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E-Mobility the need of today and tomorrow moving towards Viksit Bharat

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Abstract: **There is a great need to decrease the bad effect of carbon emissions to improve the environment. This growth in population result in increased money, traffic as well as increased need for motor-powered transportation to transfer goods, services, and people. For over a century, burning fossil fuels has generated most of the energy required to drive our vehicles.**
Electric mobility is one of the feasible solutions of this problem in India. Due to the rapid urbanization and transport 80% of the total emissions are produced to destroy the environment. Indian government has made a target to add majority of electrical vehicles in the transport system by the year 2030. By 2030, NITI Aayog expects to reach 70% EV market penetration for all commercial vehicles, 30% for private vehicles, 40% for buses, and 80% for two and three-wheelers. This is consistent to reach net zero carbon emissions by 2070.
It seems to be difficult to achieve the target because of the scarcity of resources, limited availability of technology and required infrastructure needed for EV. To generate an ecosystem for EV in India needs better policies, battery power technology, wide infrastructure of charging stations and the people mindset. It also needs indigenous production for availability and affordability for the local consumer. We want to discuss in this paper the Indian scenario of e-mobility, current practices, inventions and a proper policy to inspire the people towards the justifiable e-mobility.

Index Terms :Renewable energy, E-mobility, sustainability, availability, affordability,

I. Introduction

Increasing global population has increased necessity for electric mobility. As the demand of transportation is increasing due to rapid growth. As the population continues to grow, fossil fuel-based transportation produces a lot of pollution, hence these are to be replaced by electric vehicles. This shift is driven majorly by environmental effects, sustainability, technological aspects, government policies, and consumer attitudes. Most of the countries are promoting e-mobility.
India is is urbanizing at a very fast speed. Originally traditional Indian cities were more dependent on the use of low-carbon and low-energy transport modes like walking and cycling. Rapid urbanization, economic growth, rising household income, and segregated urban planning contributed to the need for mobility and increased the travel demand at a very high rate (Joshi, Joseph, & Chandran, 2016). Usually, metro cities have a greater share of public modes of transport and non-motorized transport, which contracts substantially as the city size declines, making us further dependent on personal vehicles. As a result of congestion, pollution greenhouse gas emissions and carbon emissions are threats to sustainability (Sharma, Jain, & Singh, 2011).
The Indian transport sector consumes nearly 16.9% of total energy from fossil fuels. Presently, with maximum of the fossil fuel-based vehicles in India, the situation is growing worse. Therefore, the government opted to accept green mobility producing less or zero emissions. Government has aimed to go for electric vehicles by the end of 2030.

II. Research objective and Methodology

The investigative study is steered targeting to investigate the shift towards electric mobility in India. Applying the comprehensive approach, the study will assess the current trends, inventions, methods and challenges. The design of research concerns both quantitative and qualitative techniques, incorporating data gathering on the EV ecosystem, existing policies, air quality measurements, accessibility of infrastructure, affordability, and end user behaviour.

Via relative analysis, the research intends to find the impacts of electric mobility in lowering carbon emissions, improving air quality, and cost savings. Subsequently the findings of this study will aid to a meaningful understanding of the challenges and barriers, offering insights for policies and innovations to foster a sustainable environment.
As recent statistics, India had a population of 1.4 billion with 326.3 million recorded automobiles running on the road. This upsurge in populace carries bigger money, trade, and economic prospects, as well as augmented demand for motor-powered transportation to transfer goods, services, and public. Consequential in a climb in the sales of passenger vehicles by at least 26.7% in the year 2022-23. Maximum of these automobiles are fuel-based, which on burning releases deadly pollutants and greenhouse gases representing that vehicular traffic is a main contributor to inner-city air quality concerns.

III. TRANSFORMATION IN E-MOBILITY TECHNOLOGIES IN INDIA

Electric vehicles are a pretty new idea in India, ought to be took in a incredibly direct way to progress by switching fuel-powered vehicles. By the increase of pollution and shocking estimates of declining environmental conditions in the coming time, a way to reach ecological sustainability and pure air is to move to electrical mobility (Jayadharashini, 2019). Though, with period the nation has realised a substantial upsurge in the discovery and acceptance owing to the increasing demand for ecological concerns, zero-emission automobiles, positive government rules, development in the want for energy-efficient traveling, and increasing petroleum charges.

3.1 Government initiatives: The Indian Government has begun some plans to stimulate e-mobility, incorporating incentives and grants for purchasing electric vehicles. Few general initiatives comprise National Electric Mobility Mission Plan 2020 (NEMMP), and FAME.

3.2 Electric two-wheelers: In the initial phase of the acceptance of electric vehicles in India during 2011-20, almost 148 million two-wheelers were sold, and these figures may increase (Kumar, M, & Joseph, 2021). Offering it a sell value of USD 893 million in 2022 according to Automotive and Transportation Research, which in 2030 can extend with a standard annual rate of 27.30%. Yet as for the intentions for 2030, the Indian government propose transforming minimum 30% of all motor vehicle to electric to decrease air contamination. The modest maintenance expenditures of EVs and the arising ICE motor vehicle prices produced by the execution of BS 6 (Bharat Stage Emission Standards 6) are compelling this course for two-wheelers. Electric two wheelers have been presented by numerous companies, like Hero Electric, Bajaj, and TVS, in the Indian market. Such automobiles are extremely becoming prevalent in India.

3.3 Electric three-wheelers: Electric three-wheelers, usually to be well-known as "e-rickshaws," have become an environment friendly method of last-mile connectivity in our country. In the year 2015, they were presented legal status offering it a market value of US$ 890 million in 2022. Further with time this market is anticipated to raise to reach US$ 2,156 million by 2028, with a yearly growing rate of 15.8% between 2023 and 2028, or about 300% year-over-year. Such passenger motor vehicle is powered by battery-built electric motors that cut added expenses linked with fuel use. These EVs' sound acceptance level is an outcome of their low carbon releases, modest size, cost-efficiency, and noise-free operation.

3.4 Electric cars: Electric cars are getting more and more common in the country market because of the manufacturers like Tata Motors, Mahindra Electric, and Hyundai, amongst several others. For FY 2022, 17.8 K units of 4-wheeler passenger cars were on the market (team-bhp.com, 2022). These cars shown to be less polluting than fuel-based cars, and they are likewise midst the most reasonably priced as of their modest maintenance costs. It makes a positive point for them in the market with a rising fuel cost.

3.5 Electric buses: In India public transport is expanding substantially due to fast development and environmental interests ensuing in electrically powered buses as a constructive selection for the government. In 2022, the market was predicted to establish a value of $603.1 million, and it is predicted to attain $2,766.1 million by 2030 (Intelligence, 2022). Varied policies and programs have been realized by the Indian government in this band such as the National Electric Mobility Mission Plan (NEMMP) 2020 and Bharat Stage (Bs) VI 2020 for real emission control actions and increased the demand for such buses. The bus market has far higher EV entrance than other automobile sectors in all 3 of the main EV sales states, with levels of 15% in UP, 12% in Karnataka, and 8% in Maharashtra in India.

3.6 Charging-Infrastructure: For the massive increase of EVS, the country should have charging setup for both current and coming electric vehicles. Presently the network of charging setup isn't convincing enough as it is needed, yet many governmental and private companies are working on and funding the advancement round the country. During 2019, a total of 1,827 EV chargers were fitted of which 5% were fast chargers (Bank, 2021). Subsequent in January 2020, additional 2,636 charging stations were authorised across 62 cities in India under the FAME-II plan. From these, 1,633 would be fast charging stations and the rest 1,003 would be slow charging stations (Bank, 2021). Hence, by the ending of 2022, there were 5,500 charging connectors and 2,700 public charging stations. We may possibly also require additional infrastructure by the end of 2030, due to a steered rise in EV sales up to that time. Via programs like FAME1 and FAME 2, the Indian government has been helping the EV industry with a focus on charging setup.

IV. E-MOBILITY AS A SERVICE WITH SMART SOLUTIONS:

V.

Through companies like BluSmart, Lithium Urban Technologies, and Yulu offering e-vehicles on a payment or rental basis at inexpensive pricing, particularly now in urban areas, e-mobility service is an developing concept and would like to nurture more in the future. To arrange perfect and successful mobility services, India is also expanding smart mobility solutions such as mobile apps, public transport, intelligent transport systems (ITS), shared mobility, and vehicle-to-grid (V2G) technologies.
Government initiatives and policies to promote E-mobility in India: By offering officials with a variety of parameters and tools inside the setting of the accessible resources, the Indian government enhanced the production of electric vehicles. In the preceding 10 years, the government has taken numerous steps to reinforce the countrywide acceptance of EVs, involving tax encouragements and the setting public EV charging setup, along with other projects.

V. OBSTACLES IN THE IMPLEMENTATION FOR E-MOBILITY

Even if having the biggest population in the globe, India's acceptance of electric vehicles is exceptionally low as of lots of barriers in the development. The leading obstacle to this acceptance is the generation of the electricity needed to drive the vehicles, as lacking electricity it is not viable to predict the future with EVs. Other than the main cities, India yet has a difficulty with rural electricity. Hence, the distribution network is in more pressure to constantly provide sufficient power. Other than from electricity affordability, insufficient infrastructure, user preferences, battery technology, and rules and regulations are other key concerns. These challenges and problems are:

5.1 Adequate Electricity Supply: According to research 3% of populations in India still not have sufficient energy resources, and the design of the present power system will not be enough to hold the expanded load of EV charging. Fast charging stations for Evs spend a lot of electricity, which could put pressure on local distribution systems.

Likewise, with an upsurge in the necessity for electricity India might need additional fossil fuels to meet the increasing demand for energy since it produces 57.7% of its electricity from fossil fuels, mainly coal (49.3%) resulting in extra toxic emissions into the atmosphere producing air pollution (Wikipedia, 2023). The deprivation of abundance of electricity hinders the improvement and support of private charging points for users. Therefore, this deprivation of electricity questions the Indian government's alteration to the Electricity Act and how the required targets will be attained in a specific time with the primitive capacities.

5.2 Affordability of e-vehicles: In comparison to an ICE automobile, prices for Evs are fairly high in India; for instance, the least price for an electric automobile is about 1.3 million (13 Lakh INR), which is significantly more costly than a car that uses fossil fuel, which is 0.5 million (5 Lakh INR). It is because the importation of lithium used in battery production, account for around 50% of the cost of a vehicle (Singh, 2021). Just now with technology maturity battery costs have declined over the past some years, but still, Evs cannot attain the cost of an ICE motor vehicle. With several geopolitical occurrences and deficiency of raw materials for battery production price variability and obtainability develop into another point of concern making it tough to decide the Evs' long-continuing running cost in the country. India has the biggest number of motorized two-wheelers in the world, approximating around 37 million motorcycles/mopeds, with an average of 7.5 percent of Indian households (1 in 12) own up a car as per the Ministry of Road Transport. Nonetheless, affordability is yet a question due to extraordinary costs, import duties, inadequate production, and the cost of battery technology.

5.3 Charging infrastructure: The shortage of charging stations is a major barrier to the acceptance of electric vehicles in India as with no set-up people cannot cover longer distances. Electric vehicles have a restricted limit of travel and want charging stations on the society level or the alternative of charging while driving. Also these capacities necessary to be extend all over the cities for simple access which is presently missing in Indian cities. At present, an plenty of fuel stations already survives in the country creating hurdle in launching charging stations (Sarode & Sarode, 2020).

Furthermore, the availability of land at funded prices and constructing a charging station needs a substantial amount of funds which at the present level of use hold back the business viability. (Bank, 2022).

Additionally, restrained demand, high installation cost, deficiency of clear policies and policies, and technological and set-up challenges are several of the other major reasons for the lack of charging setup.

VI. REGULATION AND ENCOURAGEMENT:

For the appropriate productivity of this innovative technology in the Indian market transparent rules and guidelines are needed. Via various schemes (already mentioned above) the administration is introducing the stimulation of electric vehicles by giving subsidies, foreign investments, local manufacturers, etc., however still, as contrasted to other cities we deficit proper law. The Indian electric mobility market presently needs laws to guarantee safety, reliability, and sustainability in the industry. Beside the enhancement of standards, guidelines as well as obvious policies, incentives, and end user protection for the attainment of electric mobility in India.

6.1 Range concern: Range concern can be believed a chief roadblock to EV acceptance due to the smaller range causing charging worry for the users. These days Tesla's Model S has the prolonged range of 370 miles per charge but being costly and not available in the Indian market we don't have access to it. On the other hand, EVs existing in the Indian market do not have a range of above 500km per charge (Singh, 2021). Hence, the question of range concern is directly concerned to the lack of charging base in the nation.

6.2 Battery technology: For EV to be effective in India, where lots of people drive longer distances, battery technology is critical. Consumers face range nervousness due to the short range of electric vehicles contrasted to fossil fuel powered automobiles. The high cost and the long-term performance decline of batteries due to severe temperatures are a point of concern. India cannot at present construct modern battery technology nationally as an outcome there is a bigger expense and dependence on foreign nations. Further, India's sources of necessary raw materials (lithium, cobalt, nickel, and graphite) essential for battery production, are constrained. In future, import taxes, a absence of scale in home manufacture, and a absence of technological knowledge all impact to the elevated cost of batteries.

6.3 Consumer insight: The consumer insight of this technology is all that concerns. Here various buyers are ignorant and underinformed about electric automobiles. Because of a lack of trustworthy information, there are many false impression and myths concerning EVs, with ones related to their excessive purchase prices, short range, battery life, maintenance requirements, and performance.

VII. POLICY REQUIRED TO ENCOURAGE GROWTH OF E-MOBILITY

To employ electric vehicles on a substantial scale and to meet all the goals set by several official bodies it is needed to tackle all the challenges stated above. In future, four transformative low-carbon technologies LEDs, solar energy, wind energy, and EVs will reconfigure numerous industries in India in corresponding to other tech-driven progresses like shale gas or e-commerce (Srikanth, 2018). This shows that though the nation is transforming markedly in each of these areas, small important improvement has been made, specifically in electric vehicles.

Even though the government is presently operative on a variety of projects and plans, these are not adequate to encounter the goals established for 2030. Thus, below are a few suggestions that can be accepted in the shift to low-carbon, ecologically friendly, and protected energy future.

Policies and regulations: The Indian government is presently building NEMMP and FAME, including other policies and programs, to realise electric mobility goals by 2030. Yet, there is the necessity to work in a further careful manner as these projects and plans do not propose a clear road map for their carrying out. Here, the government requires to thoughtfully focus further on the projects and programs in phases over three to five years.

Each one phase period should to be supported by the suitable tools and procedures to be carried out collectively with the related authorities. Furthermore, each phase's steps forward requires to be well tracked, and perceptions for the next phase ought to be given.

As endless destroying air quality in India has become a key reason for the acceptance of EVs in the Indian market. To be more tactically minded, the Indian government may work on a few pilot projects for some of the greatest polluted cities (see Table 1), which at least have some essential infrastructure, comprising a stable supply of electricity and a grid supply system. And these if succeeded well can be afterwards repeated in another Indian cities.

VIII. FACILITY OF ELECTRICITY IN EVERY HOUSEHOLD THROUGH A GRID SYSTEM:

IX.

Nowadays the country's 3% of the populace hardly has any access to electricity, and the further half still suffers from quality and irregularity making it problematic to attain the anticipated targets (Agrawal, Mani, Jain, & Ganesan, 2020). The government desires to work parallelly on cultivating the basic set-up wants of grid-based electricity systems by setting up power plants, the transmission of electricity over high-voltage transmission lines, and distribution of the households and businesses over local networks for the easiness of acceptance of these vehicles. Therefore, the grid setup requires to be enhanced to lever the increasing demand and smart grid technologies must be executed for load administration.

IX. AFFORDABILITY OF ELECTRIC VEHICLES:

Among the enhancement of the EV approach in India battery needs will rise constantly. Between 2017 and 2020 it was nearly 120 GWh, which can rise to 970 GWh between 2021 and 2025 and can exceed 2410 GWh from 2026 to 60 2030 (Srikanth, 2018). Currently mainly of the parts for EVs and their batteries are being trade in to the country directing to an increase in prices. Independent research establishments must be formed, and understanding laws ought to be applied for regional producers, markedly for batteries, as importing cannot be a enduring answer. Hence, the Indian government need to take action to design and construct self-made solar cells and elements. Auto manufacturer must be capable to develop batteries at smaller costs building domestic battery production, and in the long run, the country might start exporting electric batteries. This may also effect in economies of scale, which would raise the number of jobs in this sector round the nation. Hence, the government ought to work to add domestic battery manufacture, which will decrease the rate of electric vehicles.

X. ENCOURAGEMENT AND PROMOTION:

Preceding nations in the area of electric mobility have by now made a many incentives and motives accessible via numerous stakeholders to encourage electric vehicles. To boost the usage of EVs amongst its people, the Indian government must offer inducements for registration and road tax, insurance benefits, free parking, diverse toll benefits, buying subsidies, and land for the construction of public charging facilities for EVs, in addition to improvements to those that already exist. Presently, the Indian Government has no offers to sponsor and promote the manufacturers developing Lithium-ion batteries. At least the government ought to present some encouragements even for a shorter period to encourage the companies to invest in this field so that we can realize the set 2030 electric mobility objectives. The government ought to build correct policies to support EVs by PSUs. Particularly in the case of EESL (Energy Efficiency Services Limited), it can spread its services to the State Governments for public transport, which will safeguard economies of scale over standardization, and will decrease the need to offer subsidies to distinctly run electric buses in the States. Beyond it, allowing the increase of charging stations by the same association will help in the acceptance of electric vehicles by added category users. By this way the environment-related complications in our towns can be controlled as the current petrol and diesel vehicles will gradually be substituted or replaced.

10.1 Battery exchange and other charging solutions: Battery exchanging technology is the finest alternative for drivers to resume their travel without waiting for their automobiles to recharge, saving a lot of time. Conversely, this technology has not achieved much consideration due to its high cost and deficiency of uniform battery sizes. Firms like Tesla have alternatives for battery swap over but this ought to be made farther common for the consumers for each type of electric vehicle for their ease.

10.2 Customer awareness: Consumer awareness is a great issue for the Indian electric vehicle market, and consumers are the major game changers for the acceptance of these vehicles. The Indian government apart from offering different kinds of supports or incentives should also conduct workshops and additional group events or blowout knowledge over social media platforms to make people more conscious of the benefits these vehicles provide them.

10.3 Exploration and development: As required, the Government of India must focus on exploration to obtain raw materials for the batteries (such as lithium, nickel, and cobalt). So, creating research facilities to recycle or reuse Li-ion batteries to decrease the requirement to import such costly materials. Distinct government controlled and private exploration/mining administrations must be addressed to discover cobalt and nickel in India (Srikanth, 2018).

XI. CONCLUSIONS

In this analysis, an attempt is made to identify the need, existing conditions, barriers, and guidelines needed for the acceptance and promotion of electric vehicles in the Indian market. The application of EVs in India mainly points at lowering greenhouse gas emissions from fossil fuels and cutting oil expenses. The Indian Government’s plan to electrify all vehicles by 2030, is going to be a roller coaster

ride that will differ on how the whole system will work and grow from access to electricity, obtainability of infrastructure, customers' attitude, market growth, growth, and lastly how the city and urban planners support in the course to develop policies and standards for it.

With the current situation of raw materials for vehicles, decrease in fossil resources, and increase in fuel rates, India requires an energy changeover. Few obstacles in attaining the goals can be classified mainly as a shortage of necessary infrastructure for charging, affordability, high battery costs, and driving range, of these automobiles. Also, the nation ought to think about how to generate plenty of electricity with no use of fossil fuels. The electric vehicle producers too should have a proposal with a appropriate timeline and financing strategies to arise a manufacturing ecosystem and scale up the sales and obtainability of EVs in the nation at minimal prices.

Officials and city planning experts ought to make planning patterns, and regulations helping the promotion of charging infrastructure at the city, zonal, and neighbourhood levels. The authority is working effectively to push EVs in the market to reach its 2030 targets, but these attempts are not adequate. The authority requires to work in a further specified and time-framed manner with short-term objectives. There is a necessity to put efforts on some pilot projects first and then reproduce them through the nation.

At present, if the government focuses on affordability and infrastructure, then the consumers will be ready to take EVs in the coming time. Hence, along with the prospect of lowering carbon emissions, air contamination, and boost of energy security, the nation can also turn into an automotive export marketplace. These shifts will alter the business pattern in the nation and also the usage patterns for the consumers.

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