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Prospects of Electric Vehicles in India

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Abstract: ***The global automobile industry is seeing a major shift towards e-mobility over the past decade. There is a rapid increase in concept cars being turned into production cars over the years. Following the suit, India also has big plans for the emerging Electric Vehicles and its technologies in the country. In this study it is aimed to highlight, counter and suggest some solutions to the challenges that lie ahead.***
Keywords: Electric vehicle, Battery, Fast Charging, Public Transport, Futuristic Mobility Solution.

I. INTRODUCTION

Electric car manufacture is getting increasingly popular, and its market share is likely to grow significantly. By 2022, India's GDP is predicted to increase by a staggering 25%. The best aspect is that, in addition to decreasing pollution, EVs can reduce oil imports by $60 billion by 2030. In India, the electric vehicle sector is thriving. The federal and state governments have introduced policies and incentives to encourage the use of electric vehicles in the country, as well as various rules and standards. While transitioning from internal combustion engines to electric motors will benefit the country significantly, there are obstacles such as a lack of charging infrastructure, a high initial cost, and a lack of renewable energy-produced electricity. Despite this, e-commerce companies, automotive manufacturers, app-based transportation network companies, and mobility solution providers have entered the market and are gradually increasing electric vehicle capacity and visibility. India has the potential to become a global provider of cost-effective and scalable clean mobility technologies and procedures

Noise pollution is a problem for residents in various Indian cities. Some Indian cities have the highest levels of noise pollution in the world. Electric vehicles are substantially quieter, which could contribute to a reduction in city noise pollution.

Automobiles have improved in terms of energy efficiency and emission reduction. However, the increase in the total number of vehicles on the road, as well as the resulting total pollution and total energy consumption, wiped out any advances gained by automobiles in terms of energy efficiency and emission reduction. Measures to improve energy efficiency and reduce emissions have lagged behind the surge in car sales. The number of automobiles in total in 1981, 1986, 1996, 2000, and 2015, 11 million, 33 million, 40 million, and 210 million people were born. Between 1981 and 2015, there was a 39-fold increase in the overall number of automobiles. In India, the total number of automobiles sold climbed from 1,54,81,381 in 2010-11 to 2,04,69,385 in 2015-16 , suggesting a 30 percent rise over five years.

Electric vehicles can help to balance the electrical grid's balance-supply changes and create a buffer against power outages by using smart charging. When opposed to vehicles powered by internal combustion engines, electric vehicles have far fewer moving parts. As a result of their simplicity, they are less expensive and easier to maintain.

At low speeds, electric motors can produce a lot of torque. As a result, electric vehicles perform far better than IC engine-powered vehicles while starting off and on hills.

II. BACKGROUND STUDY

A. Birth of e-vehicles

It's difficult to pinpoint the creation of the electric vehicle to one creator or country. Rather it was a progression of forward leaps. from the battery to the electric engine In the 1800s that prompted the main electric vehicle out and about.

In the early piece of the century, pioneers in Hungary, the Netherlands and the United States including a metalworker from Vermont started playing with the idea of a battery-fuelled vehicle and made a portion of the main limited scope electric vehicles. And keeping in mind that Robert Anderson, a British creator, fostered the principal unrefined electric carriage around this equivalent time, it wasn't until the second 50% of the nineteenth century that French and English innovators fabricated a portion of the primary common sense electric vehicles

The electric engine is regularly credited to Hungarian architect Aynos Jedlik, While French physicist Gaston plane created Commercial, Rechargeable lead-corrosive batteries in 1859. It took an English man named Thomas parker to join the two in a carriage to make the principal creation electric vehicle, Build in London in 1884

B. E-Vehicles in India

The electric vehicles in India are a developing industry . The focal and state legislatures have dispatched plans and impetuses to advance electric versatility

Discussing electric vehicles, the credit goes to many individuals in 1996, The principal electric vehicle was created by Scooter's India Pvt.Ltd and it was named VIKRAM SAFA. Roughly 400 vehicles were made and sold. In 2000 BHEL fostered an electric transport which became well known as well. Then, at that point, approx. 200 vehicle vans were made and ran in Delhi. Yet, it didn't do well in the market as it is required a significant expense for the battery and its deadbeat.

In the year 2007 Hero cycles , In organization with UK based Ultra engine dispatched a progression of bicycles, These bicycles became famous for the sake of Electrothron India and even TVS engine, Hero electric attempted to course among the market and it didn't progress admirably

As a worry for the climate expanded in 21st century. Metropolitan urban areas like Delhi , Mumbai are over dirtied urban communities and inngas controlled vehicles transmit a ton of smoke and unquestionably unsafe to environment, Therefore the interest in e-vehicles expanded as well. Electric vehicles were well known among the people who utilized them in the city where their short reach didn't demonstrate an impediment. Another explanation that gave it a blast is there is no necessity to switch the gears , making it a simple choice it didn't have vibration sounds or any solid . It didn't need a manual beginning which was additionally an or more point as well

The huge ubiquity of electric carts ruled the whole market in the year 2016-17 around 500000 e-carts were sold in India it filled in as an incredible assistance for the populace to drive day by day. The essential utilization of these carts is in Delhi. The public authority is presently significantly focusing in contaminated urban areas to build the utilization of electric vehicles. A plan called FAME, i.e. , "Quicker reception of assembling of electric and half-breed vehicles in India " is being dispatched where appropriation is for 11 urban areas for dispatching electric transports, cabs, and e-carts. The designated urban communities incorporate Mumbai , Hyderabad , Bangalore , Ahmedabad , Delhi and so forth.

III. NEED FOR THE STUDY

India is one of the most polluted counties in the world. Everyone is becoming more and more motivated to reduce pollution levels in countries. What makes India an appealing market for electric car manufacturers is the low EV car penetration and the rising income of individuals.

In India, the number of electric vehicles on the road and in the market is very scarce. The potential users and adopters of electric vehicles may have never driven, seen or charged an electric car priorly. The characteristics of these vehicles are unfamiliar to most people. This research is being carried out in order to raise awareness about electric vehicles in India. Many car manufacturers have already begun producing and selling electric vehicles in India such as the Hyundai Kona and Tata Nexon. Now with the entrance of Tesla, it could be a game changer for the entire automobile industry.

IV. RELEVANCE

This topic is chosen to increase the knowledge of Electric Vehicles, which might soon be the future of Indian cars.

A significant reduction in fossil-fuel-run vehicular mobility can be achieved by fostering the EV sector’s organic growth and increasing its acceptance among the general public through government programmes.

In the global electric car market, India aspires to be a big player. The prevalence of battery electric vehicles has expanded dramatically in the past 5 years, thanks to various automakers in the country working on electric vehicles. Along with the traditional automobile manufacturers, a number of start-ups have emerged in the market with their own goods and technologies.

Customers are more vocal than ever about their desire to purchase electric cars. However, there are a number of obstacles impeding the expansion of electric vehicles in the country, including range anxiety, public perception of electric vehicles as opposed to internal combustion engine vehicles, the high prices of electric vehicles battery technology.

However, the low cost of maintenance, state electric vehicle policy, and a clear environment are some of the factors driving the growth of electric vehicles in India.

V. OBJECTIVE OF THE STUDY

The proposed study aims to improve know-how of the challenges dealing with the adoption of electrical vehicles in the country and to signify approaches to deal with them. The studies will recognize articulating clients' perceptions in their options and willingness to pay, the industry's imaginative and prescient focus on the challenges dealing with their manufacturing capacity, and the provision of resources.

We are able to define 'the front runners' inside the context of an electric car as the most effective additives to measure with very low funding, basic infrastructure, needs, and minimum attempt. It's said that former runners are not primarily based on demonstrations of early acquisition achievement, reliance on public charging infrastructure, client product choice, nearby capability building, ease of operation, and getting admission to government help. The adoption of electric vehicles in India is greater and faster than other elements of personal automobiles. In addition to contributing to decreasing air pollutants, switching to dual electricity may also result in substantial financial savings for users with less reliance on public charging. But, the boom in the purchase of electric automobiles is the handiest part of the size had to gain the countrywide aim. For the equal motive, electric-vehicles and electric powered vehicles are the point of interest of this examination.

The targets of this study are:-

1) *Recognize the country of tour in India:* At this degree, the look at will inspect the current tour sample in India. The goal will be to modes in passenger transport apprehend the allocation of various and their possibilities and roles. This phase will even look at the terrible impact of increased call for mobility in phrases of power intake, carbon emissions, and neighbourhood air pollutants. This part of the examination will consist of a short assessment of other gas technology in the transportation sector. Expertise the position of electric vehicles inside the Indian traffic gadget. Below this framework, research will look into the position of electric motors as an answer for sustainable mobility in India. This phase will aim to understand the Indian car industry in phrases of partial manufacturing and sale of automobiles. This segment aims to recognize India's cutting-edge country of power through technology, alternate, intake, and policy interventions on the nearby, authorities and country wide degree.
2) *Measuring The Impact Of Electricity On Electric Powered Motors In India:* Below this section, the examiner will estimate the output strength, power, and value of the numerous scales for the adoption of electric cars made as preferred. the usage of the lowest-up technique, this phase makes the assignment an electric-cars growth in 2025 and 2030 in numerous phases. In keeping with some growth estimates, emissions and electricity performance are constrained.
3) *Verify Enterprise Feasibility And Call For Complete Billing Infrastructure:* This section will consciousness on understanding the surroundings required for the fast adoption of electric cars. The section will determine the charging necessities of the anticipated increase of electric vehicles in India. through creating situations based on excessive expenses, working prices, battery fees, etc. This phase can even compare the commercial enterprise overall performance of computers and the whole price of electric vehicles of the herbal charging machine. The goal might be to pick out important factors / costs that save you the rapid adoption of dual-electric powered strength. The look at will examine the situations of public charging, domestic / residential / private charging, and battery change.
4) *Know-How The Enterprise's Imaginative And Prescient For Electric Powered-Motors Drive:* This phase will cognizance of knowledge the imaginative and prescient of the car enterprise and its supportive industries concerning the transformation of paradise into power. The purpose of this phase is to recognize the alternate inside the supply and manufacturing of a number of motors in India within the phased adoption of strength. This segment ambitions to in short degree the effect of rent and the cost of the house added for the reason that conversion of the electric vehicle. This phase will even understand the idea additionally through discussions with automobile producers and additives, journey service providers, and enterprise acceptance groups.

VI. SCOPE OF ELECTRIC VEHICLES IN INDIA

India's young electric vehicle industry is in its nascent stage which has shown unprecedented growth in India and all over the world. Even as the globe went forward and plotted a direction, all this industry got from the government was lip service for a long time. This is no longer the case. This is due to basic factors such as rising environmental concerns, lower battery prices, and more charging infrastructure availability. All of this has prompted experts to expect fast increase in EV use over the next decade, with growth projections ranging from 27 percent to 33 percent for the current year through 2030.

The industry is still in its potential blooming stage . However, when seen from a different perspective, India is the world's greatest unexplored market, particularly in the two-wheeler category. Under the automatic approach, 100 percent foreign direct investment is permitted in this sector. The federal government is also putting a premium on sustainable mobility, as seen by recent amendments to the FAME II (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India) plan to make electric two-wheelers more affordable. Private automakers rose to the occasion, investing in research and development centres as well as expanded production facilities for electric vehicles. In addition to this, the government has chosen to fund the expansion. Global businesses in the energy sector are contributing up to 60% of R&D expenditures for the development of low-cost indigenous electric solutions.

The automobile sector spends a lot of money on research and development. In addition to this, a few incentives which were introduced in the Budget by the finance minister are Interest on EV loans which are tax deductible, and many components have cheaper import duties. There is also an investment-linked income tax exemption for solar electric charging infrastructure and lithium storage batteries production. The battery exchange model can help reduce initial costs of electric vehicles and improve the charging experience. While these incentives are likely to encourage automakers to introduce more electric vehicles in the nation, the push for electrification has created a new business area of EV charging infrastructure, which is attracting a wide range of enterprises. This new company segment has a huge market potential.

The world's largest procurement for 10,000 four-wheel electric automobiles was issued by Services for Energy Efficiency Limited (EESL) in 2017, making it the best buy in the world so far. The government aims to invest in the automotive and bus portions of a three-wheeled vehicle; replacing the battery in a way that separates battery expenses from automotive costs and simplifies the charging procedure. There are some rules to follow for the first generation of public workers. Chargers for electric cars have been described, and a second generation is now in the works. India is expected to reach a volume of electric vehicle sales of more than 1.6 million cars in fiscal year 23, if both the exchange and aggregation of demand perform as predicted. Contributing to this is public procurement and public transport .Private fleet investments like as Ola and Uber are expected to boost expansion in the four-wheel vehicle industry, where increased daily traffic makes electric vehicles more economically viable.

With the government initiatives and policymakers, the fate of the industry mainly depends on the ability to create tailored solutions in different segments while also meeting the quality and innovation standards. The market growth also resides on the amount of capital available, battery manufacturer, equipment etc. It would definitely take a while to develop the technology that is needed to change the source of automobiles in India, since the country now lacks the people resources and funding to devote to adequate technological development. But with improvements in infrastructure, proper implementation and strategy as well as diversified options for customers, India will be on its way to achieving the goal in the EV Industry.

VII. CURRENT STRUCTURE OF ELECTRIC VEHICLES IN INDIA

With 100 percent FDI available, new production centres, and a greater push to improve charging infrastructure, India's electric vehicle industry is gaining traction. Other growth factors for the Indian EV industry include federal subsidies and policies supporting deeper discounts for Indian-made electric two-wheelers, as well as a boost for localised ACC battery storage manufacture. Furthermore, in September 2021, Cabinet authorised a production-linked incentive programme for the automotive sector in order to stimulate the manufacture of electric and hydrogen fuel cell vehicles.

India's electric vehicle industry has set ambitious growth goals.

India's automobile sector is the world's fifth largest, with plans to become the third largest by 2030. Reliance on traditional modes of fuel-intensive mobility to cater to a large domestic market would not be sustainable. In order to solve this, federal authorities are designing a "Shared, Connected, and Electric" mobility alternative, with an ambitious goal of achieving 100 percent electrification by 2030.By making the shift towards electric vehicles (EVs), India stands to benefit on many fronts: it has a relative abundance of renewable energy resources and availability of skilled manpower in the technology and manufacturing sectors.

According to an independent study by CEEW Centre for Energy Finance (CEEW-CEF), the EV market in India will be a US$206 billion opportunity by 2030 if India maintains steady progress to meet its ambitious 2030 target. This would require a cumulative investment of over US$180 billion in vehicle production and charging infrastructure. Another report by India Energy Storage Alliance (IESA) projects that the Indian EV market will grow at a CAGR of 36 percent till 2026

During the same time period, the EV battery market is expected to develop at a CAGR of 30%.

A. India's electric Vehicle Ecosystem and Investment Prospects

Regardless of the country's lofty goals, India's electric vehicle industry is still in its infancy. However, when viewed from a different perspective, India is the world's greatest unexplored market, particularly in the two-wheeler segment. Under the automatic approach, 100 percent foreign direct investment is permitted in this sector.

The federal government is also putting a premium on sustainable mobility, as evidenced by recent amendments to the FAME II (Faster Adoption and Manufacturing of Hybrid and Electric Vehicles in India) scheme to make electric two-wheelers more affordable is a good example.

In addition, a number of production-linked incentive schemes are aimed at fostering a local manufacturing ecosystem to aid in the adoption of electric mobility vehicles. This will be accomplished by encouraging new investments in the development of domestic supply chains for essential technology, products, and auto components.

B. Incentive Programmes Linked to Production

The government announced a Manufacture-Linked Incentive Scheme (PLI) for ACC Battery Storage Manufacturing in May 2021, which will encourage domestic battery production and minimise reliance on imports. This will provide the necessary infrastructure for the EV industry and will sign 'green automotive manufacturing' is a term used to describe the production of automobiles that

Existing automotive companies as well as new investors who are not currently in the vehicle or auto component manufacturing business are eligible to participate in the PLI Scheme for the auto sector. There are two parts to the scheme:

1) *Champion OEM Incentive Scheme:* This is a "sales value related" incentive programme that applies to all segments of battery electric and hydrogen fuel cell vehicles.
2) *Component Champion Incentive Program:* This is sales value related' incentive scheme that applies to innovative automotive technology vehicle components, fully knocked down (CKD)/ semi knocked down (SKD) kits, vehicle aggregates of 2-wheelers, 3-wheelers, and 4-wheelers

The government of India's recent announcement that it will develop a low-cost AC charge point standard for public EV charging is a game-changer for electric vehicles. We explain why local government officials, EV charging companies, and EV aficionados should be concerned.

India's EV transition is charting its own course, even while the worldwide EV transition is measured by the share of automobiles that are going electric. Two- and three-wheelers, also known as light electric vehicles (LEVs), account for roughly 98 percent of the more than five lakh EVs sold since FY2017. The International Energy Agency (IEA) is a non-profit organisation tasked with promoting

In its recently released Global EV Outlook 2021, reaffirmed that electric two- and three-wheelers would lead EV uptake in the country. By 2030, this market is predicted to have a cumulative sales share of 50%, greatly above the estimated 15% for electric buses and vehicles.

To support this predicted development, a network of visible, accessible, and affordable charging stations is a must. However, the widespread installation of EV charging infrastructure, particularly public charging, has been far slower than expected. This is due to a few major barriers

Often, public charging infrastructure is thought to necessitate large capital investments with low early returns. This is owing in part to India's initial concentration on public charging standards created for high-voltage electric vehicles, which it accepted as it began its EV journey. The cost of a single charging gun can range from INR 1.25 lakhs to INR 7.5 lakhs, as they frequently necessitate extra electrical grid infrastructure upgrades such as new distribution transformers and high-tension cable networks. As a result, high-power chargers are prohibitively expensive. The Bharat AC-001 and DC-001 public EV charging requirements, which were designed in 2017 for India's mostly low-voltage EV fleets, are still in use.

Another impediment is a scarcity of inexpensive property in densely populated locations, with public charging considered as a distinct land use that necessitates specific space, similar to fuel outlets. This raises the expense of installing charging infrastructure even more. To close the charging gap created by these obstacles, the federal and state governments offer policy incentives such as monetary subsidies and public land parcels for charging infrastructure installation. However, available charging stations are only used about 8% of the time. At the same time, EV adoption in the country continues to be hampered by a lack of suitable charging infrastructure

VIII. MARKET OVERVIEW OF ELECTRIC VEHICLES IN INDIA

The Indian electric automobile market turned into USD five billion through 2020, and is anticipated to attain USD 47 billion by 2026, registering a CAGR of more than 44% all through the forecast period (2021-2026).

The Indian electric powered car market has contributed to the outbreak of the COVID-19 epidemic due to disruptions in supply and suspension of manufacturing devices due to ongoing land closures and travel restrictions throughout the United States of America. But, the electrical car (EV) market is in its first section in India. it is predicted to develop unexpectedly throughout the forecast duration due to numerous government packages and guidelines.

E-commerce organizations (as an instance, Amazon) are introducing plans to use e-Mobility stop-to-stop delivery to lessen carbon footprint. India is making an attempt to e-Mobility for public transport, and the use of a has installed electric buses in important towns. In addition, provincial governments additionally play a lively position in enforcing regulations that sell the use of EVs.

For instance, the EV market in India has gained full-size momentum after the release of the fame India software with its intention of switching to e-mobility inside the wake of growing global coverage obligations and environmental demanding situations. further, India gives the sector's biggest unused marketplace, especially inside the -wheeled electric area. With one hundred% foreign direct funding allowed in the sector; the automatic route market is anticipated to gain momentum in the course of the forecast period.

India is the second one maximum populous United States in the world after China, and prefers China, has the biggest electric buses inside the world. India is likewise pushing hard for the installation of power on buses. Many provincial governments have begun purchasing electric powered buses from Chinese and nearby electric bus producers.

With the growing desire to control the emission of GHG (Greenhouse gases) emitted by vehicles, the government is promoting the usage of electric vehicles in all the diverse provinces, growing the call for electric buses in India. The marketplace is pushed by way of factors which includes elevated home production, rapid urbanization, and multiplied environmental consciousness.

India's EV is in the first section. However, appearance in another way - India offers the most important unused market in the world, specially inside the two-wheeled phase. a hundred% direct overseas investment is authorized in the sector underneath the automatic direction.

The coalition authorities are likewise prioritizing alternate to a cleanser direction, and the cutting-edge steps to amend the expanded electricity Acquisition and production system in India (fame) II to make two greater electric powered wheels greater lower priced, as an example.

Similarly, many production-related incentive applications aim to create a nearby manufacturing environment to help goals regarding multiplied adoption of digital goods. This demand is to be done with the aid of encouraging new investments inside the improvement of chains to provide indigenous peoples with critical technologies, merchandise, and automatic components.

A. Competitor Analysis

An electric powered car operates on power unlike its counterpart, which runs on gasoline. Instead of an internal combustion engine, those vehicles run on an electric motor that requires regular supply of power from batteries. There are a variety of batteries utilized in those cars. Those include lithium ion, molten salt, zinc-air, and diverse nickel-based designs. electric powered vehicles were more often than not designed to replace traditional approaches of journey as they cause environmental pollutants. Electric cars have gained a reputation because of numerous technological advancements. The electric automobile outperforms the traditional car offering higher gasoline economic system, low carbon emission & renovation, convenience of charging at home, smoother pressure, and decreased sound from engine. There are 3 styles of electric vehicles-battery, hybrid, and plug-in hybrid electric powered cars. In addition, electric vehicles require no engine oil modifications but are slightly greater pricey than their gas equivalents. Electric vehicles use one or a couple of electric powered motors or traction automobiles for propulsion. The electric automobiles are powered both by means of a collector device thru strength from charging station deployments or can be charged through self-charging gadgets consisting of regenerative braking structures and turbochargers.

elements such as growth in demand for gas-green, excessive-performance, and low-emission automobiles together with stringent government rules and policies closer to vehicle emission supplements the growth of the electrical vehicle market. Furthermore, elements including excessive production fee and occasional fuel economic system and serviceability are the factors anticipated to hamper the boom of the electrical automobile marketplace. However, factors inclusive of technological improvements and proactive government initiatives complement the boom of the electric car market at some stage in the forecast period.

India's electric powered automobile market length is envisioned at $ 71.1 million in 2017 and is expected to reach $ 707.four million by 2025, confirming the CAGR of 34.5% at the time of forecasting. Authorities packages and presents play a primary role in marketplace increase. In addition, growing environmental concerns due to excessive ranges of pollution in principal towns of the United States of America actually have a tremendous effect on market growth. Primarily based on generation, the Indian electric vehicle market is divided into electric powered vehicle (BEV), hybrid electric automobile (PHEV), and hybrid electric automobile (HEV). The BEV section holds the biggest proportion within the Indian marketplace, contributing extra than 70% of income volume in 2017. During the forecast duration, the BEV elegance is ready to preserve its market role in phrases of volume and quantity, because of its high pleasantness. authorities' subsidies on the purchase of BEVs in comparison to PHEVs and HEVs. Similarly, the availability of a larger model of BEVs, lower battery costs, and decrease in advance fees are expected to advantage the marketplace at some stage in the forecast duration.

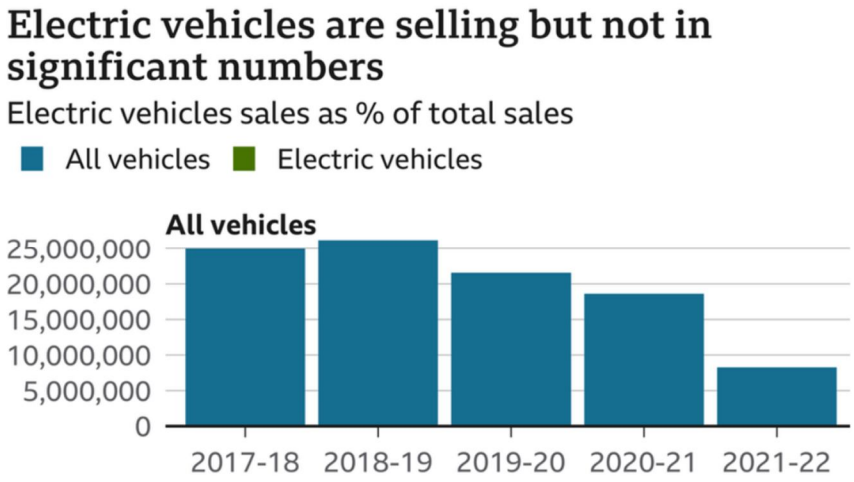
On a battery basis, the Indian electric vehicle market is divided into Lithium-Iron-Phosphate (LFP), Lithium-Nickel-Manganese Cobalt Oxide (Li-NMC), amongst others. The "different" category consists of other Li-ion-primarily based batteries, which include Lithium-Titanate oxide (LTO) batteries, Lithium-Nickel-Cobalt – Aluminium oxide (NCA) batteries, nickel-metal hydride batteries (NiMH), and lead acid battery. . The LFP battery-based electric powered automobile became the largest phase inside the marketplace, supplying a sales quantity of extra than sixty-five% in 2017, because of advantages together with high present-day ratings, thermal stability and protection requirements, and long cycle life. Maharashtra had the best income volume in 2017 inside the Indian electric automobile market.

The government is anticipated to remain the arena's main electric automobile market at the time of forecasting, thanks to the nation's electric powered automobile policy 2018 to assist the electric car market grow by supporting electric car manufacturing, enhancing charging infrastructure, and presenting customer service in buying these automobiles. The country wide authorities have introduced a subsidy for electric cars, as much as $ 1,550 (INR one hundred,000) , consistent with automobiles

IX. LOCAL VS NATIONAL VS GLOBAL ANALYSIS OF THE MARKET

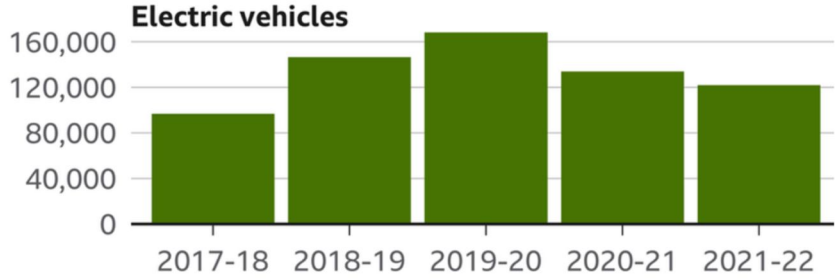
The electric vehicle industry has been on the rise in the Indian market in terms of the overall units that are being produced and respectively sold in the Indian market. September 2021 saw the highest sales for electric vehicles in the country in comparison any previous month, it is pertinent to note that factors like rising fuel prices, larger market diversification have played instrumental role in changing consumer behaviour.

In the current fiscal year, electric vehicle sales amount to 1,21,900 units, still limited to only 1.66% of the overall vehicle sold in the country based on a report published by Delhi based think tank, Council on Energy, Environment and Water (CEEW). The government of India has also committed to providing over $3.5 Billion in incentives to manufacturers in the sector in order to aid the growth of the same. More EVs on the road shall also help ensuring the country's compliance with global emission standards namely the COP 26 as well reducing the massive fuel import bill which amounts to over 24 billion a year.



Source: Ministry of Road, Transport & Highways, BBC News

The above numbers are clearly indicative of the need to promote sales of EV in the country. Even though there has been steady demand for EV vehicles in the country over the past few years. Lack of market diversification, range constraints and limited charging stations have been a huge inhibition for buyers due to which they tend to opt against the purchase of an electric vehicle. It is pertinent to note that even though these issues do exist, in the following fiscal year namely FY 2021, there has been a considerable increase with respect to the number of electric vehicles that have been sold. Various entrants namely Ola, Okinawa have established plants and have started manufacturing electric vehicles in the country. Considering the sharp rise in fuel prices this year, there has been a considerable demand towards electric vehicles which has also been aided by numerous government incentives in relation reduced taxes for electric vehicles and larger investment in electric vehicle charging infrastructure across the country.



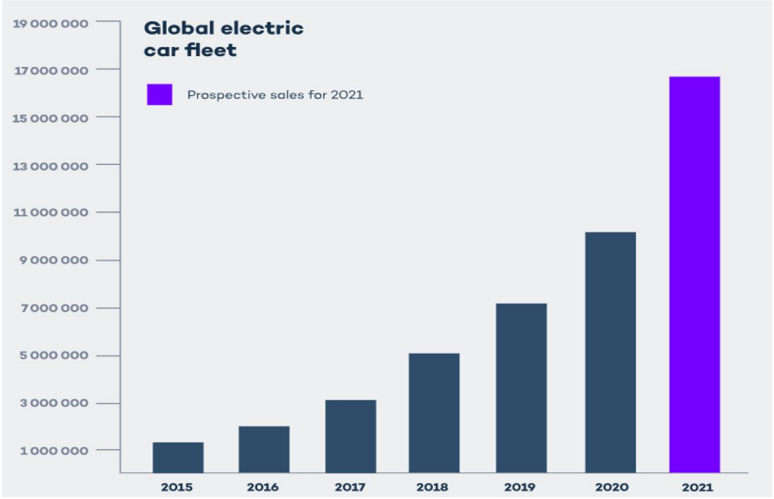
Source: Ministry of Road, Transport & Highways, BBC News

The following graph provides a clear indication with respect to the trends in relation to the sale of electric vehicles in the country. The following graph from FY 2017-18 shows a steady growth with respect to the sales of electric barring the year 2020 due to the onset of the pandemic and financial impact that it had across the country. An important observation that is to be made with regards to above graph is in terms of noting the rise in sales of electric vehicles in India in the current year 2021-22 as of October which is namely the third quarter. The said statistic is clearly indicative of the fact that there has been a considerable rise in terms of the number of EV sales in the country and that the same does only account for three quarters of the said year. It is predicated that due to the various reasons stated above that EV sales are expected to reach a record high this year.

The Indian market has immense potential in the automobile sector with over 20 million vehicles being sold on an annual basis of which only an estimated 2% amount to EVs. It is important that the above stated issues with regards to inhibitions in the EV market be addressed and changes are brought forth. If the issues are addressed, it shall enable more customers to purchase electric vehicles.

X. ELECTRIC VEHICLES IN THE GLOBAL MARKET

Electric Vehicles have been gaining significant traction in across markets seeing significant growth on year-on-year basis. Almost every automobile manufacturer has been invested in the development of electric vehicles owing more affordable options in the market. The developed markets have seen a larger growth and migration in terms electric vehicles in comparison to the more developing market where the purchasing power parity is far lesser. With advancements in technology and increased mobility options for electric vehicles, there has been a significant impact in terms of the migration from the standard petroleum run cars. This along with numerous climate change and emission control agreements have essentially accelerated the global electric vehicle sales.



Source: EV Volumes & Global EV Outlook 2021, Virta

If due reference is laid upon the contents of the above-mentioned graph, it is rather pertinent to note that there has been a manifold year on year increase with respect to the number of EVs that have been sold globally, the number considerably increases if even plug in hybrids are included. The said graph is also clearly indicative of the growth of the global EV sector being between 40-60% on a year in year basis indicating a change in the automobile trends.

The global EV market is dependent on three primary markets which are namely the European market, United States and China which comprise of over 95% of global sales. The developed markets have been more receptive to adopting electric vehicles due to better charging infrastructure as well as road transport systems. If due reference is laid upon the sale of plug-in hybrids, it depicts an overall increase of over 98% in adoption of EVs and plug in hybrids.

While there is still a lot of changes that can be respectively made in order to ensure better adoption of EVs in the market, the said statistics indicate a rather positive figure with respect to the growth of EVs. If the environmental impact of EVs were to be ascertained, it is imperative to note that the only 1% of global electricity was attributed to electric vehicles while over 4% of vehicles on roads are electric. It is estimated that in the year 2020, over 50 million tonnes of carbon emissions were saved due to the use of electric automobiles. It is imperative that the same be encouraged and that adoption to electric vehicles be increased considering the considerable decreased in global carbon emission. The present data is clearly indicative of the fact that EVs are a fundamental part of the mobility in the present and in the coming years.

XI. ELECTRIC VEHICLES IN THE BANGALORE MARKET

Bangalore, Karnataka has been an instrumental city in terms powering India's EV growth rate. The state of Karnataka alone commands over 21.9% of country's electric vehicle market and have also been brought under the ambit of the FAME Phase II policy. The government has also proposed heavy incentives to potential buyers as a part of FAME encouraging faster adoption of the same. The Ministry has also proposed setting up of electric chargers.

A large number of buyers still remain sceptical in terms of switching to EV due to lack of charging infrastructure in the country and also in terms of EV connectivity between cities. The launch of ventures like that of lithium have been ushered a new era in terms of EV mobility in the city and also encourages potential buyers. The state should take proactive measures like that of private public partnerships, as well as encourage manufacturers to set up chargers across the city and major state and national highways.

A major roadblock that currently exists is in terms of the charging infrastructure that is present. It is often an issue wherein people are limited in their travels due to range issues that exist with EVs and as to the locating chargers. Another the inhibition with adoption of EVs have been the aspect of convenience, often EVs are subject to longer charging hours due to the absence/availability of fast chargers in the city thereby making petrol/diesel more feasible to use on a day-to-day basis. If these two primary concerns are namely addressed in addition to the tax incentives that are offered, it will exponentially increase the rates of adoption and also reduce emissions. It is also imperative that the government encourage and take proactive steps to ensure the public transport systems across the city as well as the state are also made electric as the same would have a considerable impact in the reduction of emissions.

XII.FUTURE BUSINESS OPPURTUNITIES OF ELECTRIC VEHICLES IN INDIA

The electric vehicle industry in India has created a billion-dollar industry in EV charging which is attracting companies from several sectors. According to McKinsey research, even at a moderate pace of adoption, India would require nearly five million charging stations by 2030, requiring a $6 billion (about Rs 42,000 crore) investment.

The Indian electric vehicle market is expected to grow at a 37 percent CAGR from FY 2018 to FY 2023, due to the increased government initiatives and growing consumer inclination, concerns about the harmful effects of air pollution etc. Passenger cars and two-wheelers are the main segments. According to a report, Electric vehicles are manufactured by a number of companies in India, including Mahindra Electric Mobility Limited, Tata Motors Limited, Toyota Kirloskar Motor Pvt. Ltd., Volvo India Private Limited, BMW AG, Kinetic Green Energy & Power Solutions Ltd., and Okinawa Autotech Pvt. Ltd.

There are certain steps we can take to ensure the growth of future flourishment of electric vehicles in India:

1) Vehicle buyers and stockholders should both receive more incentives, tax breaks, and rebates.
2) Increased spending on Research and Development
3) Try and phase out ICE vehicles and create more demands for EVs
4) Improvement of infrastructure and innovation
5) Creating awareness among people and making them conscious about the benefits of using an EV and the need for its growth.

Battery and Hybrid electric vehicles are expected to have rapid growth in the market. In 2025, two-wheeler sales are predicted to account for a substantial portion of battery electric vehicle sales in India, with an estimated market share of 85 percent. Companies can adopt innovative business models such as swapping infrastructure, battery leasing and developing fast chargers and access to charging stations which are necessary for the increased usage of electric vehicles

A. Business opportunities of Electric Vehicles

1) *Charging Stations:* Probably the largest need for the electric vehicle market where there is access to charging points for vehicles. There needs to be improvement in the charging infrastructure in order to avoid high maintenance and repair costs
2) *Battery Recycling and Swapping:* Since batteries are the main source of energy for these vehicles, it is important to make sure they do not run out. The "Global Battery Alliance" believes that the battery may reduce carbon industry requirements by 30%, and this has resulted in numerous outcomes. Swapping will reduce the waiting time, and is less time consuming than the other methods
3) *Equipment Manufacturing:* Many giant companies have started moving to India to manufacture their respective products and it has been said that Lithium-ion batteries will emerge as dominant in the market, and it will become the world's largest EV manufacturer
4) *EV Franchise:* The demand is set to become higher and higher in the future since it is in the automotive industry.

Keeping in mind government incentives and consumer characteristics, many hurdles need to be dealt with in order to accelerate the growth of electric vehicles in India. The penetration pricing model is better suited to the Indian vehicle industry, which has a large number of middle-class buyers. This means that Indian auto officials must take action to capitalise on the sector's expansion, since electric vehicles may save a significant amount of national fuel while also reducing pollutants. India's EV ambition will also require an estimated annual battery capacity of 158 GWh by FY 2030, which provides huge investment opportunities for investors.

Many Indian states have recently established EV laws aimed at attracting industry investment and making EV adoption more appealing to the general public.

Electric vehicles are the future. Go Green, Go Electric

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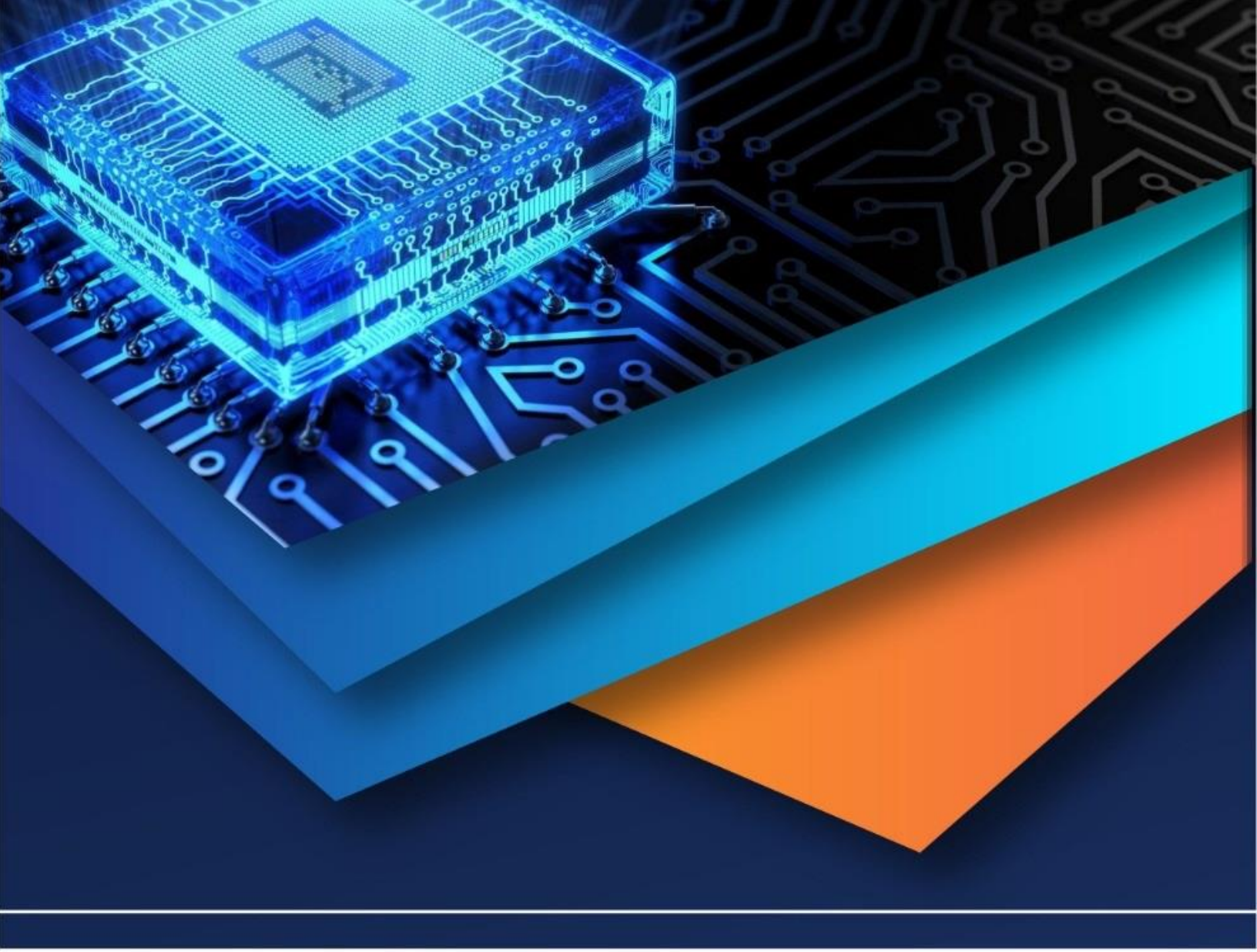

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