reports, white papers, investor presentations and financial reports were also analysed by TechSci Research.

Electric Vehicles is the latest buzz happening all around the world. With the development of Electric Vehicle (EV), there are more opportunities for the people to be safe as well as to keep the environment safe for future generations.

Here is the list of Electric Vehicle manufacturers in India 2022:

1. Tata Motors

Tata Motors was one of the first automotive brands in India to hop onto the electric vehicle bandwagon. It was quick in assessing the EV space way before the competition and currently enjoys a slight first-mover advantage. Tigor EV was the manufacturer's first electric vehicle for personal buyers which came at a hefty price in 2019. This particular car accounted for 95 percent of total electric car sales in February 2022. Apart from that, the Ziptron technology at the helm of Tata electric cars ensures the smooth performance of the battery and motor for the long term. It also allows Tata to easily offer EV versions of its existing ICE cars such as Tigor and Nexon.

TATA Motors EVs in India

1. TATA Nexon EV
2. TATA Tigor EV
3. TATA Nexon EV Max

2. Hero Electric

Hero Electric currently holds the topmost position in the electric two-wheeler segment. As it's been a well-known brand in the industry for over 14 years, consumers have built a sense of faith and trust. This of course goes in hand with the increased awareness of

electric vehicles in India. That said, Hero Electric can sell thousands of electric two-wheelers every month with record-high sales. It aims to manufacture over 1 million EVs by 2025 whilst expanding its plant and charging stations. Currently, the brand has 2000 charging stations across the country with 20,000 more in the pipeline which will make it much easier for its customers to quickly charge their two-wheelers at various standpoints. Hero Electric's lineup of e-scooters includes Optima HX, Photon HX, NYX HX, Flash LX, and Atria LX. Its sales figure shows the company has sold over 46,260 units of electric scooters in 2021.

Hero EVs in India

- Hero Eddy
- Hero Electric Photon HX
- Hero Electric NYX HX
- Hero Electric Optima CX
- Hero Electric Flash LX
- Hero Electric Atria LX

3. Ola Electric

Ola Electric Mobility, a division of Ola cabs has taken the market by storm with its Ola S1 and Ola S1 Pro electric scooters. The company's electric two-wheeler manufacturing takes place in its 500-acre automated factory in the Krishnagiri district of Tamil Nadu. Currently, Ola produces 1000 electric scooters and claims to become the largest two-wheeler brand in the world with an annual production of 10 million units in the coming years. The S1 and S1 Pro e-scooters have been able to gain all the limelight due to the high-end features such as keyless ignition, large boot space, external charging port and loads of smart features accessible via the large LED display. Both these scooters are also able to provide impressive performance outputs.

Ola EVs in India

Ola S1

Ola S1 Pro

4. Ather Energy

Ather Energy is the maker of India's first smart electric scooter called S340. Launched in 2016, the scooter brought in never seen features on a two-wheeler such as a capacitive touch screen, user-based profiles, and even an app to control various settings of the e-scooter. Being an avid player in the EV space, Ather has managed to build its charging infrastructure across 21+ cities and 220 locations in India, called Ather Grid. It currently manufactures two electric scooters, namely Ather 450X and Ather 450 Plus, with both of them boasting features like reverse assist, a high-end suspension system and tons of smart features such as Bluetooth connectivity and monthly riding stats. Ather Energy has received several investments from Hero MotoCorp in the past couple of years, which itself is a forefront player in the two-wheeler automotive sector.

Ather Energy EVs in India

- Ather 450x
- Ather 450 Plus

5. Mahindra Electric

Mahindra Electric Mobility Limited is the electric vehicle venture under the Mahindra Group. The company has several EVs in its portfolio including commercial, personal, and passenger vehicles. Being a prominent player in the automotive sector for a couple of decades just like Tata Motors, Mahindra Electric has made fast progress by quickly understanding the need for electricity-run vehicles and taking action accordingly. Its history can be dated back to 2001 with the launch of the Mahindra Reva, which is considered to be one of the world's first electric cars that even sold in international markets such as the United Kingdom, Germany, France, etc. As of today, apart from building cars such as eVerito, eSupro, Treo Zor, and e2o plus, Mahindra Electric also focuses on the manufacturing of batteries and improving the EV infrastructure in the country.


Mahindra Electric EVs in India

- Mahindra eVerito
- Mahindra Reva e2o plus
- Mahindra Treo

6. Olectra Greentech

Olectra Greentech is the largest electric bus manufacturer in India. It has bagged several orders from state governments to supply buses for public transport use. Olectra currently enjoys a share of 40 percent in the electric bus market and also plans to produce electric three-wheelers and commercial trucks in its 150-acre manufacturing facility situated in Hyderabad. Touted as pioneers of electric buses in India, Olectra Greentech buses include the K6 E-Bus, K7 E-Bus and K9 E-Bus with all of them boasting great mileage and sheer indoor silence as compared to ICE counterparts.

Olectra Greentech EVs in India

- K6 eBus
- K7 eBus
- K9 eBus

7. Ashok Leyland

Commercial vehicle giant Ashok Leyland has also entered the EV space where it manufactures passenger electric buses. However, just recently it has transferred its EV business to its step-down subsidiary, Switch Mobility Automotive Ltd (SMAL) to focus on its core business of commercial trucks and buses. That said, Ashok Leyland is still a major shareholder of the newly formed subsidiary and will be responsible for making strategic decisions in the company. In its fleet are several passenger buses such as Circuit, Solo, Metrocity and Metrodecker which are even being supplied to foreign cities such as London. The company has received orders and contracts from various state governments to deliver electric buses and commercial vehicles.

8. Okinawa

Okinawa is a popular electric two-wheeler brand among youngsters. The Gurugram based company founded in 2015 makes sporty-looking e-scooters that are often associated with speed and performance. As of February 2022, Okinawa held the second position among the top two-wheeler brands in India. It has been able to capture a good chunk of the market share by providing two-wheelers in various price brackets which gives it a competitive edge. It manufactures its vehicles in a plant situated at Bhiwadi, Rajasthan which is responsible for the production and supply of six electric two-

wheelers in its portfolio such as Okinawa R30, Ridge Plus, Praise, i-Praise, and OKHI-90 which will directly rival the feature-packed Ola S1 Pro. As for the sales, Okinawa sold a total of 29,945 units in 2021 and in January 2022 alone it has sold 11,536 units of electric two-wheelers.

Okinawa EVs in India

- Okinawa Dual
- Okinawa Okhi-90
- Okinawa Lite
- Okinawa iPraise+
- Okinawa PraisePro
- Okinawa Ridge+
- Okinawa R30

9. Ampere EVs

Ampere Vehicles is currently the third largest two-wheeler EV brand in the country as of February 2022. Founded in 2008, the company was initially into supplying vehicles for the differently-abled on a government contract basis. After years of innovation, it came up with the V60 electric scooter in 2010 and later on introduced indigenized charger and IQ battery. Over the years, it has backed several investments from personalities like Shri Ratan N Tata. It currently has four electric scooters in its fleet

namely Magnus EX, Magnus, Zeal EX and Reo Plus all ranging from Rs 45,000 to Rs 80,000. As for sales, the company has managed to sell a total of 4303 units in February 2022.

Ampere EVs in India

- Ampere Magnus EX
- Ampere Magnus
- Ampere Zeal EX
- Ampere Reo Plus

10.Bajaj Auto Ltd

Bajaj Automobile company is the Indian two-wheeler manufacturer. It will introduce the EVs by 2020. Bajaj Auto Managing Director Rajiv Bajaj has said that the company is working on the building a niche business in the EV market. They will start EVs business with a new brand name “Chetak”, which deals with the making of the EVs.

11.TVS Electric Vehicles

TVS is one of the Versatile Automakers in India, it bags with an experience of 40 years in the automobile industry. Recently, it has entered into electric vehicle market with Creon scooter. TVS Creon electric scooter is one of the best-featured EV in the Indian market TVS iQube comes with a price tag of 1.3lakh.

12. Verge Motors

Saumya Rout, the Founder of Verge Motors, created the prototype "VM KDH 100" with a team of around 15 personnel after two years of R&D. The functional prototypes has a mileage of around 100 km/l, a peak speed of the 100 km/h, the EV range of 40 km, a switchable battery, and much more. An electric scooter that not only operates on energy but also has a fuel alternative that can be switched with a flip of the switch! It can go 100 kilometres on one litre of petrol and has a peak speed of around 100 kilometres per hour. erge Motors

Saumya Rout, the Founder of Verge Motors, created the prototype "VM KDH 100" with a team of around 15 personnel after two years of R&D. The functional prototypes have a mileage of around 100 km/l, a peak speed of the 100 km/h, the EV range of 40 km, a switchable battery, and much more. An electric scooter that not only operates on energy but also has a fuel alternative that can be switched with a flip of the switch! It can go 100 kilometres on one litre of petrol and has a peak speed of around 100 kilometres per hour.

13.Kabira Mobility

Kabira happens to be the Indian electric vehicle business formed in the year 2017 by a team of proficient engineers. It has made its debut at Indian Auto Expo in the year 2020. What makes the company renowned is the fact that Kabira makes electric two-wheelers. Their vehicles get produced in Goa and Dharwad. The production plant in Goa has around 10,000 units of capacity, while the facility in the land of Dharwad has a capacity of around 8,000 units. In the year 2017, Kabira Mobility had introduced six scooters

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List of imported EVs in INDIA

1. Kia Motors

Kia Motors is into manufacturing Hybrid Plug-in vehicles, Electric Vehicles, Eco-Friendly Monitor, Hydrogen Fuel Cell cars and much more. Its efforts towards Zero Emissions established an EV mass production system. It produces Massive Lithium-Ion Polymer Battery, High-Efficiency EV Motor, Built-in Slow Charging System for Domestic Use, Supervision Cluster (for EVs only).

KIA Motors invested 1.6 billion USD for its first Electric Vehicles manufacturing Unit in Anantapur. Unemployed youth will get job opportunities with the establishment of KIA MOTORS. The first phase of electric cars is expected the launch in the last quarter of 2019. Due to Covid manufacturing its delayed.

KIA EV6 Specifications

- Maximum range: 528km
- Maximum power output: 430(kW)
- Lithium-ion Polymer battery
- Price- 59.95 Lakhs.

2. Hyundai Motors

Hyundai Motors is the parent company of KIA Motors. Is into manufacturing Hybrid Plug-in vehicles, Electric Vehicles, Eco-Friendly Monitor, Hydrogen Fuel Cell cars and much more. Its efforts towards Zero Emissions established an EV mass production system. It produces Massive Lithium-Ion Polymer Battery, High-Efficiency EV Motor, Built-in Slow Charging System for Domestic Use, Supervision Cluster (for EVs only).

Ionic5 share its platform and tech with KIA EV6

Kona EV Specification

- Maximum range: 452km
- Maximum power output: 100(kW)
- Lithium-ion Polymer battery
- Price- 28.95 Lakhs.

3. MG MOTORS

Hyundai Motors is the parent company of KIA Motors. Is into manufacturing Hybrid Plug-in vehicles, Electric Vehicles, Eco-Friendly Monitor cars and much more. Its efforts towards Zero Emissions established an EV mass production system. It produces Massive Lithium-Ion Battery, High-Efficiency EV Motor, Built-in Slow Charging System for Domestic Use, Supervision Cluster (for EVs only).

ZS EV Specification

- Maximum range: 461km
- Maximum power output: 129(kW)
- Lithium-ion battery
- Price- 24 Lakhs

4. Mercedes-Benz India

Mercedes-Benz India Pvt Ltd is a wholly owned subsidiary of the German Mercedes-Benz Group founded in 1994, with headquarters in Pune, Maharashtra, India Mercedes-EQ is a series of battery electric vehicles manufactured by Mercedes-Benz. The first model was previewed at the Paris Motor Show in 2016 with the Generation EQ concept vehicle.[1] Mercedes-Benz intends to produce ten EQ models by 2022, three of which will have the Smart brand, representing between 15% and 25% of the company's global sales. All of Mercedes-Benz electric vehicle design and production efforts will target the EQ family

EQS Specification

- Maximum range: 450km
- Maximum power output: 300(kW)
- Lithium-ion battery
- Price- 1Crore

5. Jaguar Land Rover

Jaguar is the luxury vehicle brand of Jaguar Land Rover, a British multinational car manufacturer with its headquarters in Whitley, Coventry, England. Jaguar Cars was the company that was responsible for the production of Jaguar cars until its operations were fully merged with those of Land Rover to form Jaguar Land Rover on 1 January 2013.

The Jaguar I-Pace (stylised as I-PACE) is a battery-electric crossover SUV produced by Jaguar Land Rover (JLR) under their Jaguar marque. The I-Pace was announced in March 2018, European deliveries began in June 2018, North American deliveries started in October 2018, and Indian deliveries began in March 2021.

I-Pace Specification

- Maximum range: 470km
- Maximum power output: 293(kW)
- Lithium-ion battery
- Price- 1.12Crore

6. Audi AG

Audi AG commonly referred to as Audi, is a German automotive manufacturer of luxury vehicles headquartered in Ingolstadt, Bavaria, Germany. As a subsidiary of its parent company, the Volkswagen Group, Audi produces vehicles in nine production facilities worldwide.

The Audi e-tron is a series of electric and hybrid cars shown by Audi from 2009 onwards. In 2012 Audi unveiled a plug-in hybrid version, the A3 Sportback e-tron, released to retail customers in Europe in August 2014, and slated for the U.S. in 2015. A decade after the unveiling of the first e-tron concept at the 2009 International Motor Show Germany, Audi's first fully electric e-tron SUV went into production in 2019.

Audi e-tron Specification;

- Maximum range: 484km
- Maximum power output: 233(kW)
- Lithium-ion battery
- Price- 1.1Crore

7. BMW India Pvt Ltd

BMW India started operations in January 2007. Wide range of its activities include a manufacturing plant in Chennai, a parts warehouse in Mumbai, a training centre in Gurgaon NCR and development of a dealer organisation across major metropolitan centres of the country.

The BMW i is a sub-brand of BMW founded in 2011 to design and manufacture plug-in electric vehicles. The company initially released two vehicles: the i3 all-electric car and the i8 plug-in hybrid. The all-electric iX3 SUV was released in late 2020, while iX SUV and the i4 all-electric lift back sedan followed later in 2021.

BMW i4 Specification;

- Maximum range: 500km
- Maximum power output: 250(kW)
- Lithium-ion battery
- Price- 70Lakh

BMW iX Specification;

- Maximum range: 425km
- Maximum power output: 240(kW)
- Lithium-ion battery
- Price- 1.16Crore

8. BYD

BYD India is a subsidiary of BYD that commenced its EV operations in the country in 2007 with the construction of a new electronics manufacturing plant. In 2013, BYD forayed into the electric vehicle market with its first pure electric bus, the BYD K9.

The BYD K-series bus (sometimes just referred to as the BYD E-Bus or BYD electric bus) are a line of battery electric buses manufactured by the Chinese automaker BYD, powered with its self-developed lithium iron phosphate battery, featuring a typical operating range of 250 kilometres (160 mi) per charge under urban road conditions. It is available in several different nominal lengths, from 23' to 45' and also as a 60' (articulated) bus. The rear axle is powered by two electric traction motors; the battery capacity and motor power of each model varies depending on the nominal length and passenger capacity.

The BYD e6 is an all-electric compact crossover/compact MPV manufactured by BYD from 2009. Field testing for the first generation model began in China in May 2010

with 40 units operating as taxis in the city of Shenzhen. Sales to the general public began in Shenzhen in October 2011, over two years behind schedule of the originally planned release date of 2009.A number of e6 units were operating in fleet service as taxis in China, Indonesia, Colombia, Belgium, the U.S. (New York and Chicago), the Netherlands, and the U.K.Australia will be introducing the e6 taxi fleet in 2020. Since 2010 sales in China totaled 34,862 units through December 2016.The BYD e6 ranked as the best-selling pure electric car in China in 2016 and won a golden medal for "Best Quality Product" at the Havana International Fair 2015

In India e6 compact MPV, which is targeted at the Indian B2B segment. The eco-friendly MPV is priced at Rs 29.60 lakh (ex-showroom India). E6 is equipped with a 71.7 kWh Blade Battery and a WLTC（city) range of 520km and a WLTC (combined) range of 415km with just a single charge. The 70kWh electric motor develops torque of 180 Nm and a top speed of 130kph.

List of Battery Swapping Solution providers in India:

EVSE stands for Electric Vehicle Supply Equipment, CPO stands for Charge Point Operator

1. Delta Electronics India

EVSE Manufacturers (OEM)

Offerings – EV charging equipment including:

AC charger – Type-1, Type-2, Type-2 Socket | Power Output – 3.12 kW to 22 kW

DC charger – CCS, CHAdeMO, DC001 | Power Output – 15 kW to 150kW

Site Management System for parking lots, workplaces, fleet and residential buildings, etc.

Notable Projects – Launched Mumbai's first DC Fast-Charger at Maharashtra Mantralaya. Partnership with MG Motors and EV Motors to enable EV Charging Infrastructure. Delta Electronics India with CPO partner, Charge+Zone has facilitated Ahmedabad Municipal Transport Service by providing a fleet of 150 kW DC fast chargers

2. Mass-Tech

EVSE Manufacturers (OEM)

Offerings – EV charging equipment including:

AC charger – Type-2 | Power Output – 2 kW to 43 kW

DC charger – GB/T, CCS, CHAdeMO | Power Output – 10 kW to 200 kW

Notable Projects – Panasonic Life Solutions India Ltd., Mass-Tech will be providing advanced 240KW chargers to PMI Electro Mobility Solution Pvt. Ltd./ Photon, China, who are gearing up to supply 1000 e buses to 18 cities across India. Mass-Tech Controls

has bagged an order of 200 nos of 240 KW DC Chargers, for charging of Electric Vehicles, to be installed in cities across India.

Completed Charging Station projects with TATA motors in Mumbai for DC Fast Charging station. Clients include Force, Eicher, Volvo, Mahindra.

3. ABB India

EVSE Manufacturers (OEM)

Offerings – EV charging equipment including:

AC charger – Type-1, Type-2, Type-2 Socket | Power Output – 3 kW to 22 kW

DC charger – CCS, CHAdeMO | Power Output – 11 kW to 350 kW+

EVSE for heavy commercial vehicles including buses and trucks, off-road vehicles including electric boats. Also provides Smart monitoring, predictive maintenance, and integrated payment gateways for Charge Point Operators.

Notable Projects – ABB India partners with Audi India to provide charging solutions. Installed Terra 53 Fast Charger Station at NITI Aayog office in Feb 2018. Installed its first public DC fast charger in New Delhi with EV Motors India, the major charge point operator for BSES Yamuna Power Limited.

4. Amara Raja

EVSE Manufacturer (OEM)

Offerings – EV charging equipment including:

AC charger – Type-2, IEC 60309 | Power Output – 3.3 kW to 22 kW

DC charger – CCS, CHAdeMO| Power Output – 30 kW to 350 kW

Off board AC charger for 2W, 3W

Battery swapping station for battery ratings from 1.5kWHr to 3kWHr with 4 to 20 channel variants

5. **Exicom**

EVSE Manufacturers (OEM)

Offerings – EV charging equipment including:

AC charger – SBS-75X, Type-2 | Power Output – 1.1 kW to 22 kW

DC charger – GB/T, CCS, CHAdeMO | Power Output – 15 kW to 200 kW

Notable Projects – Signed MoU with BHEL for EV charging infrastructure. Opened charging station at New Delhi's Rafi Marg EV Charging Plaza, with combo chargers with 3 connectors/guns for e-buses and electric 4 Wheelers. In 2018, Exicom won the NTPC tender for setting up DC charging infrastructure for e-buses in Jabalpur, comprising of 120kW and 50kW CCS chargers. Setup Bharat AC and DC chargers for Tata Tigor and Mahindra e-Verito cars procured by EESL.

6. P2 Power Solutions

EVSE Manufacturers (OEM)

Offerings – EV charging equipment including:

AC charger – Type-2, IEC 60309 | Power Output – 3 kW to 22 kW

DC charger – GB/T, CCS, CHAdeMO | Power Output – 15 kW to 200 kW

Combo chargers up to 142kW with Single Connector, Dual Connector or 3 Connectors.

7. Magenta Group

Charge Point Operator (CPO) with end-to-end charging solution

Offerings – 'ChargeGrid' series of EV charging stations. Flare – an EV charger integrated with a streetlamp.

Notable Projects – Magenta set up India's largest public EV charging station in Navi Mumbai in 2021.

8. Fortum India

CPO with end-to-end charging solution

Offerings – Solutions and services for EV charging for utilities, CPOs, EMPs, OEMs, as well as workplace charging and fleet management. Charging stations providing charging services over Fortum's Charge & Drive platform.

Notable Projects – Fortum Charge & Drive India set up the first 50 kW public fast-charging station in MG Motor India's Gurugram showroom at 32nd Milestone. 11 DC rapid CCS/CHAdeMO chargers spread across primary locations, in cities like Delhi, Gurgaon, Noida, Mumbai, Pune, Bangalore, Hyderabad and Ahmedabad. DC001 charging points spread across 38 prime locations in Hyderabad.

Partnership with MG to install 50-kilowatt fast-charging stations across showrooms in Delhi NCR, Hyderabad, Mumbai, Bengaluru and Ahmedabad.

9. TATA Power

Charge Point Operator

Offerings – End-to-end customized solutions offerings – Backend Power Infrastructure, EV Chargers of different charging standards, Charger Installation, Annual Maintenance, Charger Management Software Platform Subscription, and Mobile App.

Notable Projects – Tata Power has joined hands with HPCL to set up EV charging stations at its Petrol Pumps across the country. Partnered with Tata Motors to set up 300 fast-charging stations across Mumbai, Pune, Delhi, Bangalore and Hyderabad.

10. Okaya Power Group

OEM and CPO. End to End charging solution provider

Okaya Power Group, has a strategic partnership with Prakriti E-Mobility, a fleet operator of electric 4W vehicles with aim to provide well-laid out electrical vehicle charging stations for their fleet operations. Won a contract to set up 4,244 EV charging stations from state-run REIL funded by the DHI. In 2019, REIL had given a contract to Okaya for supply, installation and commissioning of over 200 multi standard EV chargers in all metro cities.

11. Numocity

Central Management System (CMS) provider

Offerings – Numocity offers EV Charging solutions to Charge Point Operators with a Central Management System. Solutions for r operating and monetizing the charging infrastructure or battery swapping operations over cloud.

12. Volttic – Parent Company Tvesas

Charge Point Operator. End to end charging solutions

Offerings – EV Charging Service provider helps with the installation of AC-001, DC-001 and DC Fast Chargers. Offers Charging Station Solutions for home, cities and highways including CMS and end-user mobile apps.

13. Zeon Charging

Charge Point Operator. Installed DC fast chargers on highways connecting Bengaluru, Central/ Western Tamil Nadu and Kerala

14.Charge+Zone

CPO. Provides end to end EV charging solutions and battery swapping solutions

Vadodara based start-up founded in 2018, operates 175 charging stations across 9 cities. Raised USD 3 million in pre-series A in Nov 2020. Launched dual gun 7.7 kW Type 2 AC chargers with 55″ display to allow advertisements or media to play.

Offerings – Customised and turn-key EV charging solutions. They have deployed EV Charging stations for electric buses, cars and two-wheelers, and swapping stations for electric 3Ws.

15. PlugNGo (EV Motors)

Charge Point Operator

Offerings – EV Motors India (under the brand of PlugNgo) provides charging network installation services for public EV charging, along with a complete solution for the management of the charging operations. EV Motors India and Hero Electric announced a partnership to support adoption of EVs for last mile delivery operations and offer advanced battery solutions and charging infrastructure integrated with Hero Electric.

16.EVRE

OEM, Charge Point Operator

Offerings – Manufacturing, installation, and maintenance of EV chargers and charging stations.

Based out of Hyderabad and Bengaluru, EVRE engineer's electric vehicle charging solutions for infrastructure developers, people transport, last mile, and logistic fleet operators in India. EVRE has setup multiple charging hubs across key metropolitan cities in India. Clients include Lodha Group, Hiranandani Group, Manyata Tech, Mahindra Glyd and Meru. EVRE has also partnered with fleet operator MoEVing to add 1000+ EV charging stations across India.

17. Statiq

Charge Point Operator

Provides end to end charging solutions. Claims to have installed over 150 charging staions in Delhi, Bangalore and Mumbai. Installed 2 EV Chargers in Himachal Pradesh for Delhi to Dharamshala and Delhi to Shimla Travellers and one in Bhainsi, Uttar Pradesh with close proximity to Food and Beverage setups.

18. VerdeMobility

EVSE Manufacturer (OEM)

A division of System Level Solutions. Offerings – EV charging equipment including:

AC charger – Type-2, IEC 60309 | Power Output – 3.3 kW to 22 kW

OCPP Controller, Charge controller for single and three phase. Also provides CMS support and Mobile app

19. goEgo network

EVSE Manufacturer (OEM) and Charge Point Operator with presence in four states, namely Maharashtra, Tamil Nadu, Telangana and Karnataka

In-house design and development of AC chargers – Type-2 and AC001

20. LUBI EV Solutions

EVSE manufacturer (OEM)

EVSE arm of Lubi Industries LLP, i.e., an Indian manufacturing company with offerings across embedded and power electronics, solar energy, industrial automation, pumping systems, and electric motors.

Offerings – EV charging equipment including:

AC charger – AC-001, Type-2 | Power Output – 3.3 kW to 42 kW

DC charger – DC-001, CCS 2, CHAdeMO | Power Output – 15 kW to 240 kW

Portable Battery Chargers, Combo chargers (CCS+CHAdeMo+AC Type 2)

21. BrightBlu

EVSE Manufacturer (OEM) and **CPO**

Offerings – AC Type 2 Charger (3.7 kW to 7 kW) and charging management software. The entity was formed in Aug 2019 from the merger of Asia Electric, an EV charging solutions company and DrivAMP, a smart charging technology provider. Amsterdam and Mumbai-based addikt has partnered with BrightBlu for communications, branding, identity design and mobile app

22.Incredible Engineering

EVSE Manufacturer (OEM)

Offerings –EV Charging Equipment including AC Chargers – Type 2 AC | Power Output 3 kW to 22 kW | Single / Dual Connector IEC 60309 | Power Output 3.3 kW to 7 kW | Single / Multi Connector

DC Chargers – CCS2 | Power Output 30 kW to 60 kW | Single / Dual Connector

23.ChargeMOD

EVSE Manufacturer (OEM) and CPO

Offerings – AC Type 2 charger | Power Output – 22 kW

Portable wall charger, charging cables and portable charging extensions

The start-up also offers provides a solution for EV charging at workplace, complete with an app for the end users and a charging management system. Plans to install 250 AC Charging Points throughout Kerala as part of the community charging initiatives.

24.Evotpoint

Charging network, CPO

Headquartered at Sanpada Navi Mumbai, Evotpoint provides franchise model for setting up Electric vehicle charging stations. Also provides solution for EV charging station at residential and commercial spaces. Working on setting up EV charging stations at Mumbai – Pune, Mumbai- Nashik highways, and shared parking charging station at Navi Mumbai and Mumbai locations.

25.Tirex

CPO

End to end EV Charging Solutions, with IoT based cloud-CMS and mobile application, for all EV segments including 2Ws, 3Ws, 4Ws, buses and trucks. Provides ARAI and CE certified chargers (Bharat AC001, Bharat DC001, CCS2, Type 2 AC, CHAdeMO) and charging infrastructure solutions for home, public charging and fleets. Has a tie-up with Kerala state electricity board for EV public charger installation.

26.Uznaka Solutions Private Limited

CPO

Offerings – Bharat AC-001 and Type 2 AC charging stations.

Established in March 2018, Uznaka Solutions is headquartered in Noida. Uznaka also manufactures on-board and off-board chargers for e-2W and 3W. They have so far deployed private charging stations at 6 locations since December 2019 spanning Uttar Pradesh, NCR and Haryana. Associated with East Central Railway for deployment of first EV Charging station for Indian Railways.

27.AARGO EV SMART

Charge Point Operator

System integrator with ABB Chargers. A division of AAR POWER SOLUTION. Claims more than 150 charger installations across India. Installed Type 2 AC chargers at IOCL pumps in MP, Karnataka and Rajasthan as well as dealerships of Audi.

28.EVQpoint

Offerings –

AC Charger – Type 2, IEC 60309 | Power Output – 3.3 kW to 22 kW

Portable AC charger – 3.3 kW

Battery swapping stations – 1.5 kW to 10 kW

Minda Corporation has acquired 26% equity stake in EVQPOINT Solutions.

29.AEIDTH Technologies

Offerings – Bharat AC001 Charger, Type 2 AC Charger | 3 kW to 22 kW

Smart Battery Management System IoT Enabled

Provides Electric vehicle chargers and charging stations with SaaS CMS & Mobile app support. Claims to have installed 95+ chargers in 10+ cities.

30. Zevpoint

Offerings – AC Type 2 charger 22 kW. Provides Installation services, charging cable, connectors and sockets. Claims to have installed 60+ chargers in Mumbai and Delhi

Government Initiatives

- The charging infrastructure got a boost from Ministry of Power
- No license would be required to install EV charging stations.
- The government promoted electric mobility by asking ministries and other government agencies to include EVs in their fleet of transport.

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.

SWOT analysis of Indian EV market

SWOT analysis (or SWOT matrix) is a strategic planning technique used to help a person or organization identify strengths, weaknesses, opportunities, and threats related to business competition or project planning. It is designed for use in the preliminary stages of decision-making processes and can be used as a tool for evaluation of the strategic position of a city or organization. It is intended to specify the objectives of the business venture or project and identify the internal and external factors that are favourable and unfavourable to achieving those objectives. Users of a SWOT analysis often ask and answer questions to generate meaningful information for each category to make the tool useful and identify them competitive advantage. SWOT has been described as the tried-and-true tool of strategic analysis, but has also been criticized for its limitations.

Strengths and weakness are frequently internally-related, while opportunities and threats commonly focus on the external environment. The name is an acronym for the four parameters the technique examines:

- **Strengths:** characteristics of the business or project that give it an advantage over others.
- **Weaknesses:** characteristics of the business that place the business or project at a disadvantage relative to others.
- **Opportunities:** elements in the environment that the business or project could exploit to its advantage.

- **Threats:** elements in the environment that could cause trouble for the business or project.

The degree to which the internal environment of the firm matches with the external environment is expressed by the concept of strategic fit. Identification of SWOTs is important because they can inform later steps in planning to achieve the objective. First, decision-makers should consider whether the objective is attainable, given the SWOTs. If the objective is not attainable, they must select a different objective and repeat the process.

- **Strengths**:

1. Favourable government policies and subsidies

   The governments of various countries have formulated stringent CO2 emission norms that have increased the demand for electric vehicles. Also, the governments are providing incentives and subsidies to encourage EV sales.

2. Heavy investments from automakers in EVs

   Heavy investments from automakers are expected to cater to the growing demand for EVs and play a major role in the evolution of the electric vehicle market. OEMs offer electric vehicles in different segments ranging from small hatchbacks such as Nissan Leaf to high-end sedans like Tesla Model 3. The wide product offering has attracted many consumers and resulted in a growing market for electric vehicles.

3. Growing concerns over environmental pollution

   Heavy investments from automakers are expected to cater to the growing demand for EVs and play a major role in the evolution of the electric vehicle market. OEMs offer electric vehicles in different segments ranging from small SUV such as TATA Nexon EV to high-end sedans like Mercedes Benz EQS. The wide product offering has attracted many consumers and resulted in a growing market for electric vehicles.

4. Growing concerns over environmental pollution

   ICE vehicles emit a high volume of GHG into the atmosphere. To curb this, the governments of several countries have taken initiatives for the deployment of EVs. These initiatives would help in improving air quality. The use of EVs will reduce the dependence on fossil fuels. Further, electric vehicles require lesser maintenance and operating costs than ICE vehicles.

5. Demand for increased vehicle range per charge

   Recent developments have shown a tremendous increase in vehicle range on a single charge. In addition, electric vehicle manufacturers now offer home charging options with every EV purchase, adding to the convenience of consumers.

6. Major increase in EV models

   Expanding e-mobility is an important building block on the road to a CO2-neutral balance. Government regulations to promote the use of EVs are the driving factor in the increase of EV models by various companies. The number of EV models introduced by automotive companies is increasing rapidly with time.

- **Weakness:**

1. High cost of EVs in comparison to ICE vehicles

   High manufacturing cost of EVs has been a major concern over their widespread adoption. As the popularity of electric cars rises over the next decade, the drops in battery prices and reduced R&D costs should see the overall cost of purchasing electric hatchbacks, crossovers, or SUVs reach levels of similar ICE vehicles

2. Limited range of EVs

   A service provider must follow a certain set of instructions while installing a charging station. Service providers need approval from plot owners (when the installation is done on private property), local government for regulatory mandates, and utility providers for energy transfer.

3. Stringent rules for installation of charging stations

   A service provider must follow a certain set of instructions while installing a charging station. Service providers need approval from plot owners (when the installation is done on private property), local government for regulatory mandates, and utility providers for energy transfer.

- **Opportunities:**

1. Use of vehicle-to-grid (V2G) EV charging stations

   Vehicle-to-grid (V2G) EV charging is a system that has a bi-directional electrical energy flow between plug-in EVs and the power grid. V2G technology enables EVs to store unused power and discharge it to the grid. V2G technology can improve the electrical component's performance and add value for EV owners.

2. EV charging stations powered by renewable energy

   EVs can be charged at an electric charging station or using a solar panel. The use of renewable energy to power EV charging stations is one of the key opportunities for players in the electric vehicle charging market. Due to the lower price and easier installation of solar panels, solar powered charging stations have become ideal for homeowners or commercial buildings.

- **Threats:**

1. Lack of standardization of charging infrastructure

   For standardization of charging infrastructure, a globally shared vision is significant. There have been several efforts to improve the user experience of charging infrastructure by promoting interoperability, both for drivers and charging network operators.

2. Lack of Proper Standards and Certification of EV

   The start-ups and EV manufacturers gain easy access to current standards of EV regarding safety and testing. The majority of EV manufacturers import parts from China of low standards and assemble them in India and are sold in their brand name, these vehicles catch fire more compared to current established brands like Ather, Tata, etc. This brings fear to buys perspective, and not prefer the purchase of EV

CHAPTER 4

ANALYSIS AND INTERPRETATION OF DATA

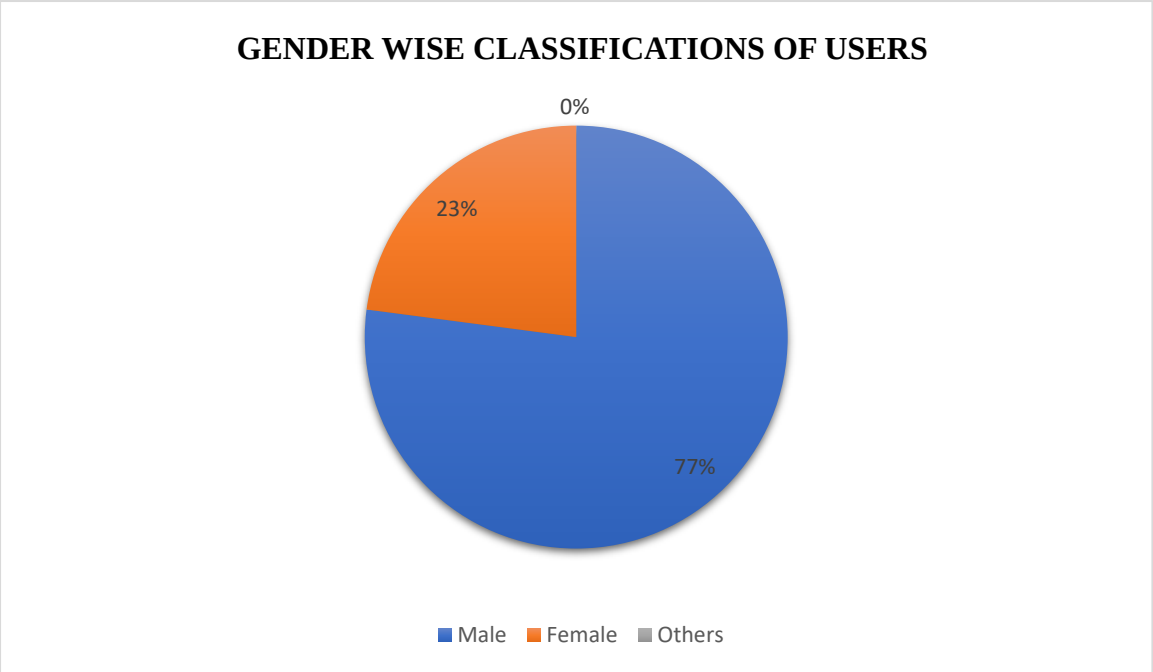
TABLE NO:4.1

GENDER WISE CLASSIFICATION OF USERS

Option	No. of respondents	Percentage
Male	111	77.083
Female	33	22.917
Others	0	0
Total	144	100

(Source: Primary Data)

CHART NO 4.1



INTERPRETATION

Table 4.1 shows that 77.083% of the respondents were male and the rest 22.917% were female

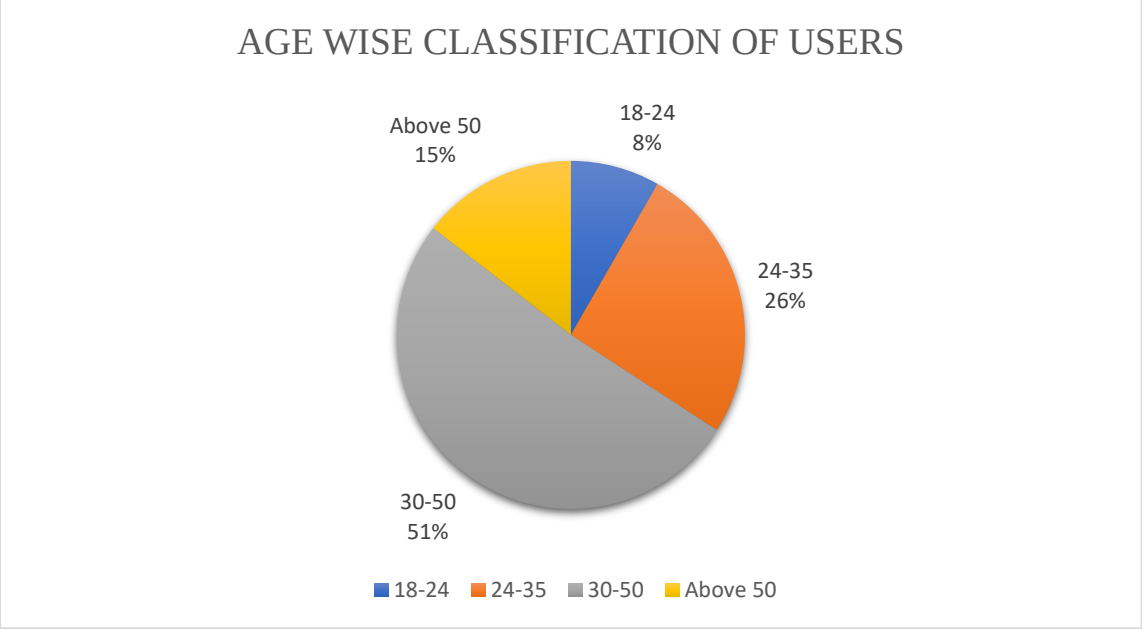
TABLE 4.2

AGE WISE CLASSIFICATION OF USERS

Option	No. of respondents	Percentage
18-24	12	8.3
24-35	37	25.9
36-50	74	51.3
Above 50	21	14.5
Total	144	100

(Source: Primary Data)

CHART NO 4.2



INTERPRETATION

Table 4.2 shows that 8.3% of the respondents were in the age group of 18-24, 25.9% of the respondents were in the age group of 24-35, shows that 51.3% of the respondents were in the age group of 30-50 and 14.5% of the respondents were in the age group of above 50.

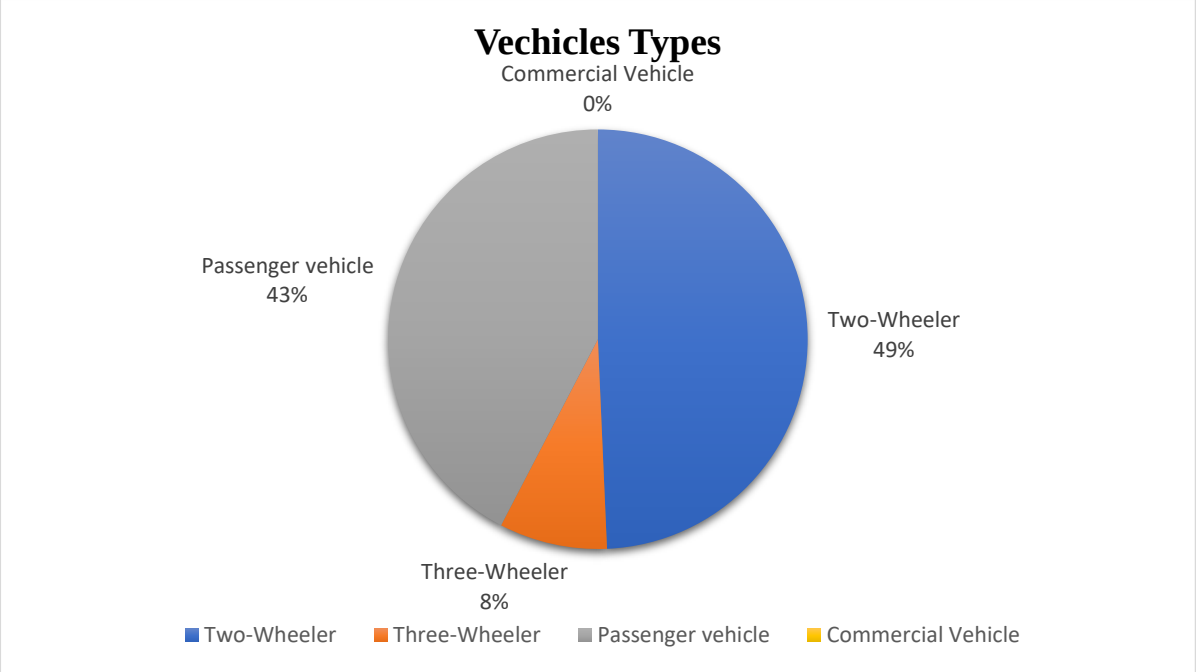
TABLE 4.3

CLASSIFICATION OF VECHICLE BY USER

Types of Vehicles	No of respondents	Percentage
Two-Wheeler	71	49.31
Three-Wheeler	12	8.33
Passenger Vehicle	61	42.36
Commercial Vehicle	0	0
Total	144	0

(Source: Primary Data)

CHART4.3



INTERPRETATION

Table 4.3 shows that 49.31% of the respondents use Two-Wheeler0, 8.33 % of the respondents use Three-Wheeler, 42.36% of the respondents use Passenger Vehicle and 0% of the respondents use Commercial Vehicle (Commercial vehicles are yet to be launched).

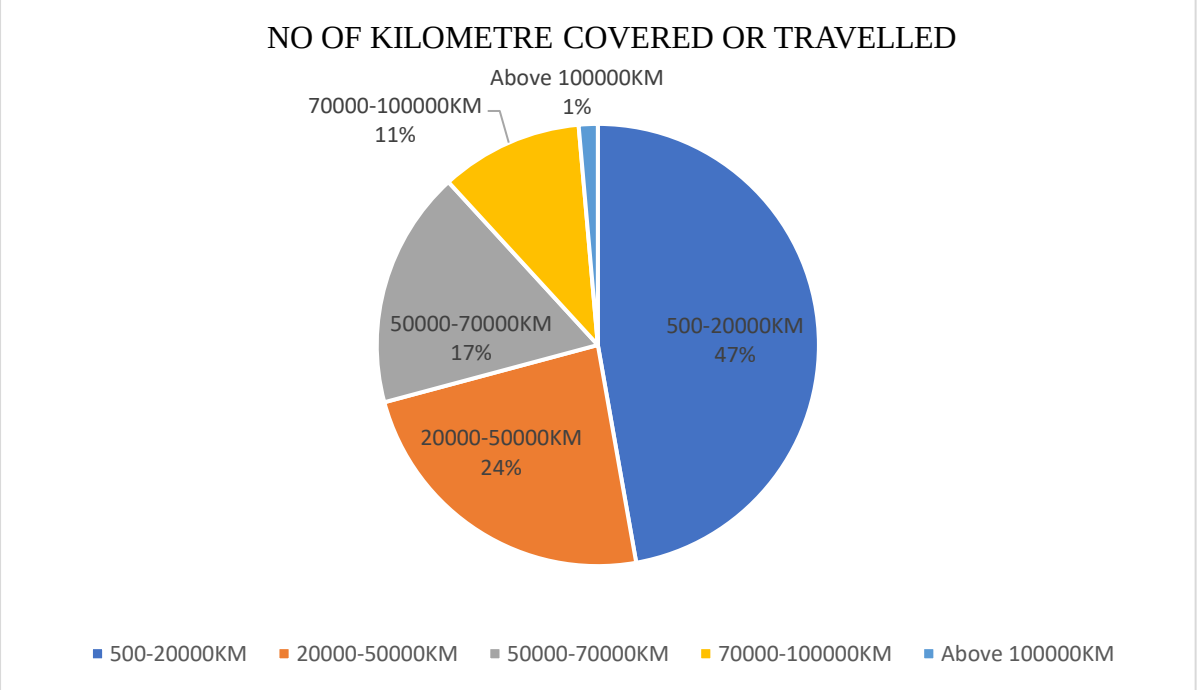
TABLE 4.4

NO OF KILOMETRE TRAVELLED OR COVERED

KMs Covered	No of Respondents	Percentage
500-20000KM	68	47.22
20000-50000KM	34	23.61
50000-70000KM	25	17.36
70000-100000KM	15	10.42
Above 100000KM	2	1.39
Total	144	100

(Source: Primary Data)

CHART 4.4



INTERPRETATION

Table 4.4 shows that 47.22% of the respondents covered in between 500-20000KM, 23.61% of the respondents covered in between 20000-50000KM, 17.36% covered in between 50000-70000KM, 10.42% covered in between 70000-100000KM and 1.39% covered above 100000KM (This cannot be considered since it's really rare only two vehicles covered 1lakh KM. 1 car and an E Rikshaw. It can warry according to availability of charging station and user)

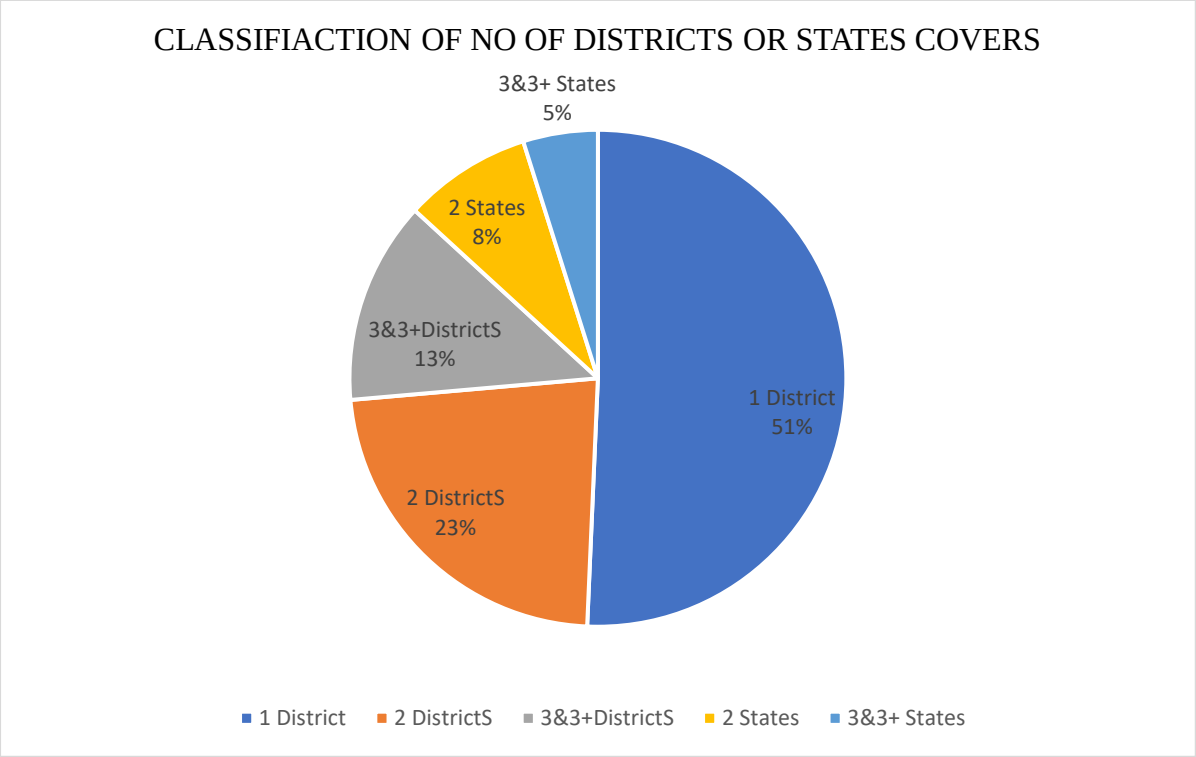
TABLE 4.5

CLASSIFIACTION OF NO OF DISTRICTS OR STATES COVERS

Options	No of Respondents	Percentage
1 District	73	50.69
2 Districts	33	22.92
More than 2 Districts	19	13.2
2 States	12	8.33
More than 2 States	7	4.86
Total	144	100

(Source: Primary Data)

CHART 4.5



INTERPRETATION

Table 4.5 shows that 50.69% of the respondents travelled in one district, 22.92% of the respondents travelled/ crossed 2 districts, 13.2% travelled 3/ more than 3 district, 8.33% travelled between states and 4.86% travelled more than 2 states. (This varies from user still users are ready to take EVs across districts and states)

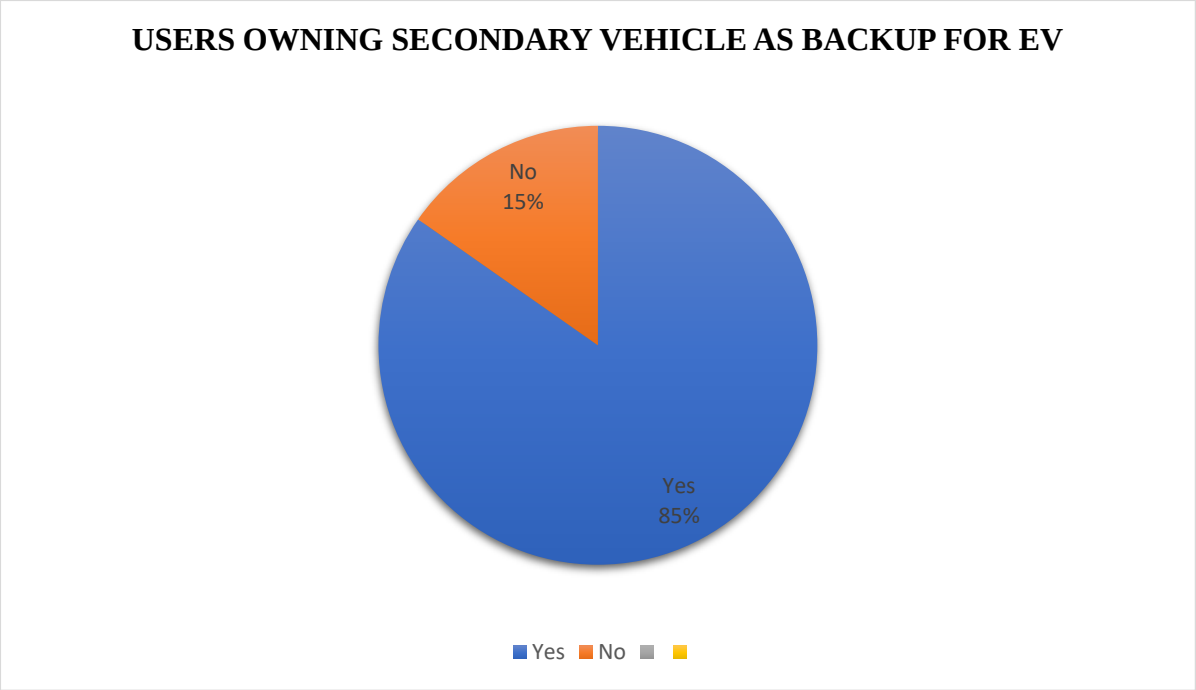
TABLE 4.6

USERS OWNING SECONDARY VEHICLE AS BACKUP FOR EV

Options	Respondents	Percentage
Yes	122	84.722
No	22	15.277
Total	144	100

(Source: Primary Data)

CHART 4.6



INTERPRETATION

Table 4.6 shows that 84.722% have secondary vehicle as backup for EVs, and 15.277% have no secondary vehicle as backup for EVs. (Here 3-wheeler autorickshaw is included hence the percentage of user having no backup is high)

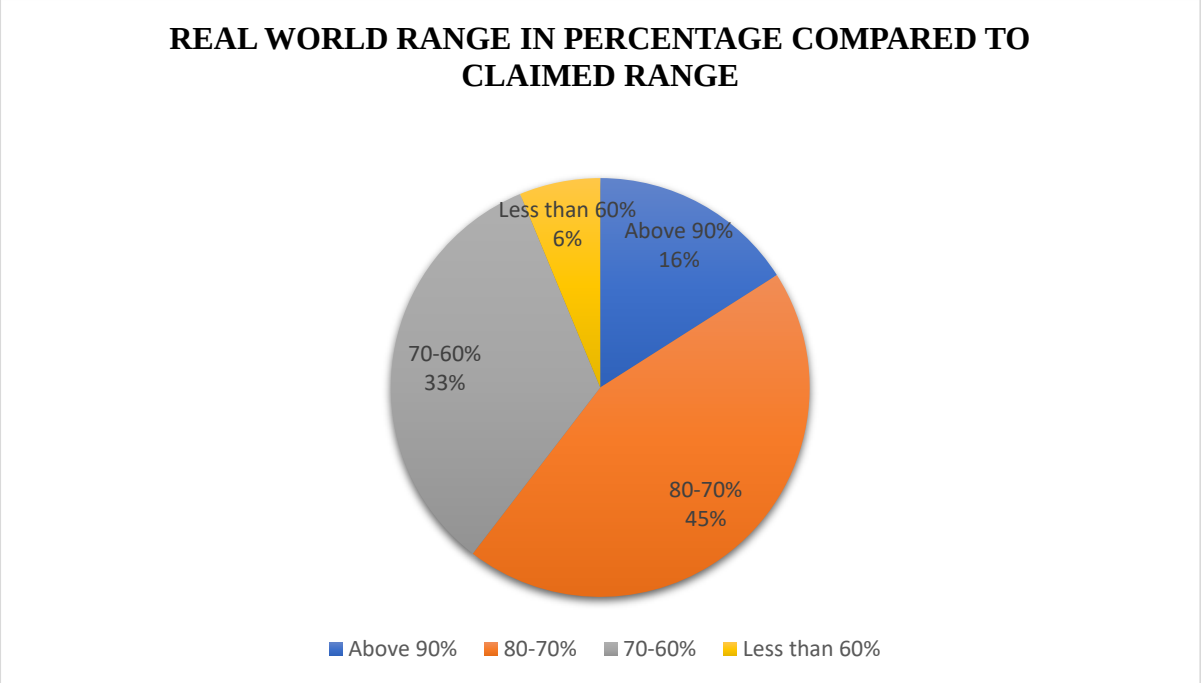
TABLE 4.7

REAL WORLD RANGE IN PERCENTAGE COMPARED TO CLAIMED RANGE

Range Difference in %	No of Respondents	Percentage
100-90%	23	15.98
80-70%	64	44.44
70-60%	48	33.33
Less than 60%	9	6.25
Total	144	100

(Source: Primary Data)

CHART 4.7



INTERPRETATION

Table 4.7 shows that 15.98% of users are getting above 90% of claimed range, 44.44% of users are getting 80-70% of claimed range, 33.33% of users are getting 70-60% of claimed range and 6.25% of users are less than 60% of claimed range. (Range of vehicle depends on driving)

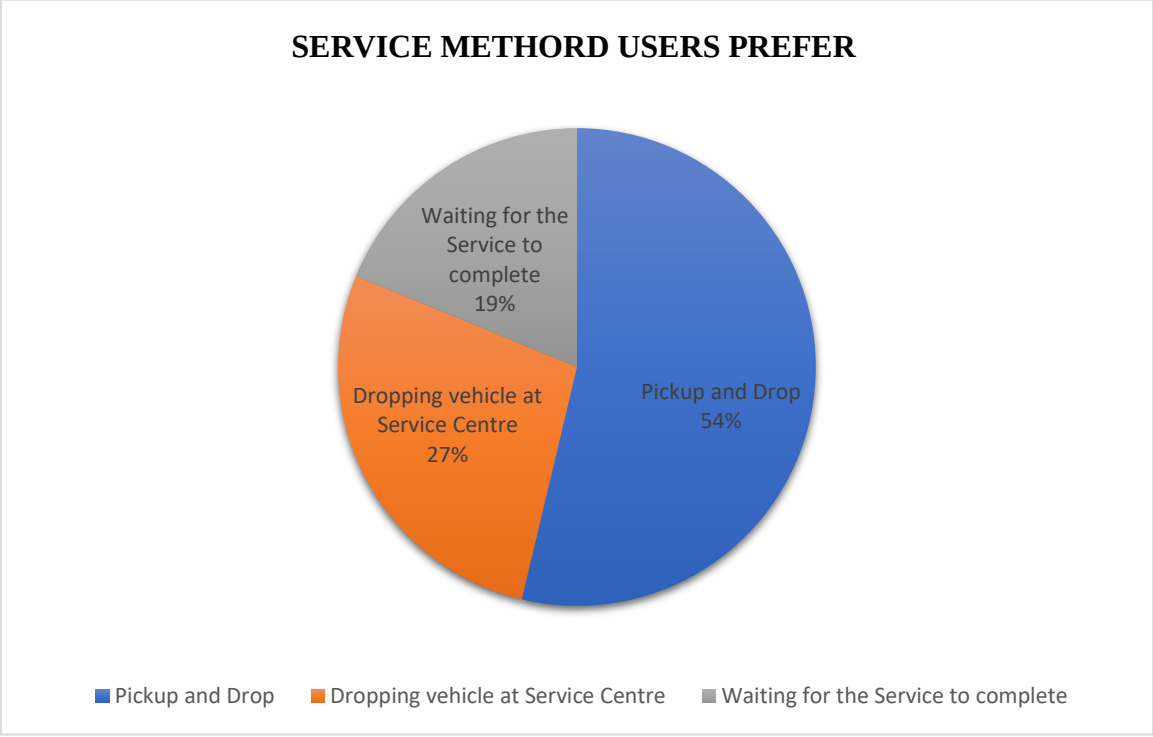
TABLE 4.8

SERVICE METHORD USERS PREFER

Methods	No of Respondents	Percentage
Pickup and Drop	82	56.94
Dropping vehicle at Service Centre	42	29.16
Waiting for the Service to complete	20	13.9
Total	144	100

(Source: Primary Data)

CHART 4.8



INTERPRETATION

Table 4.8 shows that 56.94% of users prefer Pickup and Drop, 29.16% users prefer Dropping vehicle at Service Centre and 13.9% users prefer Waiting for the Service to complete.

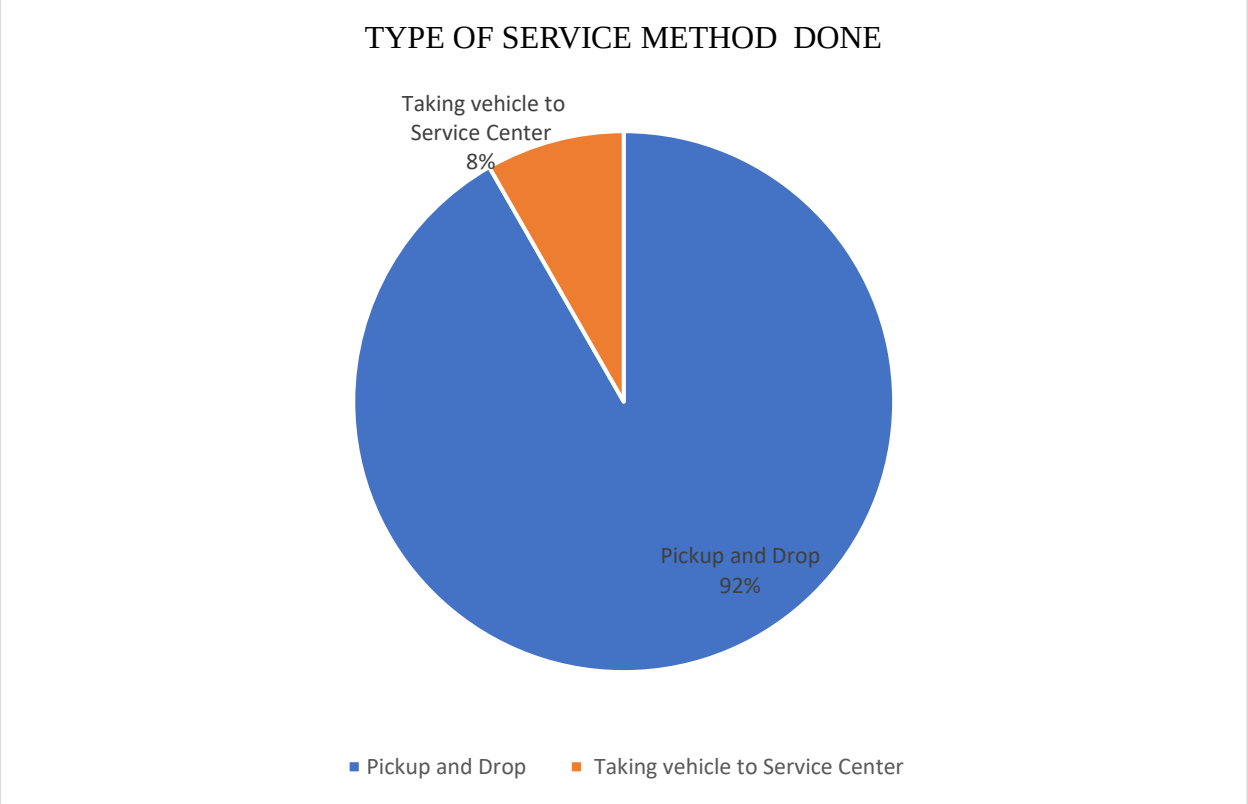
TABLE 4.9

TYPE OF SERVICE METHOD DONE

Methods	No of Respondents	Percentage
Pickup and Drop	51	35.42
Taking vehicle to Service Center	93	64.58
Total	144	100

(Source: Primary Data)

CHART 4.9



INTERPRETATION

Table 4.9 shows that 35.42% of users use Pickup and Drop, 64.58% users use vehicle to Service Center.

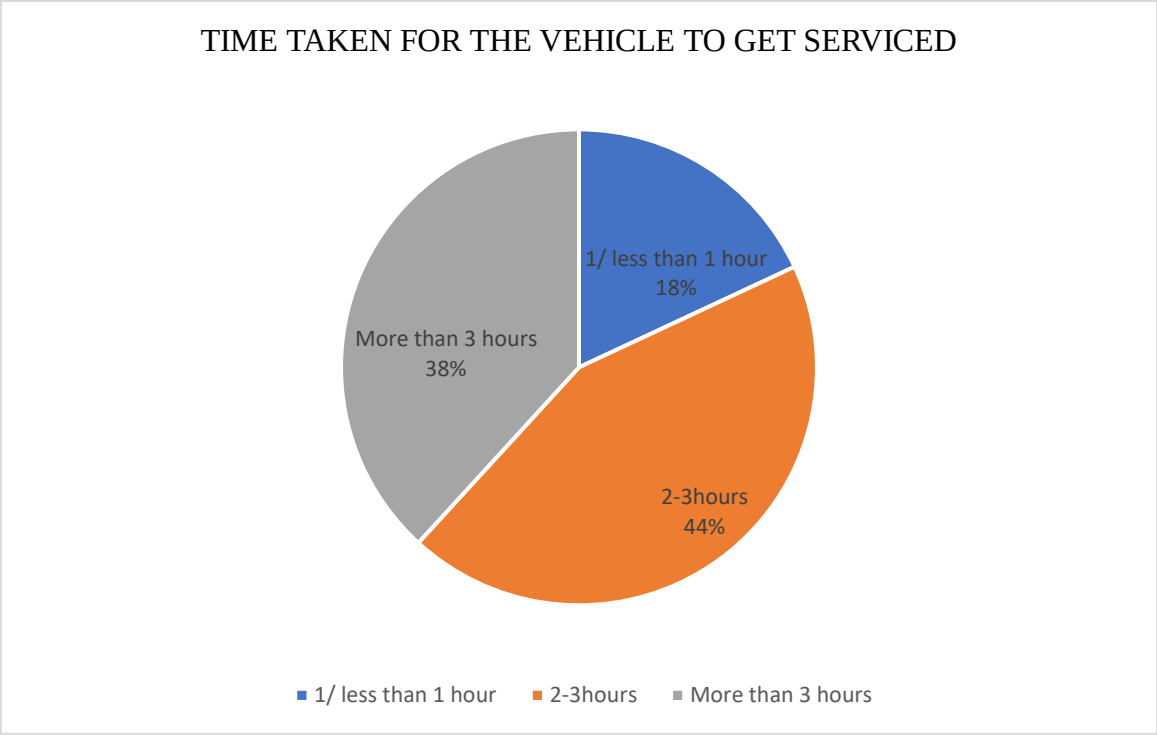
TABLE 4.10

TIME TAKEN FOR THE VEHICLE TO GET SERVICED

Duration of time	No of Respondents	Percentage
1/ less than 1 hour	26	18.05
2-3hours	63	43.75
More than 3 hours	55	38.2
Total	144	100

(Source: Primary Data)

CHART 4.10



INTERPRETATION

Table 4.10 shows that 18.05% of vehicles take 1/ less than 1 hour to get serviced, 43.75% of vehicles take 2-3hours to get serviced and 38.2 % of vehicles take More than 3 hours to get serviced.

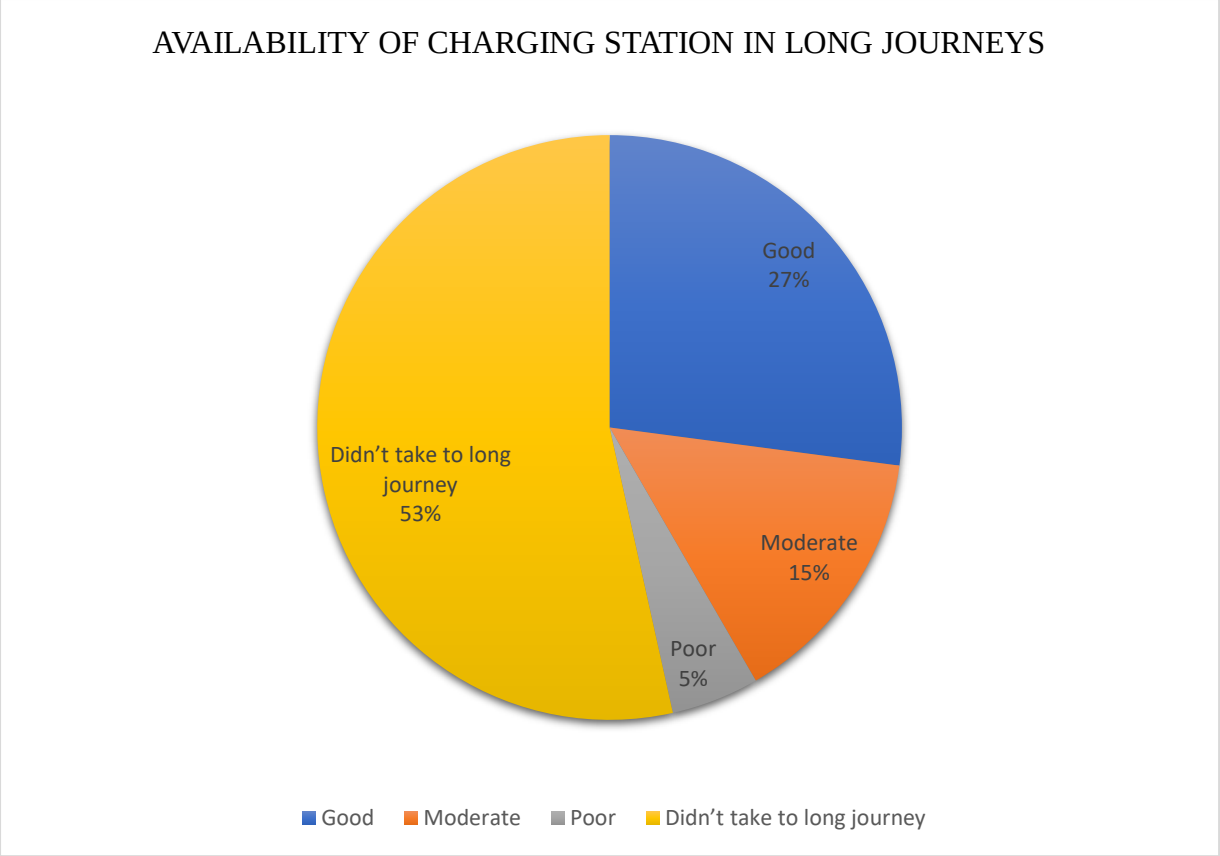
TABLE 4.11

AVAILABILITY OF CHARGING STATION IN LONG JOURNEYS

Availability	No of Respondents	percentage
Good	39	27.08
Moderate	21	14.58
Poor	7	4.86
Didn’t take to long journey	77	53.47
Total	144	100

(Source: Primary Data)

CHART 4.11



INTERPRETATION

Table 4.11 shows that 27.08% of users have experience of good availability of chargers, 14.58% of users have experience of moderate availability of chargers, 4.86% of users have experience of poor availability of chargers and, 53.47% didn't take for long drive or journey. (This is because EVs include 2wheeler which takes almost 2-4hours to charge, Availability of charger can include electricity problem, rush in charging station, bugs in app, some apps show charging stations which are going to be opened and is published before approval)

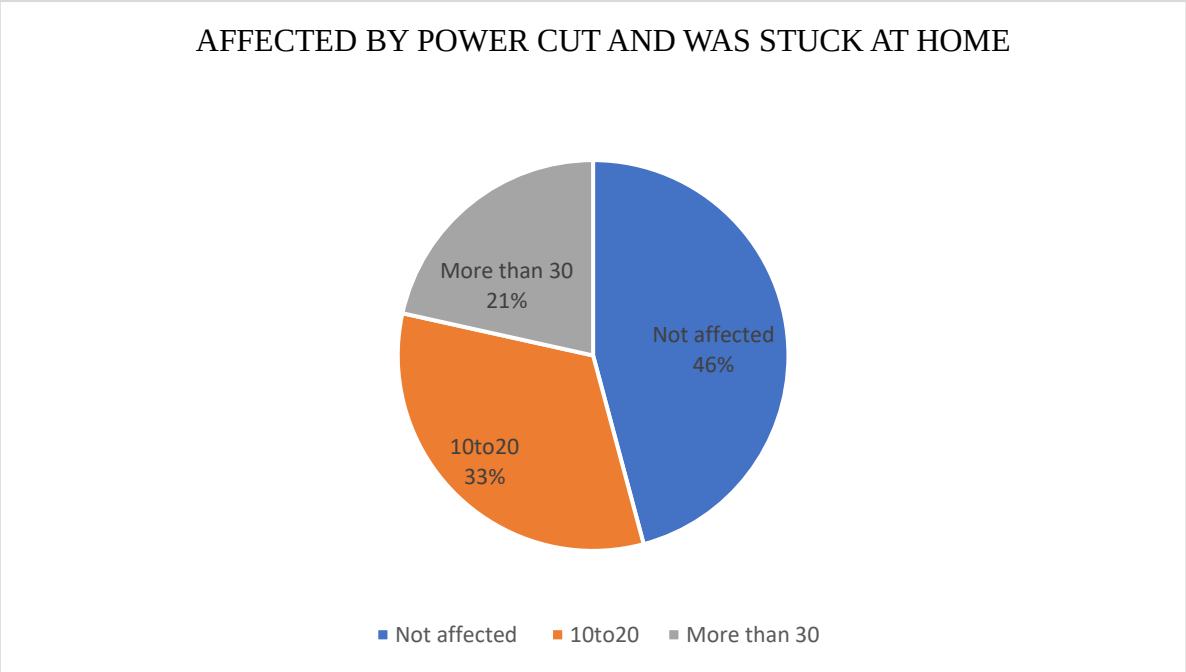
TABLE 4.12

AFFECTED BY POWER CUT AND WAS STUCK AT HOME

No of times	No of Respondents	Percentage
Not affected	66	45.83
10-20	47	32.64
More than 30	31	21.53
Total	144	100

(Source: Primary Data)

CHART 4.12



INTERPRETATION

Table 4.12 shows that 45.83% are not affected by Power Cut they may have backup such as inverter/ solar, 32.64% are affected by power cut and was stuck at home a very few times and, 21.53% was stuck at home frequently. (This happened reported to be due to electricity work such as K-Phone, maintenance or During rain)

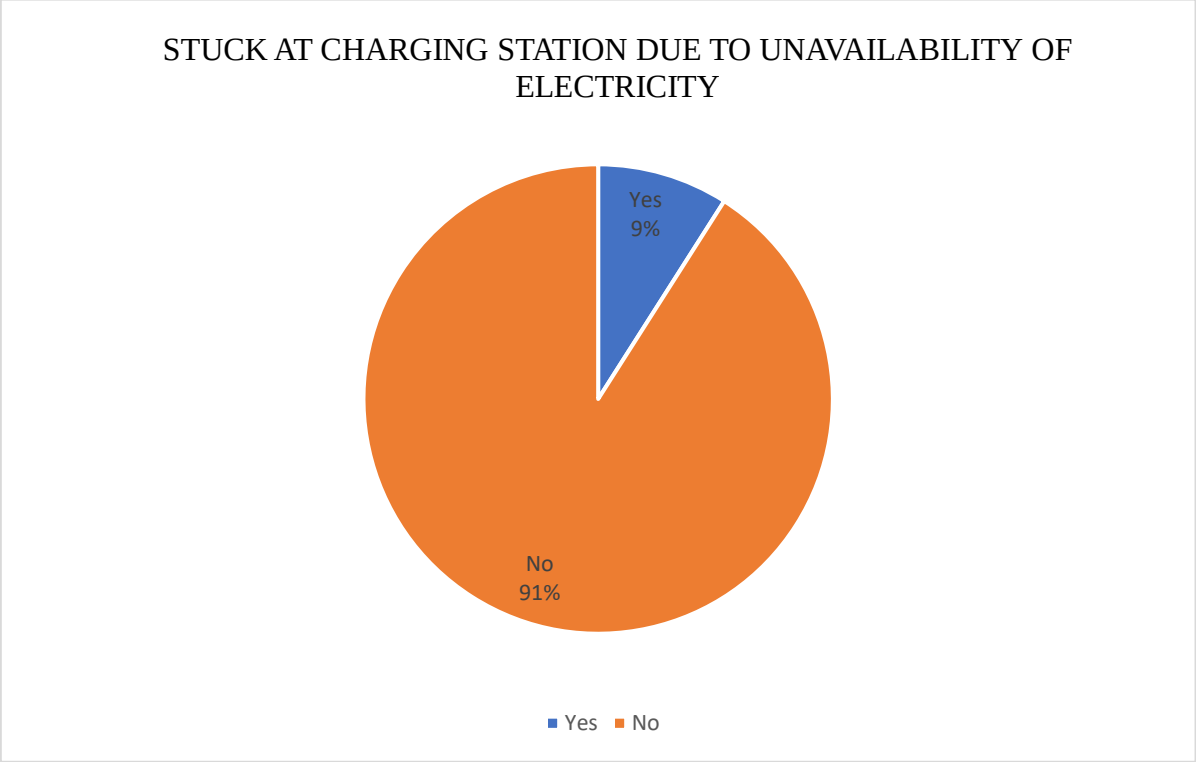
TABLE 4.13

STUCK AT CHARGING STATION DUE TO UNAVAILABILITY OF ELECTRICITY

Opinion	No of respondents	Percentage
Yes	13	9.03
No	131	90.97
Total	144	100

(Source: Primary Data)

CHART 4.13



INTERPRETATION

Table 4.13 shows that 9.03% were stuck at Charging station due to unavailability of electricity and 90.97% were not affected. (This may be due to infrastructure upgradation or during rain or during maintenance)

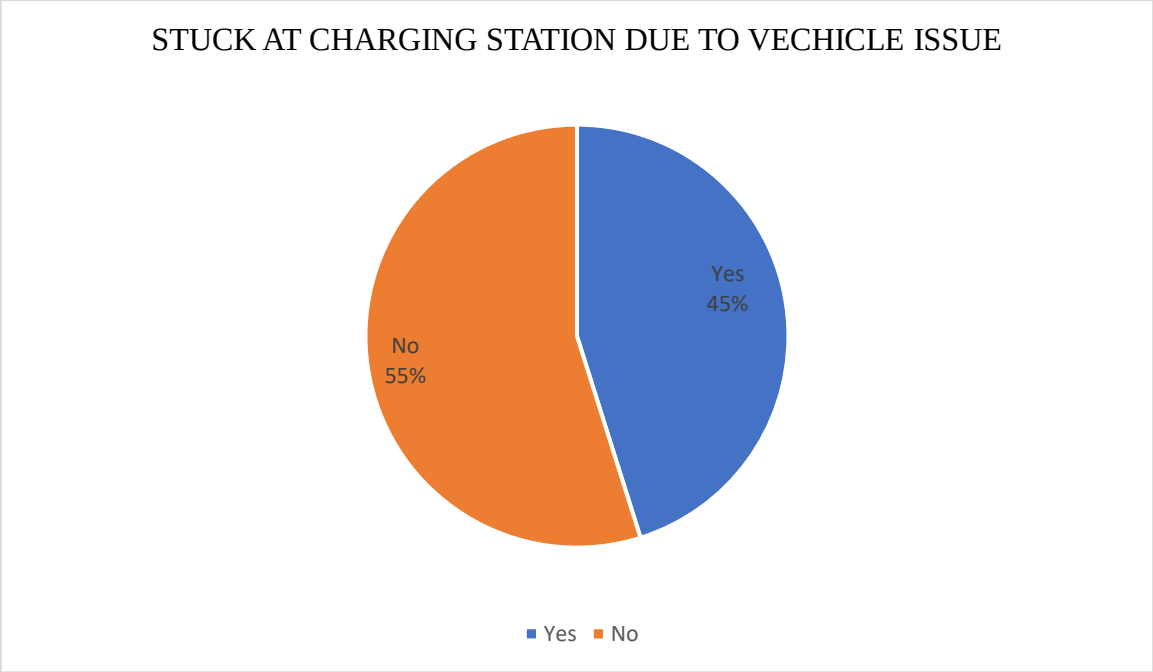
TABLE 4.14

STUCK AT CHARGING STATION DUE TO VECHICLE ISSUE

Opinion	No of Respondents	Percentage
Yes	65	45.14
No	79	54.86
Total	144	100

(Source: Primary Data)

CHART 4.14



INTERPRETATION

Table 4.14 shows that 45.14% were stuck at charging station due to vehicle issues,54.86% were not affected. (The affected user majority were Tata Nexon Ev users and Ola scooter its due to bugs)

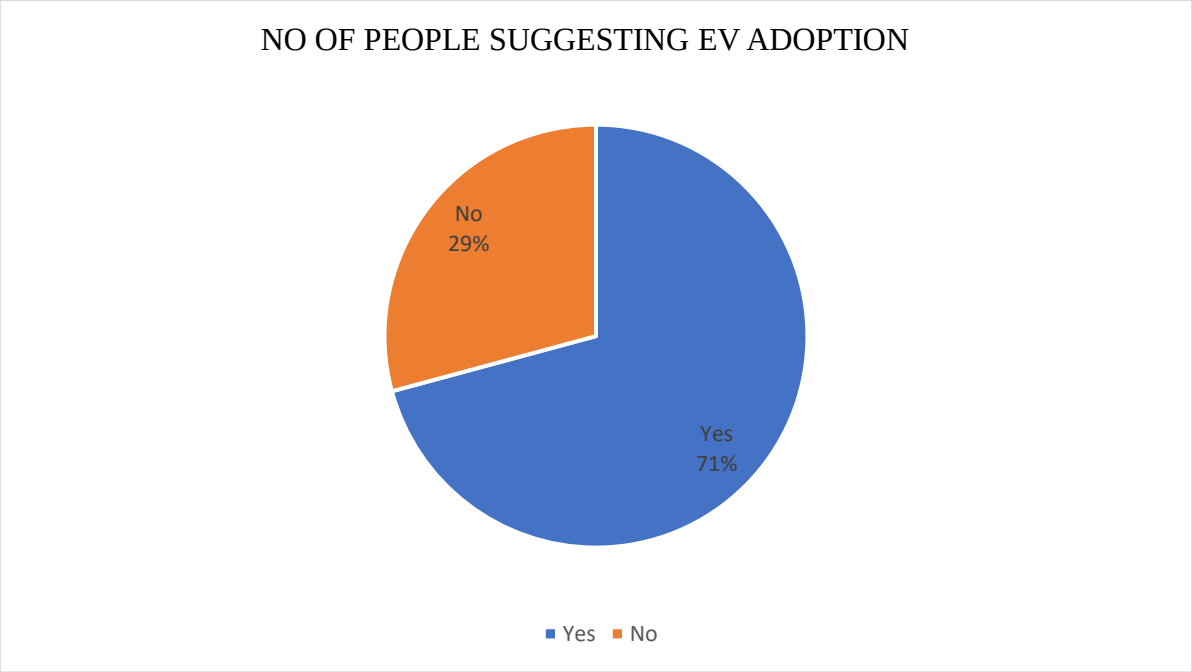
TABLE 4.15

NO OF PEOPLE SUGGESTING EV ADOPTION

Opinion	No of Respondents	Percentage
Yes	102	70.8
No	42	29.2
Total	144	100

(Source: Primary Data)

CHART 4.15



INTERPRETATION

Table 4.14 shows that 70.8% of people suggest EV and rest 29.2% Not (A small parentage of User are Ola, they faced bugs and mechanical problems, the company currently solves the issues faced by the users)

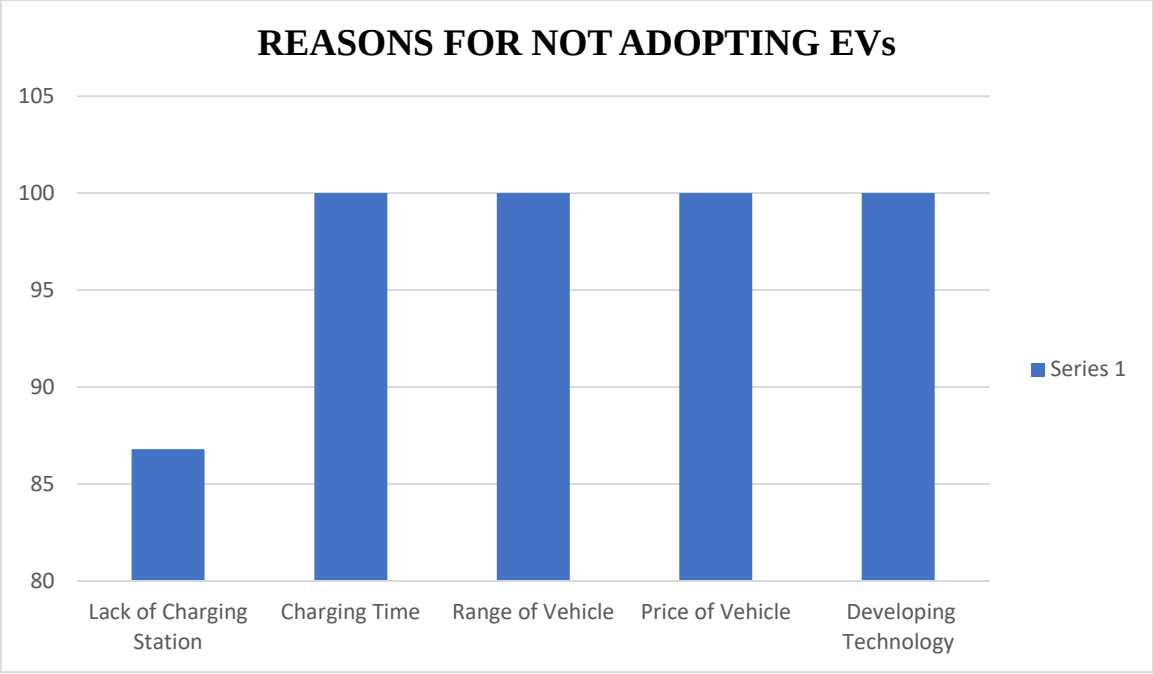
TABLE 4.16

REASONS FOR NOT ADOPTING EVs

Reasons	No of Respondents	Percentage
Lack of Charging Station	125	86.8
Charging Time	144	100
Range of Vehicle	144	100
Price of Vehicle	144	100
Developing Technology	144	100
Total	Total	100

(Source: Primary Data)

CHART 4.15



INTERPRETATION

Table 4.14 shows that 86.8% reported the fact that Lack of Charging Station is reason for not adopting EVs. The remaining reported all the facts for not adopting EVs.

CHAPTER 5

FINDINGS, SUGGESTION AND CONCLUSION

5.1 FINDINGS

1. Gender wise classification of respondents show that majority respondents are male. Still women's use EVs more compared to male or their partner, siblings prefer using EVs.
2. A majority of user are in the age gap of 35-50, then 24-35. This age gap of individuals is adaptive and are ready to explore tech or accept the technology
3. Majority of users use 2 wheelers and cars, 3-wheeler are less compared to other since it is used for commercial purpose and as taxi.
4. As EV some people covered 1laksh in 2 years it is possible on Cars because its have long range compared other, and 1 autorickshaw which is used as taxi. Rate pf mileage is more compared to IC engine vehicle.
5. 50.60% of user EV as City commute, 4.86% of users take EV for interstate journeys, covering more than 3 states.
6. 84.722% of owners own secondary vehicle for commute.
7. Majority of users get 80% 0f claimed range of vehicle, it depends on way of driving.
8. 56.94% of user prefer service pickup- drop method, (service centre can charge for this service)
9. 35.42% of user depend on pickup and drop, the rest take the vehicle to service centre.
10. The time take for the service is 1-2 hour for 61.8%, the rest need to wait for their turn for the service.
11. Availability of charging station in long is good and moderate for 42%, 4.86% reported poor availability (it may be due to unavailability of electricity, unapproved station, etc.) 53.47% didn't take for long journey this includer 2 & three-wheeler.
12. 45.83% are not affected by electricity at home they may be having backup, 21.53% are affected by electricity and was stuck at home more than 30 times.
13. 9.03% are affected by unavailability of electricity at charging station.

14. 45.14% of users are stuck at charging station or at home while charging (these are mainly users of Ola scooter and Nexon EV)
15.

5.2 RECOMMENDATIONS

- The charging station should have 2-way power, if one way is unable to provide power, other line or way could.
- The user or traveller using EV from distance should be able to know the unavailability of charging station if anything occurs due power or malfunction or complaints such that they could go for alternate station or nearest station or alternate route.
- Charging station be near restaurants or complexes where people could spend time effectively.
- Charging station could be installed in malls can effectively help users so they could spend time effectively in theatre, or shopping.
- To expand charging infrastructure, the showroom space can effectively used as charging station. The shown or car displayed can displayed in mall space such that showroom space, customer space can be saved.
- In future EV have less service or they have parts replacement more than repairs, such that service time reduces and need less space. If this accommodated near malls it helps user spend time and effectively, service centre can save space and expense on customer space and spendings for customer on this space.
- The Charging infrastructure should be well planned such that building constructed should have space for parking such that if infrastructure can be implemented in future for meeting the demand.
- The Government should take initiative on making rule in constructing infrastructure and building for accommodating EV charging station.

5.3 CONCLUTION

The project entitled “Marketing and Promotion of Electric Vehicle with Special Reference to Developing Charging Infrastructure” is about promotion of Electric Vehicle and Developing Infrastructure. The Government target in accomplishing 0 emption will take longer since promotion are only in papers Government is not investing or taking initiatives for promotion and States like Kerala and some other states are not providing incentives.

Some positives about Government initiatives are you don’t need licence for charging station, road tax benefits for first EV purchase.

There is less availability of space in crowded cities and towns you don’t have space for implementing station, the income generated form EV Charging is 10% compared to the rent of the space places like Kozhikode towns in Kerala, Bangalore City it is really expensive to implement in these areas.

There should be proper laws in construction and town planning such that it does not affect the future.

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APPENDIX

QUESTIONNAIRE

1 Gender

a) Male b) Female c) Others

2 Age

a) 18-24 b) 25-35 c) 35-50 d) above 50

3 Which type of EV are you using?

a) Two-wheeler b) Three-wheeler

b) c)Passenger Vehicle including car d) Commercial Vehicle

4 Odometer running, Mileage, Distance Cover?

(Mileage: distance covered, KM reading on Odometer)

a) 500-20000KM b) 20000-50000KM c) 50000-70000KM

d) 70000-100000KM e) Above 100000KM

5 Borders crossed/ travelled no district/ state?

a) 1-District b) 2-District c) More than 3-District

d) 2- States e) More than 3 states

6 Owing secondary vehicles as backup for EV

a) Yes b) No

7 What is the range of KMs getting from your vehicle to claimed range?

a) 100-90% b) 90-70% c) 70-60% d) Less than 60%

8 Which service method way do you prefer for servicing?

a) Pickup and drop b) Dropping vehicle at service centre

c) Waiting for service to complete

9 What type of service do you do normally?

a) Pickup and Drop b) Taking vehicle to Service Centre

10 Time taken for the vehicle to get serviced?

a) 1/=<1 hour b) 2-3hour c) More than 3hour

11 Availability of charging station in Long Journey

a) Good b) Moderate c) Poor d) Didn't take to long drive

12 Affected by Power cut or electric flections at home?

a) Not affected b) 10-20 Times c) More than 30

13 Stuck at Charging Station due to unavailability of electricity

a) Yes b) no

14 Stuck at charging station/while charging due to vehicle issues

a) Yes b) no

15 Will you suggest/recommend EV?

a) Yes b) No

16 Reason for not adopting EV in your perspective?

Questions

a) Name of the state_____
b) Total number of electric vehicles sold from 2018-20222 (by individual year) _____
c) Number of electric two-wheelers sold from 2018 to 2022 (by individual year) _____ (in units)
d) Number of electric three-wheelers sold from 2018-2022 (by individual year) _____ (in units)
e) Number of electric passenger vehicle sold from 2018-2022 (by individual year) _____ (in units)
f) To what percentage of utilization made out the FEMA incentive scheme by the People_____
g) Is there any Incentive Scheme introduced by the local state government_____ h. At what rate the electric vehicle purchase is increasing. _____
h) Number of electric vehicle models existing in current market. _____
i) Average number of new electric vehicle modes coming in market every year. _____
j) Number of electric vehicle market players or manufacturers existing in the current market. _____

Data of the Questioners collected from Society of Indian Automobile Manufacturers (SIAM), Ministry of Road Transports and Highway, Ministry of power, Auto Car India as a primary source

THANK YOU FOR YOUR