International Journal of Interdisciplinary Innovative Research & Development (IJIIRD)
ISSN: 2456-236X
Vol. 10 Issue 01 | 2025

Revolution of Electric Vehicles in India Opportunities Scope and Impact on Automobile Market

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DOI: 10.5281/zenodo.16746616

ABSTRACT

India is experiencing a major shift in its transportation sector, with electric vehicles (EVs) leading this change. Motivated by environmental issues, government policies, and advancements in technology, the EV industry offers immense opportunities and significant potential for expansion. This paper explores the current landscape of EV adoption in India, the opportunities available, its extensive potential, and the resulting impact on the conventional automobile market.

Recent technological advancements have propelled progress in the automotive sector. Electric vehicles present a viable alternative to traditional internal combustion engines. The global demand for electric vehicles continues to rise, mainly due to their reduced CO_2 emissions. To further enhance the electric vehicle landscape, the Indian government aims to increase EV production within the automotive industry. This essay delves into the business prospects and challenges facing electric vehicles in India. Factors such as economic, social, technological, and environmental influences on the electric vehicle sector in India are also examined. The development of infrastructure and battery technology is shaped by these economic and technological factors.

Keyword : - Electric Vehicles , Automobile market environmental influences , CO_2 emissions, battery technology .

1. INTRODUCTION

The worldwide movement towards sustainable transportation has highlighted electric vehicles as a crucial means to address climate change and lessen reliance on fossil fuels. In India, this shift is not only essential for the environment but also presents a significant economic chance. Given the growing population and rapid urbanization, the demand for clean, efficient, and sustainable transport solutions has reached a critical point.

Over the last decade, the international electric vehicle market has expanded at an unprecedented pace. This essay begins with an assessment of the potential and reach of electric vehicles in India. Following this, we analyze various frameworks and policies established by the Indian government. Case studies of electric vehicle adoption from around the world are then reviewed. Finally, we discuss how India can implement these strategies to gain both local and national advantages. The Indian electric vehicle market was valued at USD 5 billion in 2020, with projections indicating a growth rate exceeding 44%, potentially reaching USD 47 billion by 2026.

The global electric vehicle market is rapidly expanding, and India has also witnessed significant growth in this sector. The implementation of the FAME (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles) initiative by the Ministry of Heavy Industries and Public Enterprises in 2015 has further accelerated market expansion. Electric vehicle sales reached 365,920 units in 2018, with an expected compound annual growth rate (CAGR) of 36% through 2026. In 2018, the market for EV batteries in India was projected to be worth USD 520 million, with a CAGR of 30% anticipated until 2026. Electric vehicles represent a path toward energy independence and reduced reliance on foreign energy sources. As one of the largest crude oil producers globally, India has the potential to embark on a significant journey toward energy self-sufficiency through electric vehicles.

Electric vehicles serve as alternatives for reducing carbon dioxide emissions, particularly in major urban centers such as Delhi and Mumbai, where air pollution is a pressing concern. The smooth operation, low emissions, and high efficiency of electric vehicles make them an appealing option. Research conducted on the energy consumption and greenhouse gas emissions of plug-in hybrid electric vehicles in China indicates that they utilize 37.5% less energy and generate 35% fewer

greenhouse gases than gasoline-powered vehicles. Although the government has already initiated financial policies to promote EV adoption, a long-term perspective from policymakers is essential for effective implementation.

India's journey with electric vehicles has seen its share of disappointments thus far. The lack of charging infrastructure, inconsistent government support, and early product failures have contributed to stagnant growth in recent years.

2. REVIEW OF LITERATURE

The Indian automotive sector ranks as the fourth largest globally and is projected to become the third largest by 2021. The Indian government has set a goal of achieving 12% electric vehicle penetration by 2026, driven by the anticipation of a 5.9% annual growth rate in the automotive industry (which includes parts manufacturing) to reach between INR 16.18 and 18.8 trillion (USD 251.4 to 282.8 billion), making it the fastest-growing industry in the country. The government has articulated a clear ambition of transitioning to 100% electric vehicles by 2030, with NITI Aayog—India's primary think tank—laying out the framework for a long-term global mobility strategy.

Public transportation, including buses and trains, is increasingly favored among Indians, as detailed in the Ministry of Statistics and Program Implementation's 2016 report, which highlighted that buses are the predominant mode of transport in urban and rural areas alike. Nearly 66% of rural households and 62% of urban households allocate the most of their transportation expenditure to buses. This shift has transformed the mobility sector, suggesting a comprehensive solution. Nevertheless, there is a need for a highly efficient public transport system in the long run, featuring vehicles powered by electricity or other alternative fuels to ensure convenience, safety, and enjoyment. Notable progress is being made in the Indian electric vehicle sector toward this goal.

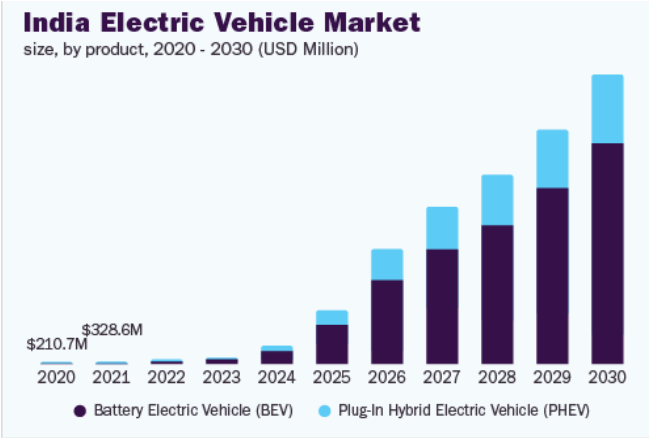

Fig -1 Growth of electric vehicles in India

2.1 Objectives of the study:

- To know the customer preference on electric vehicles.
- To study the customer satisfactions level towards electric vehicles
- To know the customer would shift normal vehicle to electric vehicle.
- To examine the relationship between normal vehicles and electric vehicles.
- To analyze the influence of electronic vehicles on the acceptance of the Indian Automotive market. To analyze the important factors that influence the Indian markets to consider the incorporation of electric vehicles.
- The advantages along with the major disadvantages that come with electric vehicles and the way they will be having an impact on the Indian automotive market.

3. OPPORTUNITIES IN THE INDIAN EV LANDSCAPE

3.1 Government Initiatives and Policies The Indian government has been proactive in promoting EV adoption through various schemes:

- **FAME II (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles):** Launched with an investment of ₹10,000 crore, this scheme offers subsidies for EV purchases and supports the development of charging infrastructure.
- **Production Linked Incentive (PLI) Scheme:** Aims to boost domestic manufacturing of EVs and components, reducing reliance on imports and encouraging local innovation.

- **PM E-DRIVE Scheme:** Introduced in 2024, allocating ₹10,900 crore to enhance EV adoption and infrastructure development across the country.

3.2 Economic and Employment Opportunities The EV sector is poised to generate significant employment opportunities, with estimates suggesting the creation of over 5 million jobs by 2030. Additionally, increased EV adoption could lead to substantial savings on oil imports, enhancing energy security.

3.3 Benefits of Driving an Electric Vehicle Transitioning to EVs can drastically reduce greenhouse gas emissions and air pollutants. In urban areas, where vehicular emissions contribute significantly to air pollution, EVs offer a cleaner alternative, improving public health outcomes.

Less expensive to run: Due to their excellent fuel economy and efficiency, electric vehicles (EVs) are less expensive to operate for their owners. An electric vehicle requires roughly one-third the electricity per kilometer to charge it.

Less expensive to maintain Comparatively speaking, BEVs have fewer moving parts than conventional cars with internal combustion engines. Fewer services are provided, and none at all costly components that are unnecessary for an EV, like exhaust and fuel injection systems. Petrol engines power PHEVs, while Though they are more expensive than BEVs due to their maintenance needs, they also include an electric propulsion system, which means that there are fewer moving parts and a reduction in the wear and tear on petrol engine components.

Eco –Friendly: Since EVs produce no exhaust emissions, they are less polluting vehicles. If you decide to charge your EV using renewable energy, you can further cut back on greenhouse gas emissions. Certain EVs are constructed using environmentally beneficial components. For example, the Nissan Leaf and Ford

Benefits to Health: Improved air quality is a result of decreased hazardous emissions. It benefits our health. In addition, EVs emit significantly less noise than cars powered by gasoline or diesel.

More Secure: EVs are less likely to capsize because of their low center of gravity. They also run a very small risk of explosions and fires. Their increased durability due to their body structure makes them safer in collisions.

3.4 Obstacles of Driving an Electric Vehicle:

a. Cost of EVs: EVs should be reasonably priced, and the vehicles that are produced should be financially sound.

b. India's EVs' Efficiency: The typical range of EVs in India is about 120 km when fully charged, which makes them unsuitable for lengthy trips. The slow pace of EVs in India may deter purchasers. The top two EVs built in India can reach speeds of 85 km/h.

c. EV demand: A rise in demand will facilitate the realisation of Vision 2030. A rise in EV demand will result in a rise in energy and raw material requirements for the battery.

d. Lithium batteries: Nickel, aluminum, cobalt, graphite, and lithium—all rare earth elements—are the batteries used in electric vehicles. components. • These materials are hard to come by, and the quantity could not be sufficient to make enough batteries to power the anticipated number of electric cars that will be built. It will be difficult to meet India's EV requirement due to the growing demand for lithium worldwide due to its scarcity on Earth's surface.

Feature	Battery Electric vehicles	I.C. Engine vehicles
Prime mover	Electric motor	I.C. engine
Powered by	Charged battery, ultra capacitors	Diesel, Petrol
Self weight	High due to battery bank	Low as compared to EV
Power Transmission	Both mechanical as well as electrical	Mechanical only
Braking system	Regenerative braking	Friction braking
Efficiency	High	Low
Eco friendly	Yes	No
Initial cost	High	Average
Running cost	Low	Very high

Fig -2 Comparison between Electric Vehicles Vs I C Engine Vehicles

4. SCOPE OF EV IN INDIA

The scope of electric vehicles (EVs) in India is rapidly expanding due to rising environmental concerns and government initiatives. With policies like FAME-II, tax benefits, and improved charging infrastructure, EV adoption is increasing. India's push for sustainable mobility and reduction of oil imports is fueling EV growth. As technology advances and awareness spreads, the EV market is expected to boom, creating new opportunities in manufacturing, services, and renewable energy sectors

4.1 Market Growth Projections: India's EV market, valued at USD 3.21 billion in 2022, is projected to surge to USD 113.99 billion by 2029. This growth is attributed to supportive policies, technological advancements, and increasing consumer awareness

4.2 Infrastructure Development: Efforts are underway to expand the EV charging infrastructure:

Charging Stations: From just 1,500 in 2020, the number of public charging stations grew to over 12,000 by 2024.

Mega Chargers: Tata EV has initiated the setup of high-speed Mega Chargers across major highways, aiming to enhance long-distance.

4.3 Technological Innovations: Indian companies are investing in R&D to develop advanced battery technologies, such as solid-state batteries, which promise higher efficiency and safety. Additionally, smart charging solutions and vehicle-to-grid technologies are being explored to optimize energy use.

5. IMPACT ON THE TRADITIONAL AUTOMOBILE MARKET

5.1 Shift in Consumer Preferences: With increasing environmental awareness and rising fuel costs, consumers are showing a growing preference for EVs. This shift is prompting traditional automakers to diversify their portfolios to include electric models.

5.2 Strategic Moves by Automakers: Leading automobile manufacturers are making significant investments in the EV sector:

- **Maruti Suzuki:** Plans to double annual production to 4 million vehicles by 2030, with a focus on EVs and sustainable initiatives.
- **Hyundai:** Announced the launch of 26 new car models by 2030, including six EVs, to reclaim its market position

5.3 Emergence of New Players: The EV revolution has opened doors for startups and new entrants in the automobile sector, fostering competition and innovation. Companies like Tata.EV are leading the charge, setting benchmarks in EV adoption and infrastructure development.

5.4 Impact of EVs on the Indian automotive market : Electric vehicles are regarded as one of the most sustainable approaches towards vehicle and transportation in the Indian market and its automotive future is dependent on EVs. With time and consistency, the Indian market has become extremely wide and open and the integration of electric vehicles is regarded as the nation's future that will help in terms of reducing the overall carbon footprint in general. Moreover, in the Indian Automotive market, it has been observed that EVs have been extremely effective in terms of reducing the overall content of pollution in the nation and the same time it has been effective in terms of reducing the overall scope of global warming if it is consistently used by customers that will have a sustainable impact on the national environmental attributes and will have a positive impact on the future transportation facilities

6. CHALLENGES AND THE ROAD AHEAD

Despite the promising outlook, several challenges persist:

- **High Initial Costs:** EVs often have a higher upfront cost compared to traditional vehicles, primarily due to battery expenses.
- **Infrastructure Gaps:** While progress has been made, the charging infrastructure, especially in rural areas, needs significant expansion.
- **Supply Chain Dependencies:** Dependence on imported components, particularly lithium-ion batteries, poses risks. Efforts are being made to boost domestic manufacturing capacities.

7. CONCLUSION

The electric vehicle revolution in India is more than a shift in transportation; it's a transformative movement towards sustainable development, economic growth, and environmental preservation. While challenges remain, the concerted efforts of the government, industry stakeholders, and consumers position India to emerge as a global leader in the EV domain.

The way that one approaches the network of public charging stations can be important regarding the adoption of EVs. In addition to bringing urban, regional, and rural populations together, massive public infrastructure

construction can assist potential buyers in overcoming their anxiety about distance. The expansion of India's infrastructure helps the country get closer to its goal of becoming a country that entirely employs electric vehicles, which is supported by the Indian government. India is concentrating on the mission, and it might take some time before they are acknowledged as an EV nation. Everyone wants an affordable, environmentally friendly means of personal transportation, and the digital economy is progressively taking control, thus it is projected that the ongoing conditions of market in India would speed up the adoption of EVs.

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