

Electric Vehicles – Growth Drivers and Barriers in Indian Four-Wheeler Automobile Market

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ABSTRACT

In India, transport sector is one of the rapidly growing sectors. The Indian government has set a target of 100% e-mobility by 2030 and India embarked upon its e-vehicle journey in November 2017 by the deployment of 100 e-vehicle units and installation of four charging stations. Electric vehicles in the current world are causing a disruption in the automobile market and in extension to the Indian automobile market. This paper investigates the growth drivers and barriers for the Indian automobile manufacturers in the four-wheeler electric vehicle segment. In order to understand the proposed objective, the intention is to study in detail the government policy, conduct interviews with stakeholders in the whole electric vehicle value chain including manufacturers, customers, ancillary component manufacturers, electric charging infrastructure owners and other relevant stakeholders. The findings will reveal a holistic report on the future of electric vehicles, understand the intricacies and the impact of government policy and the other external factors driving decisions for the future of electric vehicles in India

Keywords

Electric Vehicles, Government policy on electric vehicles, Automobile marketing

Article Received: 10 August 2020, Revised: 25 October 2020, Accepted: 18 November 2020

Introduction

India is the fifth largest car manufacturing and purchasing market in the world with over 3.0 million cars sold in FY17. The marketplace offers a noteworthy growth potential given the car density stands at 37 cars per 1,000 individuals. Electric car sales, however, have continued to be very little and created merely 0.12% of the Passenger Vehicles sales in FY19.[1]

India is at present the fourth biggest producer of greenhouse gases (GHG) on the planet. The vehicle segment represents 13% of India's energy related CO₂ outflows. Openings exist to moderate GHG discharges and make India's vehicle development progressively practical and climate good by adjusting advancement and environment variation plans. India's National Action Plan for Climate Change (NAPCC) has observed that GHG emissions from transportation can be drastically diminished by embracing a maintainability approach through a blend of measures, for example, expanded utilization of open vehicle, higher entrance of biofuels, and upgraded vitality productivity of transport vehicles [2] Electric vehicles can convey numerous added assistances (improved air quality in urban communities, complete energy independence, sustainable reconciliation, and so forth.). This situation expects that legislatures perceive these parts of Electric Vehicles and bolster their infiltration. Therefore, the situation thinks about that there will be household strategy support for Electric Vehicles which improves their intensity.

The Government of India has recognized directly the need to take a gander at feasible portability answers for decrease reliance on imported energy sources especially fossil fuels which impact the macroeconomic factors of the country with imports heavily driving the price, reduce GHG emissions and mitigate adverse impacts from transportation and mobility in the country [2]. To moderate these, different

interventions and measures have been arranged which fuses eco-friendly upgrades, improving examination and assertion systems for reducing releases from on road vehicles, urban intending to decrease travel demand, improving mass vehicle, move to elective forces and developments including biofuels and electric vehicles, and all in all general context of establishment.

In early part of the decade, the Hon' Prime Minister of India announced the launch of the National Electric Mobility Mission Plan (NEMMP) with an aim and target to enhance national energy security, alleviate adverse and declining environmental effects (including CO₂) from public transport and road plying vehicles and give an impetus to the overall need of increasing India's manufacturing prowess and catering to the demand for locally made electric vehicles. The Mission Plan intended 6-7 million units of new vehicle sales of the full range of electric vehicles, along with resultant petrol and diesel savings of 2.2 – 2.5 million tonnes. Electric Vehicles in these contexts, are expected to play a central role in reducing the overall carbon footprint in accordance to the Paris Climate Accord. [3]

From the point of view of reducing the carbon footprint generated from public transport in India, Electric Vehicles are the future and the essential vehicle on which this transition to an increased light duty vehicles sale can be banked. Which essentially points to the fact that instead of using public transport with larger carbon footprint, it would be prudent to have multiple light duty vehicles owned by people which have lower carbon footprint and generate lesser carbon emissions. The aim as set in the Paris Climate Agreement of meeting a reduction in the temperature by 2° C by 2050, would only be met if the aforementioned idea of more electric vehicles being sold are followed through. Following the increased concern of national energy security and climate change as the major challenges of the next few decades, it is imperative and crucial that Governments

across the world take this challenge of introduction and adoption of electric vehicles with the most utmost seriousness. [3]

The subsequent Government when it came into power in 2014, took up the initiative of introducing Electric Vehicles in India with the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme in 2015 with detailed an overall outlay of INR 795 Cr intended for measured expenditure. The scheme was further extended based on the evolving landscape of Electric Vehicles till 2018, focussing on development of technology, demand generation, experimental projects and infrastructure necessary for charging across the vast country. [6]

In 2018, the FAME scheme was renewed for another three years with an even more grand outlay of expenditure with a major focus to provide on more impetus to provide more Electric Buses plying on the roads of Indian cities and towns. A lot of the focus was derived from the first phase of FAME scheme which ran from 2015-18 and the transition is mandated by neither the central government nor the state governments with no particular frame of time in mind i.e., the public transportation infrastructure in all major cities are prospected to changeover to Electric Vehicles. [4]

The Indian electric car market size was valued at \$92.3 million in 2018. It is projected to reach \$689.4 million by 2025, witnessing a CAGR of 34.5% during the estimated period. [8]

Electric Vehicles could have positive ramifications for national vitality security, neighbourhood air quality, GHG relief. In the long haul, they could encourage the expansion in sustainable power source share in the power sector. This paper looks at the advent of Electric Vehicles in India, focusing on the four-wheeler Electric Vehicles market and its drivers of potential growth, the barriers such as the ever-challenging government policy decisions impacting such growth.

Literature Review

India as a country has come a long way till the time automobile manufacturing in large scale has begun with foreign companies setting up for exports. We look at the Electric Vehicles (Electric Vehicles) being a major disruptor of the Internal Combustion Engine (ICE) cars. [6]. The paper investigates the holistic sense of the opportunities that have arose in the spectrum of Electric Vehicles in India. The paper wants a certain perspective from the VUCA sense, and which got exacerbated by the current ongoing pandemic of COVID-19.

Electric Vehicles lessen contamination just if a tall level of the power blend comes from sustainable sources and if the battery producing happens at a site a long way from the streets or the use of vehicles and the area encompassing them. [5] The paper focusses on the environmental side of the impact that are expected from Electric Vehicles in India. Although the environmental factor is a major driving factor, it can be very ambitious to claim that the whole Electric Vehicles program and push from the Government of India can be based on this whole factor, the paper fails to capture the essence of the major macroeconomic driver of reducing imports through reduction in consumption of fossil fuels

such as gasoline and diesel with the latter being a major contributor to commercial activities in India.

Electric Vehicles are targeted to reduce imports via reduction in importing fossil fuels which impact the economy and also positively impacting the reduction in pollution levels in all major cities across India [6]. The paper does justice to encapsulate the major two drivers of growth for the whole Electric Vehicles market in India but fails to apprehend a truly global and other perspective from all stakeholders' point of views. The whole scenario demands a more nuanced, comprehensive and well-rounded viewpoint for all the stakeholders to deduce the whole potential of the Electric Vehicles market in India.

This paper took a gander at a nation's all out charging foundation, not looking at how as a heterogeneous dissemination of charging stations might impact Electric Vehicles appropriation. In particular, on account of the significant pretended by nearby districts in introducing charging foundation their allotment could importantly affect a nation's Electric Vehicles selection rate. [8] The paper in its essence goes into the statistical need of identifying the significance of charging stations and the impact it may have on Electric Vehicles adoption rate in Europe and Middle East Asia.

The impact and adoption rate of Electric Vehicles across the world can be improved and mapped out by tracking consumer behaviour and consumer sentiment towards Electric Vehicles. [9] This paper does a deep dive into Slovenian Electric Vehicle market where first-time car owners and adopters of this new technology were targeted with promotional policies depending on total vehicle price and fuel economy which are vital from a car owner's standpoint and point of view. The paper identifies promotional policies pertaining to customers in Slovenia which helped in driving growth in the Electric Vehicles adoption rate.

When adopting a new technology, the factor of Government subsidy to accelerate the adoption rate plays a crucial role. The paper delves into the details of how urban households price preference and subsidising Electric Vehicle purchase and maintenance cost including charging cost help in accelerating the adoption rate of Electric Vehicles. [10] The paper takes the subject country of China and delves into the van Westendorp price sensitivity model to capture price preferences of households based in cities for Battery Electric Vehicles along with gauging the independent models, dependent models and apparent behavioural control that affect purchase behaviour. [12]

Electric Vehicle adoption rate and demands have augmented rapidly since 2010. [11] This paper utilises panel data from fourteen countries and studies the impact of seven factors in a multiple linear regression model. Thus, deriving that four of the seven factors have constructive influence on the demand of Electric Vehicles and the other three are independent and do not impact the demand in any shape or form. The paper discusses the policy decisions based on the four factors impacting the demand of Electric Vehicles. [16]

Research Methodology

This section describes the research methodology and the approach to unravelling the problem statement and to

understand the perceived acceptance and overall perception about Electric Vehicles in India.

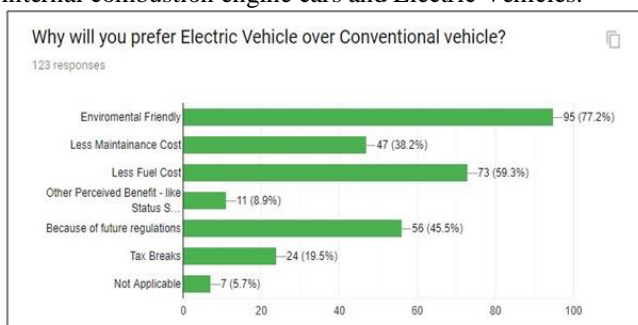
The paper approached a total of one hundred and twenty-three respondents for gathering their overall sentiment towards Electric Vehicles and understanding the factors that impact the buying sentiment of customers.

The respondents are all in the age demographics of being millennials and with potential first-time buying capacity with high disposable incomes.

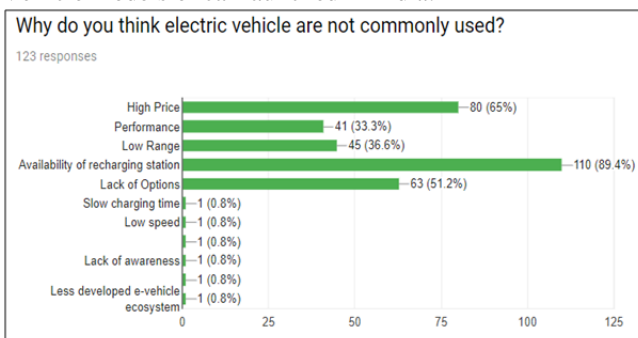
The paper also delves deep into the descriptive research with in-depth secondary research into the Electric Vehicle ecosystem in India.

Results and Analysis

The respondents were all in the millennial demographics with 67% male and remaining female. The data collected were aimed at understanding the consumer buying sentiment and the outlook and perspective towards conventional internal combustion engine cars and Electric Vehicles.



The data as shown below shows that even though there is a strong sentiment of eagerness to adopt a new technology like Electric Vehicles but there is a strong apprehension and scepticism based on factors such as lack of availability charging stations and high price of the initial Electric Vehicle models of car launched in India.



Electric Vehicles Value Chain

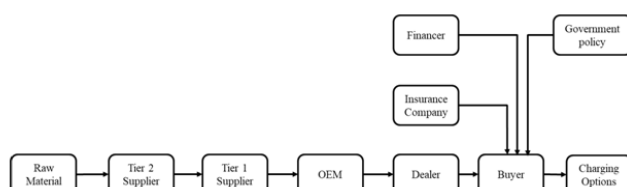


Fig. 1 – Existing Value Chain System for Electric Vehicles in India

The current existing value chain system for Electric Vehicles in India can be traced back to as shown in Fig. 1. The raw material suppliers send their raw materials to the component manufacturers or suppliers up the value stream, who in turn send their items to an OEM to manufacture

complete fit out components which gets assembled at the factory. The car users receive the car from the dealership and are aided by government policy driving the purchase decision and the financing and insurance policy. The other major component in the value chain of an Electric Vehicle is the charging infrastructure and the role Government and industry has to play in developing it or building it.

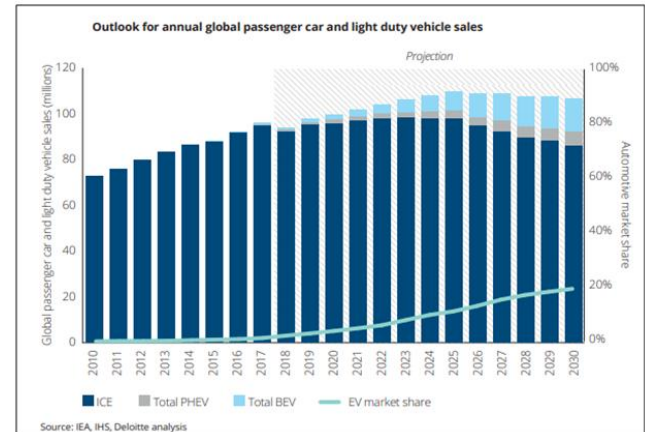


Fig. 1 – Outlook for annual global passenger car and light duty vehicles sales

The automobile ecosystem across the world has shown the decline in internal combustion engine cars and increased and more adoption of Electric Vehicles in the light duty vehicle sales.

Electric Vehicles can be classified based on the battery technology that the car runs on, and can be split into three basic classification based on the aforementioned methods. Firstly, Battery Electric Vehicle (BEV) which run completely on battery technology and can be termed as “pure-battery” vehicles. Secondly, we have Hybrid Electric Vehicle (HEV) is an amalgamation of ICE (Internal Combustion Engine) and battery powered vehicle and this is not currently the most common and popular kind of vehicle available in the market. Lastly, there is Plug-in Hybrid Electric Vehicle (PHEV) which has a mechanical drive as well as an electrical drive. The mechanical drive is from a typical ICE (Internal Combustion Engine) and an electrical drive comes from the electrical motor which can be recharged using an electrical source or using the generator run by the ICE. [15][17][18]

The Electric Vehicles segment contributes to over 70% of all electric vehicles sold in India.

Battery in a car is the hearth of the vehicle and has a large implication due to it comprising the major share of the weight and cost of the vehicle. Generally, most electric vehicles have utilized lead-corrosive batteries because of their develop innovation, simple accessibility, and minimal effort. Be that as it may, since the 1990s battery advancements have developed fundamentally and a few new kinds of batteries have been created [13][14]. All the more as of late, batteries utilizing blends of lithium particle and its varieties are increasing across the board acknowledgment because of better productivity, diminished weight, lower charging time, better force yield, longer lifetime, and decreased ecological ramifications from battery removal. The following four types of batteries are commonly used today in Electric Vehicles: 1) Lead Acid, 2) Nickel

Cadmium (NiCad), 3) Nickel Metal Hydride (NiMH), and 4) Lithium-ion (Liion). Lithium-ion batteries have sophisticated specific energy as compared to the other battery types that are available in the market. Later on, innovation developments with Li-particle and other battery advances are relied upon to bring about batteries with a lot of higher specific energy and frugal in terms of cost. [19] Disadvantages of Electric Vehicles in India

- o Currently, an Indian car uses 10-15% imported parts. Electric Vehicles will increase import dependence to 70% or more.

- o If Electric Vehicles increases, the need for electricity to charge the vehicles increases. Availability of electricity is limited in India and most of the power is generated through conventional sources which in turn increases pollution.

- o An Electric Vehicles has 20 moving parts, while a regular vehicle has more than 2,000. For this reason, when fully adopted Electric Vehicles will kill most auto component firms

- o Shutdown of existing companies due to non-adherence of Govt. new policies and standards.

Challenges of Electric Vehicles industry

- o Lack of a stable policy for Electric Vehicles production as this is a capital-intensive production

- o Lack of associated infrastructure for charging.

- o Un-availability of Lithium reserves and too much dependence on imports.

- o Unaware about the knowledge and acceptance of design, drivability of vehicle

- o Less availability of skilled local mechanics in electrical field.

Discussions

Environment Consciousness and Government regulations are important key drivers in the Electric Vehicle ecosystem.

- o Government participation

- o Environment consciousness

- o Government regulation and subsidies for Electric Vehicles

- o Integration of Electric Vehicles component on OEMs portfolio

- o Lithium battery evolution

- o Depletion of petroleum

Government of India is trying for electrification of both public and private transport system.

Government had announced a number of positive news for public charging facilities across India in the last few years. The Government announced that licenses needed for setting up of Public Charging Stations (PCS) have been done away with and any entity or individual can set up charging stations and paving the way to more private investment in charging infrastructure development in the country. The Government also announced subsidised distribution of over 4,000 electric charging stations in across the broad roadways network across the country including at 100% aid in setting up infrastructure for charging on the highways. The monetary support for FAME II was set at a huge INR 10,000 Crores. An ambitious target of installing one charging stations for every two miles in cities and every

thirteen miles on both sides of the highways which would help in increasing adoption of Electric Vehicles in India.

Conclusions

Numerous nations around the globe are most likely well in front of India regarding actualizing Electric Vehicles as a component of transportation strategy, their reactions have been blended relying upon the monetary turn of events, vitality asset blessings, innovative capacities, and political prioritization of reactions to climate change. In India, arises a golden opportunity to commence a sustainable mobility paradigm shift which may accelerate the adoption of Electric Vehicles over Internal Combustion Engines (ICE). Along with the opportunity, there are inherent risks whilst developing a marketing strategy for a new market.

The Indian market provides a unique opportunity to target a very niche segment and demographics. As per the latest government figures published by Department of Heavy Industry, the automotive sector (including two-wheelers, four-wheelers and commercial vehicles) in India has been growing at over 15% CAGR with production capacity of over 4 million four-wheeler vehicles.

As per latest Government statistics available of increasing income and number of people entering the workforce every year, the current first-time car buyer is more aspirational than ever before. The impact is being seen first-hand on the automotive sector with the traditional entry car segment of "Entry hatchback segment" dragging sales whereas the Compact and the Premium Hatchback segment growing over 6% and 9% respectively in FY '19. It can be safely inferred that one of the prime factors of such sales figures is the aspirational first-time buyer which is not willing to compromise. With the projected average age of the country to reduce below 30 years by 2020, it would be prudent to target the first time aspirational buyer (urban and rural, due to the fact that this demographic consists of the major chunk of the 12% small car segment owners in the automotive market in India) with ever increasing disposable income, need of mobility and youthful weekend getaways. Retail clients are probably going to be the preferred choice to receive Electric Vehicles, given the worries around high retail cost and a general suitability hole. Drawing from the troubling experiences, American automakers like General Motors and Ford had in Europe by introducing multiple models in the same segment, it can be suggested that a single premium hatchback Electric Vehicles model would be a judicious move as a starting point. Further, based on thorough market research and development of infrastructure across the country, models across different segments can be introduced to increase market share. The added benefit of targeting the first-time buyer would be an incentive of retaining the customer later, i.e., developing brand loyalty by the way of providing customer delight. From the publicly available balance sheets and target figures for all auto-makers across the world, the benchmark figure for Earnings Before Interests and Taxes (EBIT) is 8%, the financials and the pricing of the Electric Vehicles may be based on the thorough research of manufacturing, supply chain costs, customer demand and positioning strategy. The marketing strategy can be based on the existing process of introducing new vehicles in the

market which is aligned to the overall marketing strategy of the company.

The Electric Vehicles can be positioned based on an unbiased and market research focussing on the current youth desires in a premium hatchback car. The value proposition for the same can be developed by highlighting the fact that Electric Vehicles are reliable, clean energy vehicles with reduced maintenance costs as compared to maintaining an ICE vehicle.

Given that FAME – India (Faster Adoption and Manufacturing of Electric Vehicles) scheme is still being promoted by the Government and will continue to be subsidised for vehicles with ex-showroom prices below Rs. 15 lakhs, there is expected cut-throat competition. Also, the Government as a policy measure has been mulling Electric Vehicles to ply without any registration or a green plate, would be an added incentive and an external automatic factor encouraging Electric Vehicles sales. As a result of such policy measures being in the pipeline and the whole automotive sector looking at the Electric Vehicles market as a growth driver, it is imperative to position and market the proposed Electric Vehicles with a distinct strategy based on thorough market research.

The current Electric Vehicles market is one full of potential and waiting to be tapped with Government slowly focussing on its promise to the international community of reducing the carbon emissions by 33%-35% of 2005 figures by 2030. Clean energy and sustainable sources of energy are becoming inevitable and Electric Vehicles are the perfect tool to leverage the change. For the industry to actively start launching vehicles intended for public is still few years away, but the groundwork of product development, market research, marketing strategies should commence if one is intending to gain a considerable market share.

In the given scenario and landscape of Indian Electric Vehicle, it is becoming more and more vital for transportation and especially public transport. Electric Vehicles currently are run on fossil fuels like petrol and diesel and have contributed majorly to the increased release of carbon emissions which have offered the opportunity to Electric Vehicles to replace the Internal Combustion Engines in the country. The price element of the four wheelers need to be looked at closely and moderated so that the reasonably priced cars are made available to the normal India by 2030. Electric four-wheelers with significantly greater battery, more prominent payload limit and a progressively drawn out driving reach don't get sensible by 2035.

In the Electric Vehicles situation, because of the motivators for electric vehicles, little electric vehicles become suitable from 2020 onwards. Be that as it may, their dissemination is constrained inferable from the restrictions of vehicles (driving range, payload).

In the Electric Vehicles in addition to 2 °C situation a higher carbon value puts Electric Vehicles 4-wheeler off guard until 2025, since CO₂ substance of power is still high. Be that as it may, as power begins to decarbonise, Electric Vehicles entrance increments past the infiltration accomplished in the Electric Vehicles situation. By the by, even the higher carbon cost can't guarantee reasonability for increasingly costly Electric Vehicles that are similar in highlights to regular vehicles.

On a real sense, the push for adoption of Electric Vehicles can be achieved by providing incentives in monetary benefits such as tax exemptions or tax reimbursements. Looking at the Electric Vehicles situation, which models such monetary help, shows that if the capital expenses of Electric Vehicles were brought somewhere near around 30% from the Business as Usual, at that point a significant move to Electric Vehicles would occur. The incomes that administration would need to forego to offer this help would be 2803 billion INR for the period until 2035. To boost request would cost 371 billion INR before 2020 (for example in the period anticipated in the NEMMP). This is higher than the 233 billion proposed in NEMMP for request creation, R&D, power framework and fuel buy. The income misfortunes would decay as the interest side impetuses diminish after some time.

Financial motivating forces ought to be joined by arrangements for building residential capacities for Electric Vehicles fabricating. NEMMP 2020 as of now has components of this, in spite of the fact that the desire should be higher if Electric Vehicles are to convey their maximum capacity.

Prospects of Electric Vehicles in India

- o Estimated no of electric vehicles: In FY2019, total Electric Vehicles sales in India crossed the 7,50,000—units mark and with proper govt incentives average growth rate could be 7%
- o Sources of cost
 - a. Capital cost of setup
 - b. Operating cost –electricity, maintenance etc
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- o Focus should be on minimizing operational expense
- o Reduced attractiveness of substitutes (GST AND BS-VI) can give momentum for economies of scale
- o Current Electric Vehicles charging policy-Friendly
 - i. No qualification criteria (only monitoring) for opening public charging stations
 - ii. Individual can apply to discoms for power connectivity
 - iii. Ceilings of % cap tariff charged by stations from Electric Vehicles owners
 - iv. State govt can cap tariff charged from Electric Vehicles owners
 - v. State regulators to fix tariffs discoms can take from charging station

Success of Electric Vehicles are dependent on the following factors:

- Availability of Charging Points
 - o No fear of running out of battery
 - o Infrastructure of nearly 11000 publicly accessible charging points.
 - o One charging point per 35 km2
- Charging Maps
 - o An app from Norwegian Electric Vehicles association makes it easy to see where they are and how many are in use at any given time
- Government support

- o Financial Incentives such as exemption of purchase tax and VAT for potential buyers of electric cars
- o Free municipal parking facilities
- o Exemption from tax on toll roads etc.

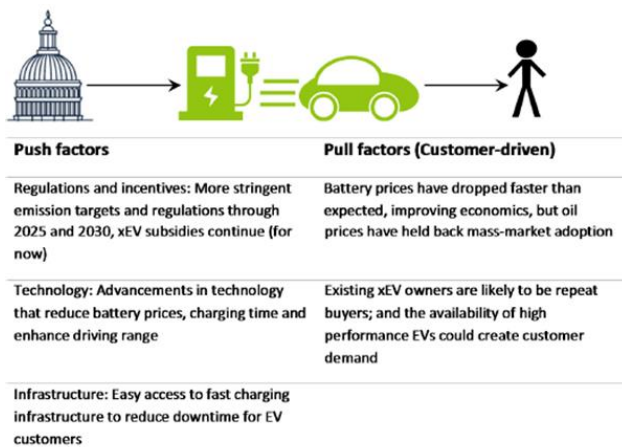


Fig 3 – Factors that affect Electric Vehicles adoption rate in India

Barriers to growth

A few expected detours for this execution have been distinguished. These detours are identified with natural mechanical, social, and industry related changes. The environment is affected because of all the new advances included the flexibly chain, for example, the electric vehicle, and the battery fabricating forms. Human conduct changes will include changes to the manner in which people see travel as vehicle proprietorship is an indication of flourishing in Indian culture. The administration today sponsors diesel costs as the vast majority of the diesel-based farm equipment in India. Any endowment that disappears from ranch hardware legitimately impacts food costs. A few existing enterprises, including oil and gas and vitality, will be disturbed and new businesses, for example, transportation value enhancers and versatility administration will be made due to this interruption.

Barriers can also be classified in the following

- o Market
- o Testing and verification
- o High capital cost and Financing
- o Quality of electrical output from charging stations
- o Market for electricity storage
- o Consumer perceptions
- o Raw Materials for batteries
- o Vehicle servicing
- o Technical
- o Efficacies of batteries
- o Driving range of Electric Vehicles
- o Charging time
- o Protection and Well being
- o Environmental Impacts
- o Policy
- o Taxation of vehicles and components
- o Subsidies on fossil fuels
- o Electricity tariff policies
- o Infrastructure
- o Charging set-up

- o Smart Grids
- o Battery reusing

In terms of market and infrastructural barriers that are there for Electric Vehicles in India can be quite daunting and major because of the very obvious and apparent absence of network of charging infrastructure across the country including cities and the highways. The other major worry in terms of infrastructure is the availability of fast charging as compared to the charging that can be facilitated from charging at home, because the time needed to charge on fast charge is one third of the time needed to charge at home. Hence, the charging infrastructure needs to be made available in abundance and frequency so as to not queue up cars for the purpose of charging. As a mitigation to the barrier, swapping battery technology can be a possible answer and charging can be alleviated with reduced loads especially on the electricity grids. Also, another alternative to lack of charging infrastructure can perhaps be setting up charging focuses for storm cellars of structures and in parking structures as is being done in numerous different nations like China. Essentially, Electric Vehicles rental plans of action can assist buyers with encountering Electric Vehicles direct and manufacture customer certainty. Such models can lessen forthright speculation required by shoppers and furthermore help in expanding purchaser trust in Electric Vehicles. Strategy related difficulties incorporate picking and organizing strategy instruments to advance Electric Vehicles, setting up foundation, boost car makers to deliver Electric Vehicles, and prompt customers to change to Electric Vehicles. From various perspectives, the difficulties impersonate the old-style chicken and egg situation. Should the framework be prepared before infiltration of Electric Vehicles could go up? Or on the other hand should the entrance of Electric Vehicles arrive at a 'tipping point' before the necessary framework is turned out? The quandary goes up against policymakers, vehicle producers and the related organizations.

Technical barriers of Electric Vehicles encompass a few wide-ranging views such as the driving reach and the grid availability. One of the critical blocks is the low unequivocal imperativeness thickness of most batteries used in Electric Vehicles, especially lead destructive batteries. To achieve reasonable driving degrees in this manner requires unwieldy batteries adding to the general heap of Electric Vehicles. To address this issue, battery creators are going after bleeding edge batteries with higher unequivocal imperativeness thickness, for instance, lithium molecule and lithium sulphur battery which can diminish weight necessities of batteries in future, along these lines provoking abatements in weight and possibly cost of Electric Vehicles. Some other EV related concerns relate to the driving reach and charging time of batteries. Nevertheless, as watched, even stream headways consider Electric Vehicles with high driving reach and low charging time. As battery types and battery developments improve, the concerns regarding driving degree and charging time will get also reduced. Market and infrastructural deterrents by and large relate to nonattendance of submitted ways for Electric Vehicles, nonattendance of charging establishment, and nonappearance of strategies to consider unequivocal necessities of Electric Vehicles.

Failures of Electric Vehicles are dependent on the following factors:

- Charging Stations
 - o Only 150 charging stations in India as per July 2019
- Range Anxiety
 - o Electric Vehicles in India provide a mileage of only 80 Km/charge as compared to 1250 Km/full tank for diesel or petrol vehicles
- Lack of Infrastructure
 - o India is still facing a shortage of power in many parts.
 - o Inefficiencies in usage of electricity
- Charging time
 - o Electric car (60kwh) takes about 8hr to charge from empty to full of a 7kw charging point
- High maintenance cost
 - o Battery to be replaced every 2 years.
 - o Costs around ₹ 60,000-1,50,000

Limitations

The paper looks at the holistic and a macro sense of the Electric Vehicles and its pace of adoption and factors affecting it in India. A deeper dive into the factors and the micro sense is limit and can be scope for further research and study. This paper likewise doesn't consider the effect of the continuous pandemic of COVID-19 and does not cover the probable impact and changes it may have in the acceleration or deceleration of adoption rate of Electric Vehicles in India.

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