



RESEARCH ARTICLE

Scope of electric vehicles and the automobile industry in Indian perspective

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Abstract

The fast changes in the market price of crude oil are a direct outcome of the fundamental concept of economics known as the “Law of Demand,” which states that as globalization progresses, the demand for oil-based energy rises. Because of the wild swings in crude oil prices and demand, governments and policymakers are being pushed to explore new options, such as the use of environmentally friendly technology. The future of business and the marketplace seems to be green alternatives. Large corporations are increasingly allocating resources to research and development (R&D) to keep up with the competition, with a lot of attention being paid to green technology. With the objective of becoming a major manufacturer of electric vehicles (EVs) for the Indian and worldwide markets, India, a rising country, is ready to dive headfirst into this new creative sector. This article’s goal is to investigate the forecasted interest in EVs, the EV market share, and the EVs’ and related technologies’ contribution to international commerce.

Keywords: Electric vehicle, Developing country, India retrofitting, Conventional vehicles.

Introduction

In India, electric cars, often known as EVs, play a significant part in mitigating the effects of environmental issues such as air pollution and greenhouse gas emissions. India is home to five of the world’s 10 most polluted cities, five of which are located in India. New Delhi, implemented an odd-even selection scheme in the winter of 2020, based on the license plate numbers of vehicles, with the goal of reducing the amount of individual driving that occurred in the city. This was done specifically to reduce the amount of air pollution that was caused by the presence of smog. When it comes to the release of greenhouse gases into the atmosphere, the transportation sector is responsible for a large portion of the problem. The transportation sector is responsible for about 15% of the world’s total greenhouse gas emissions

and for more than 20% of the CO₂ emissions that are caused by energy EVs have recently arisen as a feasible answer to clean and sustainable mobility, with the goal of boosting the economy of the city, lowering the levels of pollution, and creating job opportunities in the transportation industry. The growth in worldwide sales of electric vehicles from 2018 to 19 was led by Europe (Germany, France, the United Kingdom, and Spain), which accounted for 93% of the total increase, followed by China (17%) and the rest of the world (22%). When 2020 rolls around, there will be almost three million more electric cars on the road than there were in 2019. China continues to have the largest number of electric vehicles on the road, with over five million. This is followed by the United States, which has 1.77 million. Despite the difficulties of the next fiscal year 2020, the electric vehicle sector in India reported a domestic sales total of 156,000 units, which is a 20% increase over 2019. In contrast, the internal combustion (IC) engine-powered vehicle category had a drop of around 34% when compared to the same time in the previous year. This extraordinary increase presents substantial hurdles for the coalition of developers working on charging infrastructure, which will have a considerable influence on power distribution networks.

The road network in India is the third biggest in the whole globe. The vast majority of Indians delight in travelling throughout the country by automobile. Research found that 60% of persons either owned a vehicle or used a car that was shared with other people. The use of fossil fuels like

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How to cite this article: Singh, R.R., Gupta, N., Yadav, G.R. (2023). Scope of electric vehicles and the automobile industry in Indian perspective. *The Scientific Temper*, 14(3):563-569.

Doi: 10.58414/SCIENTIFICTEMPER.2023.14.3.01

Source of support: Nil

Conflict of interest: None.

gasoline and diesel is the primary cause of climate change as well as air pollution. Diesel automobiles are the direct cause of 66% of all of the fatalities that may be attributed to air pollution in India. According to the findings of this study, diesel emissions in particular, pose a considerable risk to the general population's health in India, a country in which the vast majority of people use this fuel. According to the findings of research carried out by an environmental expert, the government of India has implemented a number of policies that aim to promote the manufacturing of electric vehicles and their broad use. EVs are gaining popularity as a result of this, which is causing them to become more widespread in India. The government of India has announced its intention to entirely ban gasoline-powered automobiles by the year 2030. It has been proposed that beginning on March 31, 2023, the sale of all three-wheeled vehicles and all two-wheeled vehicles in the country shall be required to be electric vehicles. The faster adoption and manufacturing of (hybrid &) electric vehicles (FAME) India project is included in the National Electric Mobility Mission Plan. The primary objective of FAME is to encourage the widespread use of electric vehicles by customers of its products via the provision of financial incentives. One way that FAME schemes intends to encourage the wider adoption of electric vehicles and plug-in hybrid electric vehicles is by providing up-front incentives for the purchase of electric vehicles. It is vital to have a charging infrastructure for electric vehicles. To battle the unsafety of the air and the fuel. This is the case in (FAME policy). In India (FAME India) is an initiative that has been introduced by the government as part of the National Electric Mobility Mission Plan (NEMMP) 2020. This initiative aims to encourage the production of electric and hybrid vehicle technologies. The major objective of the National Energy Management and Planning programme is to guarantee the dependability of the country's overall energy supply. Reduction of the environmental damage caused by autos. Capacity for the production of automobiles inside the United States was increased (NEMMP policy).

Review of Literature

Mohamed, M. (2018) found in their study that customers would financially benefit from the transition to electric motors, which would also significantly reduce pollution caused by internal combustion engines (ICEs). This technique has been embraced by a number of countries, which is helping to green the world. The study's author was aware of the country's opportunities and challenges regarding the introduction of EVs. Opportunities such as those offered by government initiatives, advancements in battery technology, certain businesses, and efforts to safeguard the environment are now being investigated. It was taken into account that EVs have a relatively low fuel economy in India, a large demand for EVs, and the prices of EVs are quite expensive. Electric vehicles are becoming more widely available in India with

the primary objectives of cutting greenhouse gas emissions and lowering the country's reliance on imported oil. The government needs to make the most of the opportunities it has and come up with reasonable solutions to the problems it is up against.

Pritam, K., & Gujarathi, V. A. (2018) presented in-depth look at the expanding market for these vehicles in India, where the market share for electric vehicles and plug-in hybrids is now at 0.1%, making it a one-of-a-kind scenario. The majority of automobiles on the road today are powered by fossil fuels. When they are allowed to escape into the atmosphere, they cause harm to the environment and contribute to the process of global warming. The disparity between the United States' petroleum production and its demand is widening. The vast bulk of India's annual oil demand is satisfied by imports. Consequently, there is an urgent need for research into the factors behind, as well as the challenges presented by, solutions that are greener and more sustainable. Further studies were made by Masurali, A., & Surya, P. (2018). Salamah Ali, Pretty Bhalla, Incas Afroze Nazneen, and Pretty Bhalla (2011), Overview and Obstacles Facing the Adoption of Electric Vehicles in India was written by A. Rakesh Kumar, Dr. Sanjeevikumar Padmanaban, (2012), Janardan Prasad Kesari, Yash Sharma, and Chahat Goel are the authors of the article titled Future Prospects for Electric Vehicles in India(2013), EVs in the Indian market A tea party in the middle of the hurricane: Yogesh Aggarwal, Vivek Gedda and Kushan Parikh,(2014).

India's Transition To Evs

In the past, road transportation and the use of fossil fuels have been inextricably linked, and the success of electric vehicles has been limited to a select number of specialized markets. Research that has been carried out over the past few years has shown that countries and areas outside of Europe, China, and the United States are slipping behind in the exploration of the EV industry for several reasons. Two-wheelers account for almost 79% of the total vehicle demand in India (NITI Aayog Report, 2020). This disparity in road transport mobility demand characteristics between India and other developed countries can be understood from the fact that two-wheelers account for almost 79% of the total vehicle demand in India. Utilities from real estate infrastructure companies and government agencies are upbeat about the future of electric vehicles. They are working on the ground level to generate affinity toward electric vehicles in preparation for the impending surge in demand. Commuters travelling within cities may soon have access to electric mini buses thanks to initiatives being taken by state governments.

The challenges for the EV market in India

There are just 650 charging stations in India, according to information that were officially released in 2018. EV startups

and auto giants in India are caught between investing in infrastructure and lowering the prices of EVs. As a result, the average on-road pricing of EVs does not appeal to customers as much as it should. The price tag for electric cars is quite high. In addition, the price of an EV in India is approximately INR 13 Lakh on average, which is significantly higher than the price of an inexpensive automobile in India, which is INR 5 Lakh on average. In India, the price of an electric scooter or motorcycle can range anywhere from INR 75,000 to INR 1,250,000. This is significantly higher than the range of INR 30 to 40K for traditional bikes powered by internal combustion engines (ICE) and even lower than the price of scooters. Experiencing Uncomfort While Separated Customers are said to suffer from "range anxiety" when they are concerned that their electric vehicle will not have the capacity to drive them to the destination of their choice. The same standardization of services for electric vehicles is still in its infant stages, in contrast to the widespread availability of petrol stations for recharging conventional automobiles. Both the president of BMW Group India and the CEO of the company, , have stated in the past that the lack of clarity in the legal environment for electric vehicles will have an impact on the pricing of such cars in India as well as their appeal. Toyota has also discontinued building hybrid and electric vehicles for the Indian market since insufficient charging infrastructure exists.

Opportunities in EV

- Electric Vehicles as a Promising Solution to the Nation's Energy Security Concerns Given that the country imports more than 80% of the crude oil it consumes, which amounts to approximately \$100 billion annually, electric vehicles are a promising solution to the nation's energy security concerns. The rising demand for electric vehicles is very beneficial to the local electric vehicle manufacturing company, which directly results from the push toward E.Vs. It is projected that electric vehicles, also known as EVs, would strengthen the grid by providing a number of grid support services. This will make it possible for greater penetration of renewable energy sources while maintaining the system's safety and stability.
- Possibilities Regarding the Production and Storage of Batteries: Possibilities Regarding the Manufacturing and Storing of Batteries Battery storage has a significant potential to encourage sustainable development in the nation, especially in light of recent government measures to promote e-mobility and renewable electricity. Recent disruptions in technology have created this potential, and it is important to note that these measures are already in place (450 GW energy capacity target by 2030)
- An increase in the amount of discretionary income has resulted in an increase in the use of high-tech consumer goods such as mobile phones, UPS systems, laptops, portable chargers, and power banks. This trend can be

attributed to the rise in the number of people who have more money to spend. Manufacturing more advanced batteries is expected to be one of the industries with the most promising economic prospects in the twenty-first century.

- Electric Vehicle Charging Infrastructure: Charging stations for electric vehicles can be installed in the parking lots of businesses such as shopping centers, train stations, and bus depots. They can also be installed in homes and public utilities such as gas and compressed natural gas (CNG) pumps. The Ministry of Power has issued a directive that requires charging stations to be located every 25 kilometers on both sides of key roadways, with a distance increment of three kilometers between each station. The Model Building Bye-laws, 2016 (MBBL) issued by the Ministry of Housing and Urban Affairs, requires that 20% of parking spaces in residential and commercial buildings be earmarked for electric car charging stations. [Note: MBBL stands for Model Building Bye-laws, 2016]. In addition, the MBBL mandates that state governments must make modifications to the building bylaws that govern their jurisdictions.
- Increasing Research and Development in EVs: Research and development (R & D) efforts for electric vehicles should be bolstered because the Indian market needs support for homegrown technologies that are strategically and economically advantageous for India. This is one of the reasons why increasing R&D in electric vehicles is important. It makes perfect sense to make advantage of local colleges and established industry clusters in order to invest in research and development on the local level and bring prices down. Research and development on EVs have to be coordinated between India and other countries, such as the United Kingdom.

Findings

The expansion of any nation's economy and industrial base relies heavily on the automobile industry. The introduction of electric automobiles is a major step forward, both in terms of technical advancement and the reduction of harmful effects on the environment. Because of its powerful multiplier impact and extensive connections to several other sectors, it is essential to the growth of the nation in both the short and long term. The automobile sector significantly impacts the gross domestic product of India. As a result of a range of demographic variables, such as growing earnings, the introduction of vehicles that are more fuel-efficient, an increase in international commerce, and the widespread availability of financing, there has been an increase in the number of automobiles that have been sold. The availability of trained workers, advancements in transportation and energy infrastructure, certification testing facilities, and the backing of government initiatives. The major companies in the global automotive industry now see India as a promising

market in which to invest their capital. At the present time, India is the second-largest manufacturer of two-wheelers and the fifth largest producer of commercial vehicles worldwide. The potential for electric vehicles is immense in Japan, which is the most important manufacturer of motorbikes in Asia and the fourth biggest market for passenger automobiles in the region. The Indian automobile industry is leading the charge in the promotion of alternative fuels by using cutting-edge technology in the form of battery-powered electric, hybrid, and other vehicles. To assist India's automobile manufacturing sector, the Indian government has advocated for further assistance in the form of programmes, subsidies, and regulations. Several plans, such as the Modernization and Phased Manufacturing Programme (MPMP), the Auto Policy 2002, the National Automotive Testing and Research and Development Infrastructure Project (TRIP), and the Automotive Mission Plan (AMP) 2006-2016, have been developed with the intention of bettering the automotive industry.

Discussion

The market for automobiles in India may be broken down into many submarkets, the smallest of which is the two-wheeler sector, which also happens to be the biggest. It is anticipated that the most significant market share for electric vehicles would be held by motorcycles and passenger autos. By the year 2025, the passenger automobile sector in India would be responsible for 75% of all sales of electric vehicles throughout the globe.

According to the World Bank's evaluation of countries' environmental quality, India is ranked 155 out of 172 countries and has the world's worst air pollution. India's Auto Fuel & Vision Policy 2025, which was published in 2014, called for the gradual implementation of BS-IV, BS-V, and BS-VI (based on Euro 4, Euro 5, and Euro 6) throughout the country by 2017, 2020, and 2024, respectively. These standards will be based on the Euro 4, Euro 5, and Euro 6 standards. India has been discussing whether it should adopt BS-VI or make a clean changeover to BS-VI immediately due to the country's growing levels of air pollution. In November of 2015, the Indian government issued a directive to implement BS-V and BS-VI by 2019 and 2021, respectively. Within the specified amount of time, it is predicted that the proposed upgrades will lower the emissions of PM and NO_x from vehicles by between 40 and 80%, depending on the nature of the planned modifications. The performance of Euro 5 for NO_x control in diesel automobiles has been mediocre, and Euro 6 climbs beyond this, thus, industry experts are encouraging a transfer directly to BS-VI.

Alterations in customer preferences and rising awareness of environmental issues are transforming the automotive industry, which will have implications for the future of transportation with electric vehicles. A vehicle is a high-tech, internet-connected device that handles activities associated

with driving. Automakers are finding themselves in the position of having to review their plans and goals as a result of changing client preferences and disruptive technologies.

It is anticipated that the construction of public charging stations for EVs would alleviate the worries of motorists who want to maintain their present routines while yet achieving performance levels comparable to those of vehicles powered by internal combustion engines (I.C. engines). Therefore, infrastructure for charging should focus on high-traffic routes and be carefully surveyed, taking into consideration the safety of drivers of vehicles, the ease of the location, and the closeness of local facilities such as shops and restaurants.

At least one charging station that is located at regular intervals of four kilometers should be made available in each of India's major cities. This would increase consumer confidence. When individuals use public transit, software experts are working on creating innovative apps that will assist them in locating the most convenient charging stations nearby. However, the disorganized charging of electric vehicles has the potential to have a detrimental effect on the distribution network (via, for example, transformer and feeder overloading, voltage variations, and other imbalances). A coalition of key parties, including a technological partner, will be required in the future for it to be viable to make investments in charging infrastructure that include a system for revenue sharing (that is, charging stations).

- Power distribution firms
- Land for electric vehicle charging stations
- Method of pricing that is efficient

The incorporation of electric vehicles into the automotive industry may encounter resistance due to a dearth of charging stations capable of providing rapid power. The amount of time necessary to completely charge an electric vehicle using a standard AC bus is extremely lengthy, yet the installation of infrastructure for dc rapid charging stations is costly. A further significant obstacle is standardizing the ports and characteristics of charging stations to accommodate various automobile brands and categories.

Charging EVs networks may be entirely supported by renewable energy resources accompanying micro- and macro-grids in distant places, as shown in Figure 3, if and when such resources are available. Distributed generation can support the installation of the necessary infrastructure for a fast-charging station that can handle five to ten electric vehicles. The topographical situation will determine which kind of renewable sources are available to be used.

If a self-contained electric vehicle charging infrastructure is connected to the grid network using renewable energy sources, the infrastructure will have a less impact on the environment. This bus scheme is often utilised because ac components have established standards, and several technologies and products that are based on ac are readily available on the commercial market. On the contrary, a system

Table 1: Comparative study of E.V.s and I.C. engine-based mobility variants

Sl.	Types	Electric Vehicle		IC Engine Vehicle		
		Mahindrae 20 Plus	Tata Nexon EV (XZ)	Ritz petrol vehicle	Tata Nexon XZA (Petrol)	Tata Nexon XZA (Diesel)
1.	Variants					
2.	Vehicle costs	INR 5.46 lakhs	INR 16.40 lakhs	INR 4.3 lakhs	INR 11.00 lakhs	INR 12.80 laks
3.	Running cost					
	(a) Capacity	10.08 kWh INR	30.20 kWh INR	43 L INR	44 L INR 91.35	44 L INR 84.35
	(b) Cost of fuel	7.22/Unit	7.22/Unit	91.35		
	(c) Total cost	INR 72.78	INR 218	INR 3928	INR 4020	INR 3712
	(d) Range	110 km	312 km	800 km	748 km	946 km
	(e) Cost/km	INR 1.51	INR 1.44	INR 4.91	INR 5.37	INR 3.93
4.	Maintenance cost	Substantial		Nominal		
	(a) Battery replacement	INR 1.5–3 lakhs	-	INR 20000	INR 29020	INR 42660
	(b) Cost battery life	3–5 Years	8 Years or 160000 km	6 Years	6 Years	6 Years

built on a dc bus makes it simpler to include renewable energy sources while also improving energy efficiency.

Let's say the energy and associated services markets are organised the way they should be. If this is the case, then programmes known as vehicle-to-grid, or V2G, may improve the stability and efficiency of the distribution system while also delivering financial advantages to owners of electric vehicles and those who operate charging stations. V2G approaches can deliver several grid services, including frequency control, virtual inertia, reactive power compensation, peak load management, and the integration of variable distributed energy resources (DERs).

In many strategic locations around the country of India, high-speed charging stations are now under construction. When it comes to charging station safety, municipalities may want to consider installing charging stations underneath popular areas. Because flyovers are specifically constructed at these stations, right-of-way (RoW) difficulties will be reduced to a minimum. These stations are located at the intersections of state and national roads. As a result, the total startup costs will go down greatly when there is access to a large number of customers. The state government of Bihar plans to install 400 charging stations around the state, focusing on high-traffic areas and popular tourism destinations. The primary areas of concentration are those places along the route where a customer would typically stop for food and rest for an average of one hour.

In response to its distinct transportation requirements, India has developed an EV sector in line with the trends seen elsewhere. Although 2.4 million cars were purchased in India in 2018, only 5,000 were EVs. Due to the prohibitively high cost, inadequate charging infrastructure, and restricted availability of electric cars, very few people have jumped on the bandwagon of purchasing EVs. For additional facts, please check Table 1 below. For this reason, drivers of electric cars continue to see their vehicles as a secondary form of

transportation rather than their main mode of conveyance.

Despite this, the majority of sales of electric vehicles have been limited to two-wheelers and three-wheelers (passenger and freight) that move slowly and do not call for registration or licencing. This action to distance ourselves from automobiles that contribute to pollution was unquestionably a positive move. NITI Aayog has developed a long-term concept that encompasses the following steps in order to increase demand for electric vehicles and reach the government's aim for sales of these vehicles:

Phase I (Action Plan for 2017 to 2019): The first action plan focuses on influencing the stance of the government, the expansion of businesses, economic prospects, and the basic formation of the organization.

Phase II (Action Plan for 2020 to 2024) focuses on seizing commercial opportunities as they become available, collecting and executing solutions via a larger geographical package, and developing an initial setup. This phase will last from 2020 to 2024. A collaboration between key strategic actors will be essential, particularly in conjunction with ongoing technical improvements, in order to accomplish these goals.

Phase-III (the Action Plan for 2025 to 32) will combine all economically possible choices into a single strategy to attain national objectives.

To achieve this goal, the Government of India (GoI) created the FAME-India Scheme to promote the wider distribution of electric and hybrid cars that are safe, affordable, and energy efficient (GoI, 2019). The first phase of the plan was permitted for a period of two years beginning on April 1, 2015, and it has now reached the end of its allotted time. A couple different time extensions have been granted for the programme, the most recent of which runs until March 31, 2019. In February of 2019, the Government of India approved the FAME-II plan, which has an estimated budget need of INR 10,000 crores (about US\$1.3 billion).

Conclusion

The recent development of the electric automobile industry is both welcome and needed given the escalating volumes of greenhouse emissions that are being produced all over the globe. The economic, society, and environmental evaluations that have been given here demonstrate that the benefits of electric automobiles far exceed their costs. Gasoline and the vehicles that run on it are readily available, handy, and inexpensive, all of which play a big influence in defining the market for automobiles across the globe and in especially in countries like India. According to our schedule, we anticipate that advances in technology and legislative initiatives will make it easier to transition away from conventional fuel-powered automobiles throughout the next decade. We are of the opinion that if broad advertising and environmental education programmes were implemented, people would be encouraged to transition to electric cars as their principal means of transportation and would be better suited to do so. Electric vehicles are increasingly becoming the method of transportation of choice for those who are concerned about the environment in every region of the world. In addition, the government of India has implemented measures that would speed up the spread of EVs. Before electric cars can be employed on a widespread scale in India, many challenges must be overcome first. As an alternative means of transportation, electric cars are still in their infancy; thus, there are a number of obstacles that need to be conquered before they can take the place of conventional vehicles. Everyone in the consumer market is dedicated to reducing their impact on the environment. However, a number of variables make it challenging to do so in an affordable manner (including initial investment, minimum operating cost, vehicle cost, payback time, running cost, maintenance cost, power cost, and resale).

As a result, the Indian market needs a car that can be purchased at an affordable price. Participants at industry seminars held in Delhi and Chennai by the Center for Future Mobility mentioned the high purchase cost as the biggest impediment to the acceptance of electric vehicles (EVs). These events were held in India. Issues such as the absence of a comprehensive charging network, uncertainty over the durability of the cars' electric propulsion systems, and the apprehension of prospective buyers are some of the significant obstacles that stand in the way of the widespread adoption of electric vehicles. According to the findings of the study, a penetration pricing strategy is most suited to meet the needs of the automobile industry in India because of the country's vast number of middle-class purchasers. Because the widespread use of electric automobiles has the potential to drastically cut down on fuel consumption and pollution across India, policymakers in the automotive sector in India should react to this trend. Nevertheless, the technology itself has a great deal of potential, and if

the challenges outlined above can be overcome, there is a chance that it may thrive in India. In order for this option to be able to compete with traditional vehicles on the Indian market, there is a lot of work that has to be done to enhance it, particularly in terms of price and range. If this is ensured through the utilization of technology, and if the charging ports for the automobiles are taken into consideration, along with how they may be implemented in India, which has a large number of topographical obstacles to overcome, then unquestionably, this will lead to a better and more sustainable green future.

Acknowledgement

Without continued support, encouragement, cooperation, guidance, and direction, one cannot perform well in the fulfillment of academic pursuit. It is my humble duty and obligation to pay sincere regards and gratitude who significantly contributed to completing a research work. I sincerely appreciate my research supervisor Dr. Nimish Gupta, Associate Professor, Amity Business School, Lucknow and the Research Committee for allowing me to pursue my doctoral research work on this relevant issue. I am highly obliged to my supervisor who sustained my academic interest and provided all kind of encouragement. Prof. (Dr) G.R.Yadav (Rajat Degree College, Lucknow), being my external supervisor, in spite his busy schedule, extended all support for the realization of this work. Last but not least, I wish to acknowledge the contribution of Prof. (Dr.) Rohit Kushwaha (Director, ABS, Lucknow), for giving immense support, motivation and encouragement. Finally I am endowed with the grace of almighty God for showering graceful drops on my future and instilling courage to cover the research journey with all success.

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