An Electric Vehicle Segment Scenario in India: Growth, Challenges, Policy and Future Prospects.

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ABSTRACT

The current state of air pollution in India is a major concern. Numerous Indian cities are among the most polluted found a recent global report. The industrial and transportation sectors are the main sources of air pollution. Around 51% of air pollution is caused by the industrial sector while transportation sector contributes nearly 27%. Two million Indians lose their lives each year as a result of air pollution. Electric vehicles are a blessing in that they can reduce greenhouse gas emissions, hence reducing air pollution. Although there are many benefits to electric vehicles, establishing them in India presents a number of difficulties. This paper provides brief idea regarding growth, challenges, and future prospects of electric vehicles in India.

Keywords: electric vehicle, challenges, opportunities, future needs, battery, charging

INTRODUCTION

Among the biggest threats facing the world today is air pollution, and in a nation with the second-largest population in the world—approximately 140 million people — many of the major cities in the country are experiencing breathing difficulties. . Over the past ten years, India has experienced significant increases in air pollution, and the problem is getting worse at a frightening rate. The primary factors contributing to this rise in pollution levels are low-quality

fuel, aging cars, improper maintenance, heavy traffic, badly maintained roads, antiquated vehicle technology, and outdated traffic control systems.

The categories of Electric Vehicles are as follows :

HEVs: Hybrid electric vehicles combine the power of an electric motor and fuel to power their vehicle. Battery charging is facilitated by the energy produced by the braking system
PHEV: Plug-in hybrid electric vehicles are almost similar to hybrid electric vehicles but have bigger batteries and a smaller engine. The two ways that the batteries are recharged are via an external electric charging outlet or the braking system
BEV: These vehicles run on electric motors without an engine and store their energy in batteries. For battery charging, they rely on external power outlets. Battery electric vehicles (BEVs), or plug-in vehicles are other names of these cars.
Across the globe, the market for electric vehicles, or EVs, is expanding quickly. The EV market is currently experiencing significant growth in India as well. The FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) program, launched in the year 2015 by the Ministry of Heavy Industry and Public Enterprises, has resulted in a greater expansion of the market. In 2018 total 365920 units were sold and sales are predicted to increase at a CAGR of 36% through 2026.

OBJECTIVES

The study's objectives are outlined below:
1. To comprehend the sales trends of electric vehicles in India.
2. To understand the potential and challenges of the Indian electric vehicle market.
3. To become familiar with the electric vehicle policies of the Indian government.

RESEARCH METHODOLOGY

This research attempts to shed light on Indian electric vehicle market, as well as the opportunities and challenges facing the electric vehicle (EV) sector. The study utilized descriptive research design with the use of secondary data. The secondary data were acquired from a variety of sources, including books, magazines, reports, journals, websites, and the internet.

LIMITATIONS OF THE STUDY

This paper is limited in its scope to examining only the current and prospective state of electric vehicle scenarios; consequently, other automobiles are not included in the analysis. It is outside the purview of this study to address all facets of electric vehicles in detail.

ELECTRIC VEHICLES SALES

The electric vehicle (EV) market has experienced significant changes in a number of segments over the past ten years. ..

Two Wheelers: In 2013, 1,989 electric two-wheeler units were sold. Despite a minor decline to 1,678 units in 2014, there was impressive growth in the following years. Sales increased dramatically to an amazing 6,22,337 units by 2022, a significant 209% growth. In 2023, the number of electric two-wheelers exceeded 8,58,920.

Three Wheelers: In 2013, the three-wheeler market had 36 units; in 2014, that number slightly increased to 48. But the real boom came in the next few years, particularly in 2016 when sales hit an incredible 46,561 units. By 2022, the total sales of electric three-wheelers reached 9,53,151 units, reflecting a significant growth.

Four Wheelers: The category of four-wheelers has steadily expanded over the years, beginning with 374 units in 2013. The sales spiked to 37,792 units in 2022, indicating a substantial increase. Over the course of the ten years, 52,898 electric four-wheelers were sold.

Buses: The electric bus market started out with just one unit in 2013 and grew steadily to 1,932 units in 2022 ,exhibiting an impressive rate of growth. Throughout the ten-year period, 3,742 units of electric buses were demanded.

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The cumulative EV sales across all segments in last ten years period amounted to an impressive 18,71,643 units, showcasing the dynamic growth of the electric vehicle market.

It is widely acknowledged that during the past ten years, EV sales have increased dramatically indicating a growing consumer interest in electric vehicles. In 2023 India register record sales of 18,71,460 units in all EV category. The number of units sold in 2023 fell into the following categories: two-wheelers (8,58,900), three-wheelers (9,53,150), four-wheelers (52,890), buses (3740), and goods carriers (2930).

In the Financial Year 2022-23, India recorded year-over-year increase sales of 154% over FY 2021-22 across all vehicle segments. Additionally, In the same fiscal year, the electric vehicle market in India achieved record sales across all vehicle segments, making up to 5.59% of all automobile sales.

For FY 2022-23, Ola Electric had highest sales in 2-wheeler EV category with 1,65,589 units sold with 21% market share far ahead of the second highest sales Hero electric company which sold 97,810 units. With a 79 percent market share, Tata Motors is still the market leader in India for e-4W vehicles. In 3-wheeler segment YC Electric and Mahindra & Mahindra hold top most position with market share of 8% and 7% respectively.

CHALLENGES FOR ELCERIC VEHICLE IN INDIA

There are barriers in the path of realizing India's EV potential. In India, the transition to a widespread EV adoption is a sluggish process fraught with obstacles. There are currently numerous obstacles in the way of establishing the future of electric vehicles. The main obstacles preventing the adoption of EVs in India are as follows. Challenges can be view from various angles like Economical, Technological, Environmental, Social, and Regulatory.

A. Economic

One of the biggest obstacles to EV use in India is economic challenges. There are various facets to economic challenges.

1) High upfront cost/EV Cost: The electric vehicle price is one of the main obstacles to their adoption in India. When considering their initial costs, electric vehicles are typically more expensive than traditional internal combustion engine (ICE) vehicles. the price of electric vehicle (EV) parts like batteries and motors is more than that of traditional fuel engines. the ex-showroom prices of the Tata Nexon (XMA AMT S) Petrol and EV Prime model are ₹994,900 and ₹1,663,000, respectively, serve as a comparision. Mass production of the pricey EV parts is still not economically justified because the systems are not developed enough and the majority of the assembly process are manually. As a result, the selling price of EVs must be high in order to keep healthy profit margin for the business.

2) Expensive Battery: The adoption of electric vehicles is still significantly hampered by the cost of batteries. The batteries of an electric vehicle account for a sizeable portion of the vehicle's overall cost. Even though battery costs have likely declined over time, they remain a substantial expense. The higher initial cost of electric vehicles is largely due to their expensive batteries, which prevents many consumers from affording them. High-performance batteries are made, but they also cost more.

3) Underdeveloped Charging Infrastructure: In order for electric vehicles to be widely adopted, a strong charging infrastructure must be made available. Inadequate infrastructure for charging electric vehicles (EVs) is the primary obstacle to their commercial viability in India. The infrastructure for charging is still comparatively small and undeveloped. For EV owners, inconvenience and range anxiety are caused by the absence of charging facilities and the length of time required for charging. As of 2022, China, had 11.8 million electric charging stations, in contrast there are 934 charging stations in India, the majority of which are found in cities. To construct larger batteries and fast-charging stations., however, necessitates a large capital outlay. Low utilization rates and high initial investment costs have made charging stations unprofitable. In order to encourage more people to convert to electric vehicles, a large and dependable charging network must be established.

4) Financial Sensibility At the moment, purchasing an electrical car in India isn't financially sensible because of the high insurance premium and the unpredictability of battery costs beyond the warranty period.

B. Technology

1) Electric Vehicle: The scarcity of raw materials has made it difficult to develop and manufacture energy storage systems for EV's. This is due to the fact that an EV's energy storage system uses premium materials to guarantee superior performance and safe, explosion and corrosion-free operation. Contemporary electric vehicle systems are built to be able to efficiently handle every potential energy resource, provided that energy is available. The cost and size of the existing energy storage systems is another significant problem. The energy storage system accounts for one-third of the electric vehicle's overall cost. The energy storage system is expensive since it includes labor, packing, material, replacement, power conversion, operation and maintenance costs.

2) Battery Technology: Because of their increasing popularity, Li-ion batteries are quickly taking the place of conventional battery technology in the automotive sector. Li-ion batteries are used in electric vehicles, yet there are safety and economic issues because of the temperature effects in the batteries. It is necessary to safeguard Li-ion batteries in electric vehicles against overcharging and over discharging. Heat buildup within Li-ion batteries is the main cause of thermal runaway, swelling, electrolyte fires, and explosions, among other safety issues. The advancement and manufacturing of cutting-edge battery technology is essential to raising the efficiency and cost of EVs. Unfortunately, India can't produce many batteries domestically and must import most of them. To meet these challenges, it is essential to establish a strong ecosystem for battery manufacturing and charging.

3) Infrastructure: Instead of using fuel, electric vehicles are powered by energy storage devices like batteries, which need to be recharged. The present power plants and grid must therefore provide more energy. For this reason, in order to produce energy, renewable energy sources like solar and wind power must be used. This implies that both the charging infrastructure and the technologies employed in the power grids may have an impact on the cost of charging. Meanwhile, the number of EVs on the market and the charging time may be impacted by advancements in charging technology.

4) Lack of Standardization: One of the industry's challenges is the absence of industry standards for electric vehicle technologies. Power train configurations, charging connectors, and battery chemistries vary amongst manufacturers. This lack of consistency makes charging more difficult and prevents the growth of an infrastructure for interoperable charging. Standardization initiatives are required to guarantee compatibility and simplify the charging process for owners of electric vehicles. .

C. Environmental

1) Safety Challenges: Consumer trust in electric vehicles is heavily reliant on safety concerns. There are risks related to battery technology that must be considered, including thermal runaways and fire incidents. Strict safety guidelines and laws should be implemented by the government for EVs, charging stations, and battery production. Gas emissions are decreased by

EVs. However, the process of producing electricity to charge EVs emits greenhouse gases as well. Global warming is brought on by greenhouse gas emissions into the atmosphere. Diseases of the lungs, brain, and respiratory systems can result from the manufacturing and processing of energy storage devices in addition to the removal of batteries possessing electrochemical characteristics. Therefore, safety precautions, particularly with regard to the batteries, must be taken when producing energy storage systems. Although electric vehicles (EVs) do not completely eliminate emissions throughout their life cycle, the overall environmental impact can be decreased with the use of alternative energies and advancements in manufacturing technology.

2) Absence of Clean Energy: If the electricity needed to charge electric cars comes from fossil fuels, the switch to them will not be entirely sustainable. In India, a substantial amount of nation's electricity is still produced by coal-power plants the environmental advantages of electric vehicles might be offset. To guarantee a cleaner and greener transportation system, a greater emphasis on renewable energy sources must coincide with the widespread adoption of electric vehicles.

D. Social

The social component is also significant since it influences consumer attitudes, the performance of EVs, and indirectly encourages people to adopt EVs. Perceptions of cost and benefits, as well as attitudes toward emerging technologies and social influence, are examples of psychological factors that impact consumers.

1) Range Anxiety: A common concern among consumers is the EVs' short range and the potential hassle of finding charging stations when traveling long distances. Long-distance driving is not feasible with most EVs on the market in India, as their range is only 100–150 km.

2) Charging Time: The charging time of an EV from an empty state to a fully charged state using a 7 kW charging point can reach up to 8 hours if the charger is slow. The battery's size is the primary determinant of the charging time. The amount of time needed to recharge a car battery from empty to full state increases with battery size. One of the biggest things holding people back from adopting EVs is the comparison of the charging time of an EV with that of refueling car at petrol station.

3) Persistent Resistance to Change: Despite the long-term financial and environmental advantages of electric vehicles, Indian consumers continue to exhibit resistance to change**.** This results from a general reluctance to adopt new technologies, particularly in rural areas, and a lack of knowledge about EVs. When it comes to EVs, their perspective on new technologies plays a significant role in their choice..

4) Lack of Consumer Awareness and Education: The benefits, charging needs, and general performance of electric vehicles are not well-known to many Indian consumers**.** A lack of knowledge and instruction makes switching to electric vehicles more difficult. In order to overcome this obstacle, awareness-raising and educational programs may be extremely important. Since many two-wheeler OEMs have been successful in raising awareness of this issue, the growth of two-wheelers in the passenger market has outpaced that of four-wheelers. ..

E. Regulatory

1) Policy and regulatory challenges: One of the primary hindrance to the widespread adoption of electric vehicles has been the lack of a well-defined and uniform policy framework. Clear and advantageous regulations, tax benefits, and subsidies are examples of policies that can have a big impact on consumer behavior and market dynamics. The absence of a stable, long-term policy framework has created uncertainty among stakeholders despite the Indian government's numerous efforts to promote electric vehicles. The recent cut to the Fame 2 subsidy might be detrimental to the EV industry's expansion.

INDIAN GOVERNMENT POLICY AND PROMOTIONAL MEASURES ON ELECTRIC VEHICLES

In order to promote the use of electric vehicles in the country, the central government has launched several promotional initiatives over the past ten years, such as tax benefits for EV owners, construction of public EV charging stations and so on

India's premier initiative to promote electric mobility is called FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles). With this scheme, the gradual introduction of dependable, reasonably priced, and effective electric and hybrid vehicles is encouraged. .

On April 1, 2015, Initially, the scheme’s first phase (FAME I) was authorized for a two-year duration. Periodically, the scheme has been extended. The most recent extension was granted until March 31, 2019. For every type of vehicle, including plug-in hybrids, strong hybrids, mild hybrids, and pure electric vehicles, as well as battery specifications, an incentive amount has been established.

FAME-II will be in effect from 2019 to 2022 for a duration of three years, with a 10,000 Cr budgetary allotment. The scheme's primary goal is to promote the quicker adoption of electric vehicles by providing up-front incentives for the buying of such vehicles and by setting up the infrastructure required for their charging. This phase intends to create demand by supporting ten lakh electric two wheelers, five lakh electric three wheelers, fifty five thousands electric four wheeler passenger cars, and seven thousand electric-buses. Furthermore, 2700 charging stations

in 24 States and Union Territories spread across 62 cities have received approval from the Department of Heavy Industries as part of the FAME India phase II program.

The scheme provides the following incentives.

Sr No	Total Approximate Incentives
1	Electric Two Wheeler: 15000 Rs per kWh
2	Electric Three Wheeler: 10000 Rs per kWh
3	Electric Four Wheeler : 10000 Rs per kWh
4	Electric Buses: 20000 Rs per kWh
5	Electric Trucks: 20000 Rs per kWh

Table 1 : Incentive Scheme

The following is category-wise breakdown of the demand incentives provided by the FAME scheme in phase-II which open until October 2022.

EV Category	Amount
EV-2 Wheelers	Rs. 2464.27 Cr. approx
EV-3 Wheelers	Rs 351.21 Cr. approx
EV-4 Wheelers	Rs. 114.65 Cr. approx.
EV-Buses	Rs. 687.93 Cr. approx.

Table 2 : Category-wise Incentives

A phased manufacturing roadmap has been developed to support the development of electric vehicles and increase electric mobility. It takes into account the current state of the manufacturing ecosystem in the nation. Through a graded duty structure, indigenous manufacturing of electric vehicles, their assemblies and sub-assemblies, and parts and inputs for the sub-assemblies will be promoted over time. The objective is to greatly increase value addition and capacity building within the nation from which Phased Manufacturing Programme (PMP) assistant is available.

To help EV owners afford their vehicles, the government provides a variety of financial incentives. The following are the main ways to obtain incentives

- Purchase Incentives: A straight discount off the price of the electric vehicle for the user.
- Coupons: A financial incentive with a later repayment period.
- Interest Rate Subsidies: A reduction off the interest rate while obtaining a loan.
- Road tax exemption: A waiver of road tax at the time of purchase.
- Registration fee exemption: A one-time registration fee that applies when buying a new vehicle is waived
- Income tax benefit: Offsets The amount of taxes that an individual must pay to the government.
- Other incentives: Additional incentives include interest-free loans, top-up subsidies, and exclusive offers on electric three-wheelers, among other things. is also accessible.

In an effort to support "Make in India," the Indian government has raised the import duty on electric vehicles, according to statements made by Nirmala Sitharaman, Finance Minister during the presentation of the union budget 2020.

OPPORTUNITIES AHEAD

The market for electric vehicles is expected to grow as a result of the government's ambitious plans and initiatives. In order to achieve significant electrification by 2030, The Indian government has put in place a variety of programs to promote and reward the use of electric vehicles and the construction of infrastructure for public charging. In the upcoming years, India wants to cut back on its excessive oil imports and urban pollution. In order to meet this goal, electric vehicles will be crucial.

CONCLUSION AND FUTURE SCOPE

Worldwide, the use of electric vehicles is rapidly growing as a sustainable mode of transportation. The adoption of EVs has also been accelerated by the Government of India. To encourage India’s adoption of EVs, however, a number of obstacles must be removed. Although consumers are eager to reduce pollution but there are a lot of costs involved with electric vehicle (purchase cost, operating cost, vehicle cost, maintenance cost, electricity cost, resale). For this reason, an affordable electric vehicle is necessary for the Indian consumers. According to market researchers, EV will eventually replace internal combustion engine transportation. According to projections made by the International Energy Agency (IEA), the number of electric vehicles in the world will rise 13 million by 2020 from 3.7 million in 2017, and ultimately reach 130 million by 2030. This suggests that in order to benefit from the expansion of this industry, Indian auto policymakers need to take action. Sales of electric vehicles (EVs) are fueled by a number of factors, including government incentives, rising environmental consciousness, and significant fuel and maintenance savings. On the other hand, the main things hurting EV sales are the phasing out of government subsidies in important markets, EVs' short range and slow charging times, their high current cost, and inadequate infrastructure.

In spite of this, EVs have a brighter future ahead, with a projected rise in market share worldwide due in large part to recent and upcoming advancements in battery technologies, which have the potential to significantly reduce manufacturing costs, increase range, and reduce charging times.

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