

Rise Of Evas An Emerging and Convenient Market in Automobile Sector in India

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Abstract

India now ranks fourth among countries that generate greenhouse gases (GHG). Due to a lack of a clear policy or plan, India has been lagging behind other nations in the adoption of electric vehicles (EV). As a measure to reduce air pollution and fossil fuel usage, the USA, China, Norway, and Germany have all provided significant subsidies and incentives to convert to EVs. By examining both the Indian EV market and the overall development of EVs, this paper's primary goal was to analyse the policies, strategies, and technological factors for developing EVs. Also, the research and development status of EVs in India were taken into account in this study. Also, a strength, weakness opportunity and challenges (SWOC) study was conducted on the present EV deployment in India, along with the potential and difficulties that exist within this industry. By coordinating the development and climate change objectives, there are opportunities to reduce GHG emissions and improve the sustainability and climatic compatibility of India's transportation expansion. The National Action Plan for Climate Change (NAPCC) of India acknowledges that GHG emissions from transportation can be decreased by adopting a sustainability approach through a combination of measures, including increased use of public transportation, increased use of biofuels, and improved energy efficiency of transportation vehicles.

In 2018, India overtook Germany as the fourth-largest vehicle market in the world. Two-wheeler sales in India have nearly tripled over the past ten years, and both passenger and commercial vehicle manufacturing have increased by half.

OBJECTIVES:

The proposed study aims to better understand the obstacles preventing the widespread use of electric cars in the nation and to provide solutions. The study will concentrate on presenting the viewpoints of the industry, concentrating on the issues faced in terms of their production capabilities and resource availability, and perspective of the customers in terms of their preference and readiness to pay. In India, the uptake of electric two-wheelers is greater and occurring more quickly than in other personal vehicle sectors. Aside from helping to reduce air pollution, moving to electric two-wheelers will result in significant savings for users with little reliance on public charging. Even though, the adoption of electric two-wheelers is still growing, but at a far slower rate than is necessary to meet the country's objective. The major emphasis of this study is the electric two-wheelers for the same reason.

The broad objectives of the study are as follows:

1. To comprehend the Indian mobility situation

The study will look at India's present mobility trend in this part. The objective is to comprehend the proportions of various passenger transport modes, as well as their characteristics and functions. Moreover, the negative externalities of increasing travel demand in terms of energy use, carbon emissions, and local air pollution will be evaluated in this section. Also, a brief overview of alternative fuel technologies for the transportation industry will be included in this study's component. Understanding the preferences, shares, and functions of various modes of transportation in urban and rural India will help you:

2.To comprehend how electric vehicles fit into the transportation picture in India:.

The section's goal is to comprehend the Indian auto industry's segment-specific car production and sales. In terms of technology, sales, usage, and municipal, state, and federal governmental interventions, this section seeks to explain the present condition of electric mobility in India.. Recognize the components of the Indian auto sector, including car manufacture and sales.

3. To estimate emission and energy impact of electrification of two-wheelers in India Under this section, the study will estimate the potential emission, energy, and cost impact of different scales electric vehicle adoption developed as scenarios. Using bottom-up approach, this section projects the growth in two-wheelers by 2025 and 2030 across different segments. Based on alternative growth projections, the emissions and energy savings are estimated.

4. To understand perspective of consumers in electrification of two-wheelers Under this component, the study will investigate current consumer preference, focusing specifically on the two-wheelers segment. The aim will be to gain insight on their product, technology, infrastructure, financial, and policy preference. Based on the literature and secondary data, consumer's willingness to pay will also be estimated.

5. To assess business feasibility and overall expected charging infrastructure requirement This section will focus on understanding the ecosystem required for faster adoption of electric vehicles. The section will estimate the charging requirements for the predicted increase in electric two-wheelers in India. By developing scenarios based on capital costs, operational costs, battery prices, etc. this section will also assess the business feasibility of a PCS and the overall costs per electric two-wheeler for the charging ecosystem.

6. To understand industry's perspective in electrification of two-wheelers This section will focus on understanding the perspective of the automobile Industry and its ancillary industries regarding the paradigm shift into electric. The objective of this section is to understand the change in the supply and value chain of automobiles in India on phased adoption into electric. The section aims to briefly scope the effect on employment and domestic value added from the EV transition.

Sector Overview: Automobiles

India's automotive market, which was estimated to be worth \$100 billion in 2021, is anticipated to grow to USD 160 billion in 2027, showing a CAGR of 8.1% over the projected period (2022-2027). Due to its low-cost manufacturing, India is a renowned global centre for the production of automobiles. The variables influencing the manufacturing industry include inexpensive labour, easy access to the low cost of raw materials, and a depreciating currency. With an average yearly output of about 4 million

automobiles, India is the fourth-largest automobile producer in the world. The country sold 4.5 million automobiles in total in 2019, while in 2020, fewer than 3% fewer vehicles were sold. Yet, in 2021, more automobiles were produced than in 2020—about 30% more. The development of cars powered by internal combustion engines (ICE) has been the primary driver of India's automobile industry. The desire for personal mobility has been driven up, especially in large metropolitan centres, by the expanding middle class and their rising ambitions as well as the accessibility of more affordable financing. The desire of the rural population to possess a car is increasing as a result of different reforms and the success of farms, which is boosting demand in rural regions.

Emerging economies have come into sharper focus thanks to the phenomenon of frugal and reverse innovation. Disruptive innovation (DI), though, is rarely seen in this situation. This paper uses an important case study to describe the development of DI in the Indian automobile industry. By examining how dynamic capabilities (DCs) at the firm level actuate DI manifestation, our study reinterprets the phenomena in the context of developing economies and provides a series of takeaways that are focused on the DCs' features necessary for such manifestation. Additionally, we identify any other constructs that could be important in accelerating DI in emerging economies. Although not predicted, we do find that larger firms actively actuate disruption in emerging economies, and a turbulent or VUCA environment makes it possible to identify disruptive technologies.

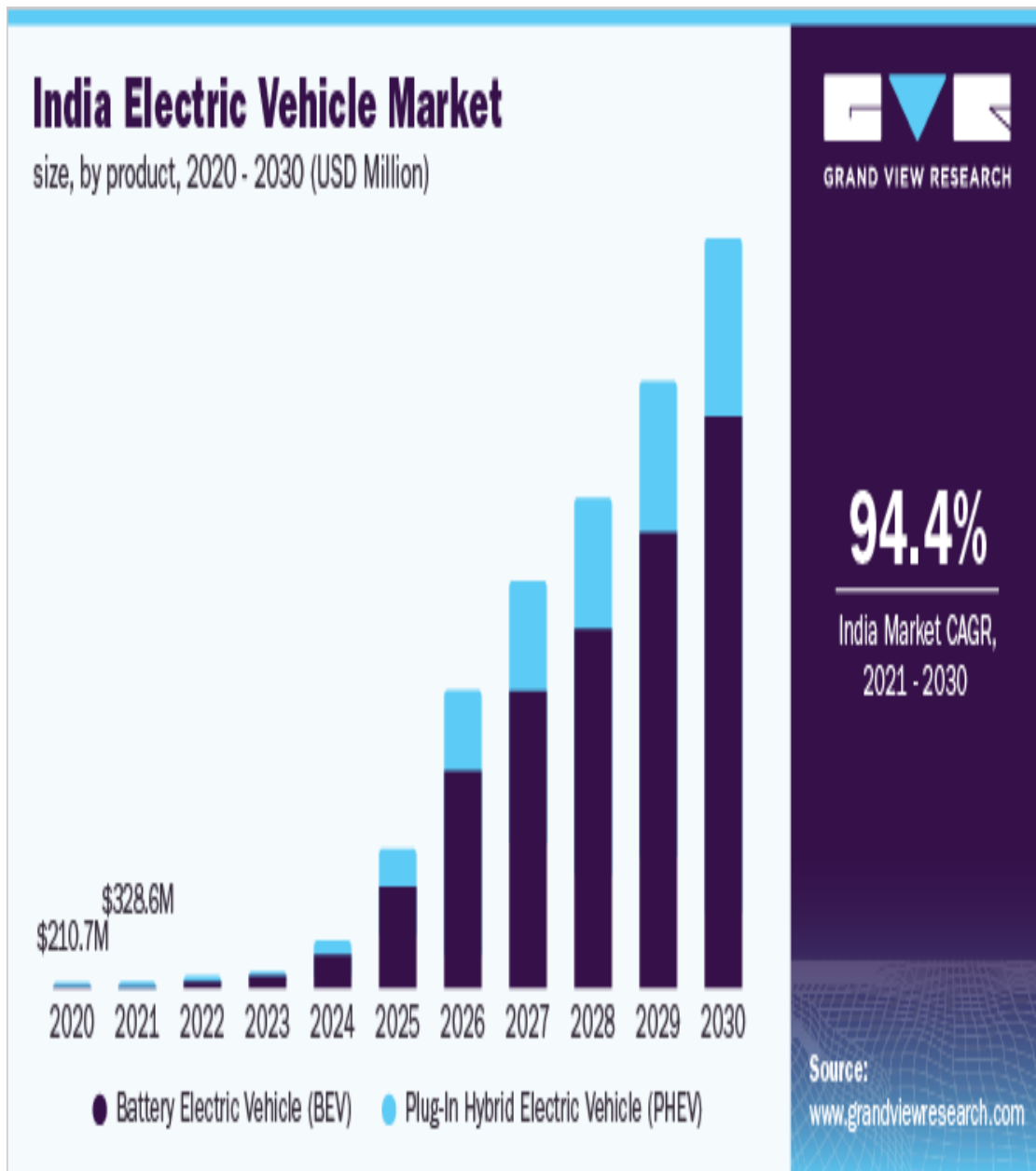
Review of literature:

Several automakers are currently working on vehicle and battery technologies in response to the rising demand for cleaner vehicles in order to maintain their competitiveness in new countries. Recently, there has been an increased interest in considering hybrid electric cars as a transition technology to close the technological gap, particularly in developing nation markets (UNEP, 2009). Contemporary electric cars have seen tremendous advancements, and in the case of E4Ws, nearly every major international automaker has recently introduced a completely electric or hybrid model.

By the middle of 2010, EV success has increased significantly. Every year, EV sales surpass past records, particularly for buses, light-duty vehicles (LDVs), and smaller vehicles including three-wheelers, mopeds, kick scooters, and e-bikes (IEA 2017, 2018a, 2019, 2020). Global automakers are now making additional investments. 50 light-duty EV models are offered for sale on the U.S. market, and more than \$140 billion has been invested in the electrification of transportation (Moore and Bullard 2020). According to AFDC 2020, Moore and Bullard 2020, there should be 130 EV cars available by 2023. The role that EVs will play in LDV markets in the future is predicted to be quite variable, ranging from modest success (10% of sales in 2050) to complete market dominance, with EVs accounting for 100% of LDV sales long before 2050. According to several research, EVs will become economical. India's EV sales increase by more than 2000% between 2019 and 2022. Sales of EVs have surged over the last three years by more than 2,218 percent; as of December 9, FY 2023, over 4,42,901 electric cars have been sold, up from 19,100 in FY 2020. Also, as of December 9, about 64 original equipment manufacturers (OEMs) of EVs had registered, and as part of FAME India Phase II, 7,47,000 EVs had been sold. Over 8,00,000 of these EVs have two wheels and are utilised for personal mobility, with more than half of them being three-wheelers for commercial usage. There are now 5,151 EV charging stations operational in India. The world's largest electric scooter plant will be built in Hosur (about two and a half hours from Bengaluru) over the course of the next 12 weeks at a cost of US\$330

million, with a target production rate of 2 million units per year, Ola Electric, the subsidiary of the unicorn Indian ride-hailing start-up, also announced in March 2021. By 2022, Ola Electric hopes to increase manufacturing to produce 10 million vehicles yearly, or 15% of all e-scooters in use today. Karnataka was the first state in India to implement a complete EV legislation, and it has since become a hub for R&D and production of EVs and their ancillaries. The supply chain, bigger land parcel, closeness to ports, and aggressive investment help provided by government websites like Guidance Tamil Nadu are all contributing to Tamil Nadu's outstanding rate of growth.

The EV itself is still unquestionably at the centre of e-mobility. In the past, cities like Delhi and Kolkata have paved the way for widespread e-mobility. To reduce operational and financial expenses, several cities encouraged the usage of e-rickshaws. According to reports, there are over a lakh e-rickshaws on the streets of Delhi, and Kolkata is following suit. Further promoting an increase in EV sales for personal usage, this development



Framework in Consumer Perception and Adoption of EV:

Consumer awareness and perception are key factors in determining whether an invention is adopted. The review of the literature demonstrates that the perception and uptake of electric vehicles around the world are being researched by concentrating on lowering CO emission (Pro Environmental lifestyle), technology (Speed, distance, efficiency), cost (EV and Fuel), infrastructure (Charging Points), and social acceptance. By contrasting the functionality, features, acceptability, and dependability of conventional automobiles with impending electric vehicles, the current exploratory research sought to understand how electric vehicles are perceived and used in India. The most pertinent subject for contemporary India is the growth of technology, which would benefit from this. Multiple review literature study shows that majority of the studies focused on intention of EV adoption by consumers compared to actual purchase studies. Consumer mind set on adoption of innovation play a critical role (Jansson et al , 2011) . Various types of metrics like readiness, willingness to buy and willingness to pay are considered as a variable in adoption behaviour(Arts et al, 2011). Summarising multiple research studies , it has found researches has used nine categories of theoretical frameworks (Barbarissa et al , 2015) in significant consumer adoption researches.

Current Research Gap in Electric Vehicle Adoption:

To explore consumer adoption of electric vehicles, a number of theoretical frameworks have been employed. According to some study, consumer adoption consists of deliberate, emotional, and symbolic behaviour (Moons & De Pelsmacker, 2012). Giridhar et al. (2015) said that there is a study gap in the research on the choice of electric automobile representative groups. As no respondents from the industry have been included, Jansson J. (2017) claims that there is a gap in the study on the adoption of electric cars.

Importance of the Study:

Because of the economic perspective, the analysis of the study is important. The advantages of electric cars are numerous because they play a crucial role in preserving the environment by lowering the carbon emissions caused by burning fossil fuels and by promoting a healthy price for fossil fuels because they require electric charging to operate. In order to compare the costs of electric vehicles with traditional transportation systems, the article seeks to examine the major driving factors. For an Indian viewpoint on a study of the economic significance of electric cars. India's EV sales witness over 2000% surge from 2019 to 2022. Governments throughout the globe are supporting the EV sector with subsidies and regulations, and customers are seeking low-emission commuting over the fossil fuel-powered cars that are destroying the environment. The industry did not take off when the first EVs were produced or presented because of their extremely high starting cost, short battery life, poor speed, and few environmental concerns. Nevertheless, during the past ten years, there has been a widespread interest in EV production and battery technology among original equipment manufacturers (OEMs), consumers, and governments. As a consequence, significant investments have been made, and millions of EVs have been sold in several nations. Governments all across the world are supporting the EV sector with subsidies and laws, and commuters are requesting low-emission vehicles rather than those powered by fossil fuels.



EV Projects in India

EVs are now a possible way to lessen climate change's consequences and global carbon emissions. It has been shown to be essential for achieving sustainable transportation goals, making it more logical to deploy EVs in developing countries to support the same. The next part concentrates on the ongoing pilot projects, business models, and other programmes offered in several emerging economies that have lately taken a favourable stance towards the deployment of EVs. The same obstacles described in the previous section apply to all nations, but they differ in their degrees of severity. There are anywhere between 65,000 and 80,000 auto-rickshaws (rickshaws that operate on CNG and diesel) on the market, which can accommodate 229 million journeys yearly.

Opportunities created by electric vehicle & Trend of EV in Indian Economy till 2025 (GIZ & NITI Aayog., 2021; Bhattacharya, K et al., 2020;)- Transportation companies like Ashok Leyland Mahindra and Mahindra Omega Seiki.

- mobility, and Tata motors announced an investment of around \$6.5 billion in the market related to electric vehicle battery manufacturing and its components. The sector also promotes several startup companies like hero electric magenta and ola
- electric which also invest in the Indian economy around \$446 million in manufacturing, battery, supply equipment, and so on. The penetration of two-wheeler electric vehicles is assumed to reach 15% by 2025.
- Although, the penetration of four-wheelers was also accelerated gently with 5% till 2025,

- which was about 0.12% in the present scenario. The market demonstrates electric vehicle components' opportunity with promises to
- introduce \$2 billion by 2025. Indian Energy Storage Alliance assumed that the EV battery market would boost by more
- than 32% in the upcoming financial years (2020-2027) at a CAGR of 32%

A Road map for India:

The success of EVs in public transportation and the two- and three-wheeler sectors will determine the best strategy for India to eventually expand the EV market to private automobile owners.

By lowering carbon emissions, this technique will win over more consumers and help achieve sustainable transportation goals. Establishing thriving business models for electric rickshaws, buses, and two-wheelers is difficult for the following reasons:

1. Government Regulation Challenges:

- (a) In order to spur demand for all electric vehicles, the Indian government established the National Electric Mobility Mission Plan in 2013. But, the government hasn't developed a specific programme or business model for the prospective two- and three-wheeler industry alone.
- (b) Additional policy measures must be used to boost incentives and capacity for battery technology research and development.
- (c) There is no intervention in the policy of sustainable transportation to incorporate electric buses to gradually phase out diesel buses.
- (d) Increasing the use of EVs through the promotion of public-private partnerships through vehicle sharing programs³⁶.
- (e) To determine whether public transportation pilot initiatives in various cities are feasible for the Indian market, they should be promoted. This would enable data sharing for the installation of charging stations.

2. Technology and Infrastructure Challenges:

- a) In order to encourage private investment in this industry, there has to be a comprehensive layout and price plans for public charging stations operated by public-private partnerships.
- (a) To promote flexibility and accessibility, all EV market participants must adopt a single standard for the charging and battery infrastructure.
- (c) Parking spaces designated only for EVs will help with range anxiety problems.

Challenges faced by EV industry

Inadequate infrastructure for charging: In India, there were just 650 stations in 2019 compared to nearly 0.3 million in China. One of the main reasons customers frequently choose not to purchase EVs is a lack of adequate charging infrastructure.

High prices: The present high cost of EVs is a big issue among potential buyers, along with range anxiety (km/charge). In the same market category, electric automobiles are often more expensive than lower-end (ICE) ICE vehicles. This is mostly due to the increased expense of the technology used in EVs, which accounts for a sizeable amount of the cost and leaves little room for other amenities often seen in high-end vehicles.

Customers have a relatively little selection of items to pick from because the business is still in its early stages in India. Increasing investment will eventually increase the sector's competitiveness, which will assist fuel further demand.

Reduced mileage: There is a tonne of room for R&D because the business is still relatively new. Internal combustion engine (ICE) cars are now more cost-effective than electric vehicles (EVs) in India, making EVs less affordable for the typical consumer.

increased dependence on imports Another element driving up the price of EVs in India is the country's reliance on imported .

Grid issues: If EVs gain popularity, there will be concerns about the cost of charging at private charging stations. Even with a reasonable penetration of EVs, Brookings India's forecasts for 2030 indicate that the increase in electricity consumption is anticipated to be around 100 TWh (tera watt-hours), or roughly 4% of the total power generating capacity. Hence, expanding power generation technologies are required to keep up with the increase in demand. batteries and other parts.

Here are some of the benefits of owning Electric cars:-

- **Reduced Maintenance Cost** - Compared to internal combustion cars, electric vehicles require less maintenance than do petrol or diesel vehicles since they have fewer moving components.
- **Reduced operating costs:** EVs are more economical since they charge their batteries with electricity rather than fossil fuels like gasoline or diesel.
- In addition to making EVs more environmentally friendly, charging with the aid of renewable energy sources installed at home, such solar panels, might further cut expenses.
- **Zero Tailpipe Emission** - Using EVs helps minimise carbon footprint because there are no emissions from the tailpipe. By utilising renewable energy sources to power one's house, one may further lessen the environmental effect of charging automobiles.
- **Benefits from taxes and money** - Buying an electric car costs less to register and pay road tax than buying a gasoline or diesel vehicle.
- There is no noise pollution since electric cars don't have gears and are simple to operate; all you need to do is accelerate, brake, and steer. Due to their reduced noise emissions, electric cars help to lessen the noise pollution caused by conventional automobiles.

- Convenience of home charging - Those who own EVs do not need to spend hours at gas stations during busy times. Fast chargers and even battery changing services are widely accessible alternatives to standing in long lines.

Suggestions:

People are still not at peace with EV technology, despite the shift towards EVs and the simplicity of taxes. In time, this will pass as the globe transitions to EV highway alliances. Also, distribution firms are collaborating with tech partners to offer charging stations and a charge-per-unit model. State transportation agencies are introducing electric vehicles (EVs) into mass transit of people at areas like train stations, airports, and significant public buildings. These locations are considerably more organised, and it is simple to construct charging stations using their infrastructure, which can be easily converted from parking lot to EV charging station. While the cost of the battery is still one-third of the cost of the car, an increase in the number of charging stations will also enable low-capacity battery cars to charge at a shorter distance. Because recycling Li-ion batteries still costs more than mining for lithium, there are assumptions made that there will be a scarcity of batteries as their numbers rise.

India's electrical infrastructure frequently lacks proper earthing protection. Vehicles cannot be charged at 230 VAC level charging outlets in residences, parking lots, and restaurants because improper earthing might create charging mistakes that violate safety regulations. To operate EVs over the varied market, emphasis on solid earthing system infrastructure is still required.

Conclusion

In view of the rising levels of greenhouse gases in the atmosphere, the development that the electric car sector has witnessed in recent years is not only warmly welcomed but also desperately needed. The advantages of electric cars considerably outweigh the expenses, as shown in the economic, social, and environmental analyses parts of this webpage. Cost is the main barrier to the wide-scale adoption of electric-powered transportation, as gasoline and the cars that use it are more easily available, practical, and less expensive. As shown in our timeline, we anticipate that over the course of the following ten years, governmental modifications and technology developments will facilitate the transition away from conventional fuel-powered cars. Since the introduction of the first electric vehicle in 1837 to the present, there have been significant advancements in technology as well as in people's perceptions of the effects of automobiles on the environment and other mobility options. For businesses and start-ups in India, the electric vehicle industry is now a profitable target, but there are still a number of issues that must be resolved before EVs can be widely adopted. Manufacturing electric vehicles locally is one example of a high-cost barrier. The production of batteries is fundamentally an expensive endeavour. To address these issues, the Indian government must concentrate its efforts on fostering technological disruption. Due to the worrisome amount of pollution and the fact that renewable energy sources and transmission are the only option, e-mobility in India in the future won't be a luxury but rather a need for existence. In light of the fact that EVs are ultimately unavoidable, it is preferable to plan and coordinate how the advances will take place as opposed to trying to avoid the transition. Certainly, the time has come for an integrated policy on future transportation with an emphasis on zero-emission mobility. But, such a programme should also take into account the industry's financial stability, tax income, and job possibilities for millions of people.

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