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Original Research Article

Future of electric vehicles in India: Prospects and challenges

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ABSTRACT

The transport system of any country is like the arteries of the human body, in the absence of which the development journey of any country cannot be completed. Increasing transportation resources on one hand facilitate development; on the other hand, increasing vehicles on the road are also giving rise to many problems like environmental pollution, over-dependence on fossil fuels in the world. Increasing environmental pollution and rising cost of fossil fuels are a matter of great concern, in such a situation; electric vehicles are being seen as a better alternative to green energy. In this paper, the future of electric vehicles in India along with prospects and challenges is reported.

1. Introduction

An automobile with at least one electric engine is referred to as an electric vehicle. It typically runs on power from extravehicular sources and is controlled by a gatherer framework, although it is also capable of running on its own battery (sometimes charged by solar chargers, or by switching fuel totally to a power-using energy unit or a generator) [1]. Electric vehicles (EVs) include, but are not limited to, surface and submerged watercraft, electric aircraft, and electric shuttles. EVs first debuted in the middle of the 19th century, when power was one of the preferred methods for engine vehicle propulsion. They provided a level of comfort and activity simplicity that the fuel vehicles of the period couldn't match. For around a century, internal combustion engines predominated as the primary form of propulsion for cars and trucks. However, given other factors being equal, electric propulsion continued to be the norm for other vehicle types, such as trains and smaller cars. Due to mechanical developments, the increased focus on sustainable power, and the anticipated reduction of the impact of transportation on environmental change, air pollution, and other natural challenges, EVs have experienced a renaissance in the twenty-first century [2].

Government incentives to construct reception were first made public in the latter part of the 2000s, particularly in the United States and the European Union, which sparked the growth of the car industry in the 2010s [3]. Expanding public awareness and preference as well as underlying drivers, such as those incorporated into the green recovery from the COVID-19 epidemic, are expected to significantly boost the market for electric vehicles. Lockdowns have reduced the amount of ozone-harming emissions from gas or diesel automobiles during the COVID-19 outbreak [4]. The International Energy Agency stated in 2021 that states should take other actions to satisfy environmental goals, including preparations for large electric vehicle technologies. By 2030, sales of electric

vehicles may increase from 2% of the global market in 2016 to 30%. The writing study suggested that while the use of electric four-wheeled cars appears financially far-fetched in developing nations, the use of electric bikes is reasonable. Much of this development is normal in business sectors like North America, Europe, and China. More two and three wheel EVs are available than any other kind. EVs can be divided into three major groups [5]:

1. Battery Electric Vehicles (BEVs) – These are powered by the energy stored in the battery.
2. Plug-in Hybrid Electric Vehicle (PHEV) – This uses both a battery charged from an external socket and energy from internal combustion such as gasoline.
3. Hybrid Electric Vehicle (HEV) – In this, electrons are separated from hydrogen to obtain energy.

2. Current scenario of EVs in India

Figure 1 represents the worldwide electric vehicle deals and market share from 2013 to 2018. It shows a continuous growth of electric car sales on the global level. Figure 2, depicts the sale of EVs in India from 2017 to 2020 [6]. This Figure clearly illustrates that the sale of EVs increased by 50% in 2017-18; increased by 23% in 2018-19 and then decreased by 26% in 2019-20. This decrease in sale of EVs may be attributed to COVID-19 pandemic. In the same Figure, the region-wise sale of EVs from January 2020 to December 2020 in India is also represented. Out of 1,19,584 units of EVs sold, 26% EVs were sold only in Uttar Pradesh. In Figure 3, the expected sell of EVs from FY 2021 to FY 2030 is plotted. It is expected that total sell of EVs, which is less than 2 million in FY 2021 may grow to 26 million in FY 2030.

Currently, less than 3% of all automobiles sold in India are electric vehicles. This is despite December 2021 seeing EV enrollments surpass 50,000 units without precedent and the biggest monthly sales ever. 80% of electric cars sold are low



cost, low speed three wheelers, however the growth of next generation two wheeler companies has largely accelerated their sales. Only 7,96,000 electric vehicles (EVs) have been registered in India as of December 2021, and only 1,800 public EV charging stations have been installed. While EV sales

increased by 133% from FY15 to FY20, they are generally considered to be negligible when compared to the sales of normal EVs. Only 1.32% of all automobiles sold in the country for the fiscal year 2021–2022 were electric vehicles.

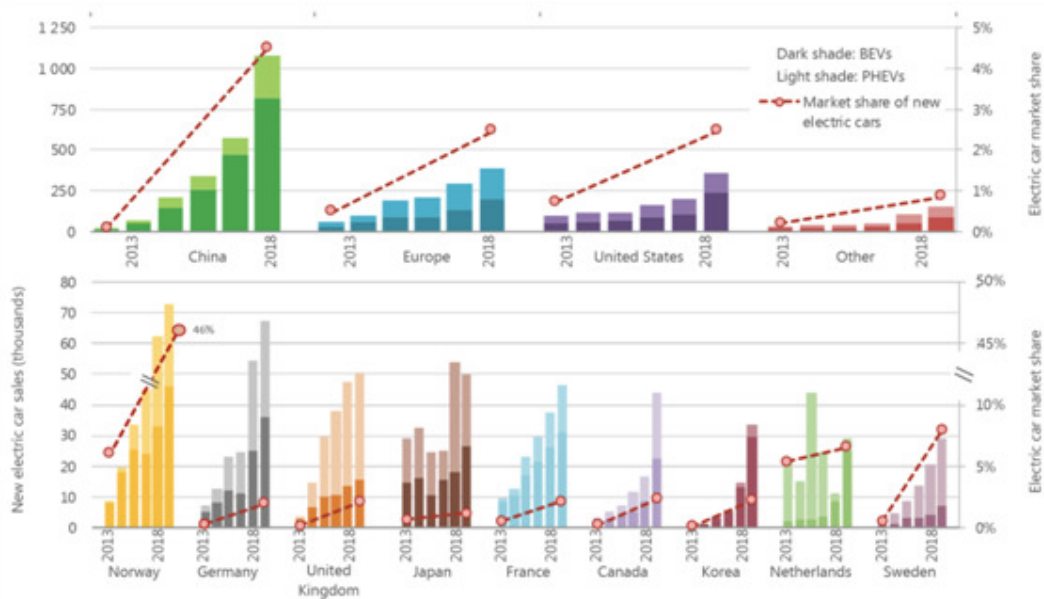


Figure 1: Worldwide sale of electric cars and market share (2013 to 2018).

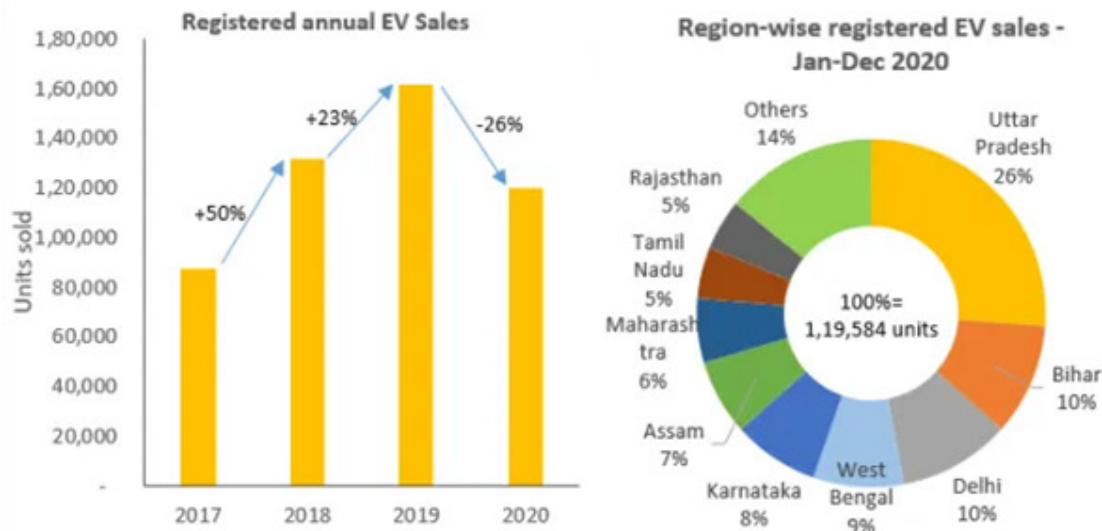


Figure 2. Sale of EVs in India from 2017 to 2020

3. Need and future of EVs in India

The report of NITI Aayog and Rocky Mountain Institute (RMI) published in January 2022 looks at the immense potential in the electric vehicle finance market in India. The electric vehicle finance industry in India has the potential to reach 3.7 lakh crores by 2030. It can be said that the interference of electronic vehicles in the country’s transport system can increase significantly. India is the 4th biggest market of vehicles globally, but this market is currently based on fossil fuels. If India is successful in converting it into the EVs market, then it will be the beginning of a golden future for

the EVs market [7]. According to IQAir’s 2020 report, a total of six cities were included in the ten most air-polluted cities of the world, the problem of pollution has become common in big cities as well as small cities, surely electric vehicles can be a better solution to this problem. India has bought fossil fuels in large quantities from other countries, about 85% of the total consumption of oil we import from other countries, for this a huge amount has to be paid in the form of foreign exchange. The use of electric vehicles can also reduce dependence on fossil fuels.

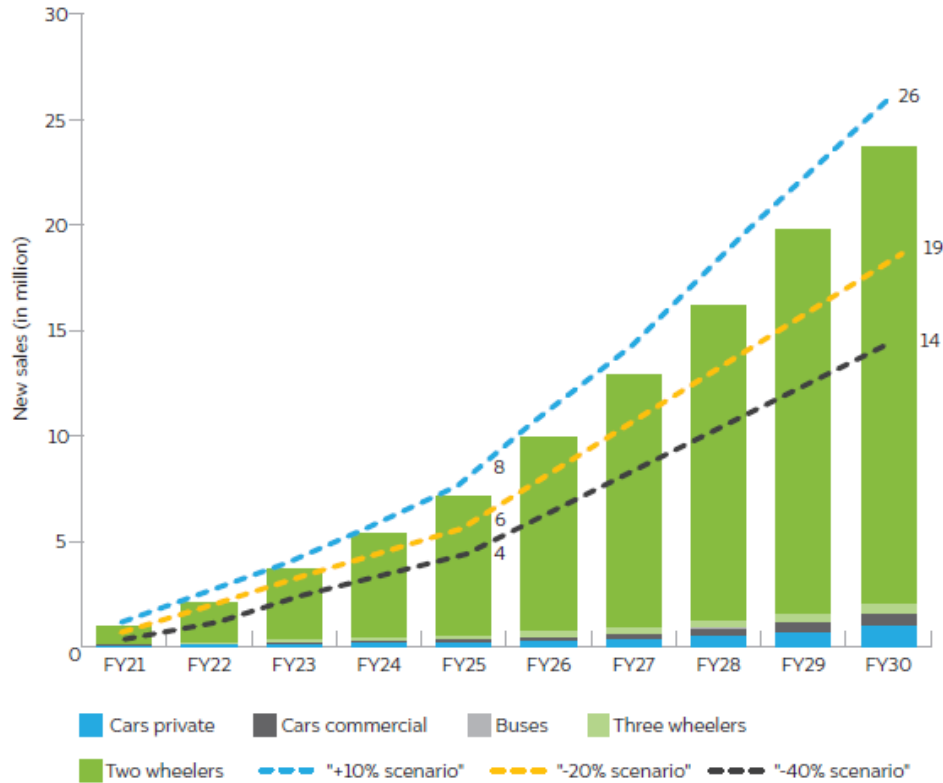


Figure 3. Expected sell of (category wise) EVs from FY 2021 to FY 2030

4. Recent measures on EV manufacturing in India

FAME and PLI Schemes: Through several strategy plans like FAME-II (Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles Scheme-II), the Indian government is pushing for a more significant restriction on the production of EVs. By 2030, FAME-II wants to increase the proportion of electric vehicles in the public vehicle sector to 30%. In order to promote local supply chains for essential EV parts, it has also put out a number of Production Linked Incentive (PLI) programmes to manufacturers in the automotive, auto component, and advanced chemical cell (ACC) battery sectors. The Indian government aims to reach 400 million electric vehicles by 2030 under the National Electric Mobility Plan (NEMMP) 2020.

Consumer-centric incentives: The government has also provided a few customer-driven incentives to encourage purchases, such as tax exemptions, endowments, and financial help programmes, in an effort to inspire widespread demand for EV mobility solutions.

Battery manufacturing at gigafactory: The government recently stated that it would accept bids from ten companies to use the PLI system for producing ACC batteries domestically. At "gigafactories," which represent end-to-end battery manufacturing and mass production, these next-generation batteries would be produced.

Guidelines for charging infrastructure: To incorporate an income sharing model for use of public lands, the government has also reviewed its guidelines for charging structure. The government reaffirmed these claims in the Union Budget by committing to develop a battery trade plan, interoperability standards, and clear portability zones.

In order to promote the charging point, it has been included in the service category, after its inclusion, no license

will be required to set up a charging station. The state and central governments keep announcing economic incentives to promote electric vehicles in the budget. The GST rate on electric vehicles has also been reduced in the last few years. Many state governments also provide subsidy on the purchase of electric vehicles and rebate on road tax. In India, companies like Amazon, Swiggy, Zomato are gradually increasing the use of electric vehicles for delivery.

5. Challenges in EVs manufacturing

Supply chain disruption: The most recent two years of store network disturbances because of the COVID-19 pandemic and the US-China trade war have paved the way for fundamental changes in global manufacturing strategies. This scenario especially emerged for high-tech industries which are still facing various logistical problems including shortage of basic parts such as batteries and silicon chips [8]. India's major automobile companies also had to stop production due to lack of chips (such as the chips that powered the new multimedia features in vehicles).

Expensive materials: Basic parts have become prohibitively expensive as a result of supply chain interruptions and the race to shorten the supply chain. In an effort to produce lithium-ion batteries, which are typically imported from China, South Korea, and Taiwan, Indian manufacturers are also attempting to produce EVs. A substantial input, the cost of battery-grade lithium carbonate increased by 400% in November 2021 compared to the prior year [9].

Import dependency for raw materials: Lithium-ion battery cells are made from raw elements including nickel, cobalt, and lithium, none of which are available in India. As a result, battery cells must be imported heavily by Indian manufacturers from China, Japan, Korea, and Taiwan. Although investors

have responded positively to India's plan to manufacture ACC batteries locally under the PLI scheme, most of the bids are expected to start production by 2025. Therefore, India's import-driven process for domestic battery pack production will continue for a few more years.

Battery manufacturing: India's total battery demand is predicted to reach between 900 and 1100 GWh between the years 2020 to 2030. In any case, the lack of a battery assembly facility in India is concerning because the country must rely only on imports to meet the expanding demand. According to government data, India imported lithium-ion cells worth more than \$1 billion in 2021, despite the low penetration of electric vehicles and battery storage in the power sector [10].

Consumer issues: In contrast to its neighbouring partner countries, which had more than 5 million charging stations operational, India had only 650 charging stations available in 2018. Customers cannot rationally travel long distances in the absence of recharge outlets. Additionally, using a personal light-duty slow charger at home, it can take up to 12 hours to fully charge a car [11]. Furthermore, the expense of an important electric car is a lot higher than the average expense of an ordinary fuel-powered vehicle.

Lack of technology and skilled labor: While this business is the backbone of the EV industry, India lags behind other developed nations in terms of producing electronics like batteries, semiconductors, and controllers. EVs need a high level of skill and have substantial maintenance expenses. India needs specific training programmes for acquiring these skills.

6. Future prospective of EVs

EVs as a future measure: EVs will contribute to improving overall energy security conditions since the country imports over 80% of its essential, \$100 billion-worth, unrefined petroleum needs. It is anticipated that the development of EVs will also play a big role in the creation of jobs in the adjacent EV manufacturing industry. Additionally, by utilising various

grid-support services, electric vehicles can help to strengthen the system and mandate a high penetration of ecologically beneficial renewable energy sources while ensuring safe and reliable grid operations.

Battery manufacturing and storage opportunities: Battery storage with the most recent technological advancements can aid in encouraging sustainable development in the nation given government ambitions to improve e-mobility and renewable energy (450 GW energy capacity target by 2030). The demand for consumer electronics, such as mobile phones, UPS, laptops, and power banks, which require advanced chemical batteries, is expanding quickly as per capita income levels rise (ACC). As a result, one of the biggest business prospects of the twenty-first century is the production of improved batteries.

EV charging infrastructure: Homes, utility services like CNG and petroleum pumps, and parking facilities of business foundations like shopping centres, train stations, and bus stops can all be equipped with EV charging foundations (which will draw power from the local power supply). The goal established by the power ministry is to install one charging station on each 3X3 framework and every 25 kilometres on either side of the roadways. In accordance with the 2016 Model Building By-Laws, the Ministry of Housing and Urban Affairs has mandated that 20% of parking spaces be reserved for EV charging offices in private and commercial structures (MBBL). To make MBBL effective, state governments will also need to make the appropriate changes to their individual building byelaws.

Increasing R&D in EVs: The Indian market need drivers for indigenous advancements that are both necessary and profitable for India. Utilizing nearby institutions and established industrial hubs makes sense given the importance of local inventive work in reducing costs. UK to India These nations ought to cooperate and coordinate the advancement of electric automobiles. Figure 4 suggests that as EV technology advances, CO₂ emissions will decrease.

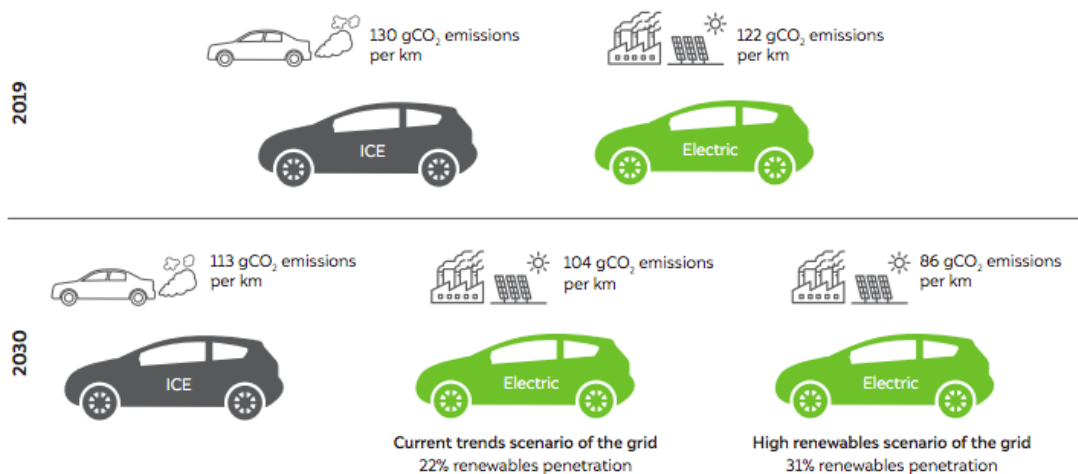


Figure 4. Illustration of CO₂ emissions per kilometer

7. Advantages and disadvantages of EVs

The use of electric vehicles does not emit harmful gases, due to which it does not harm the environment either. Electric vehicles generate much less noise as compared to vehicles running on conventional fuel, due to which these vehicles also keep the environment free from noise pollution. Although

electric vehicles also require electricity to charge, their cost is 25 to 30% less compared to the cost of petrol or diesel, which makes it economically viable [12]. To fill petrol or diesel, we have to go far away from home to the petrol pump, but electric vehicle can be charged at home too.

Just as the availability of petrol or diesel is easily available from big cities to towns, there is still a lack of charging stations in the country, due to which it is difficult to travel by electric vehicles in long distance travel. Charging an electric vehicle takes a long time, which complicates its use. Electric vehicles cost much more than vehicles that run on fossil fuels. Lithium is used in electric vehicle batteries, there is a shortage of lithium in India, due to which India is dependent on these countries for lithium. In the spare parts of conventional vehicles, our dependence on other countries is from 15% to 20%, but in electric vehicles this dependence increases to more than 80%, due to which we have to buy most of the parts from other countries. In India only assemble is done.

8. Conclusions

With the rise in electric vehicles, India will have to provide training to vehicle mechanics as required by the Fourth Industrial Revolution. They will also have to possess advanced electric equipment with the necessary training to repair electric vehicles. At present, the future of electric vehicles looks very bright as it can help reduce our dependence on mineral oil, which can help in tackling the challenge of climate change along with reducing global pollution in a big way. . Their energy storage capacity has been the biggest challenge in the context of electric cars.

This was one of the main reasons why diesel/petrol cars gained prominence in the last century. Electric vehicles may be the future of the transport sector, but for this, availability of affordable and next-generation battery technology will be essential. In India, with a population of around 1.3 billion, shifting from conventional transport to electric vehicles is not an easy task. In such a situation, it will be necessary to establish a fair framework for comparing state policies and a platform to encourage public-private cooperation with a strong approach to promote electric vehicles in the country.

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