ISSN: 3049-1479(Online)

Examining the Literature on Electric Vehicles

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Abstract: With the current depletion of fossil fuels and its rise in price there is a need to locate an alternating energy supply to run the vehicle. Given the catastrophic environmental effects of burning fossil fuels and the significant contribution of modern vehicles to pollution, electric vehicles, or E-vehicles, have emerged as a blessing for the globe. Even the recent increase in gasoline prices and the paucity of natural resources inspire people to consider e-vehicles as a great way to commute with no environmental impact. In the current global climate, green energy is essential, and the use of e-vehicles contributes significantly to the reduction of pollution. Since it is well acknowledged that e-vehicles have a vast market, it is necessary to use effective marketing strategies to raise customer awareness of the benefits of owning one and encourage them to make a purchase. It is necessary to comprehend the expectations and perceptions of the client. This article attempts to examine the body of research on the adoption of e-vehicles and to highlight consumer attitudes and intentions about e-vehicle adoption.

Keywords: E-vehicle, consumer perception, purchase intention, Environmentally Friendly

I. INTRODUCTION

The automotive sector has grown to be a significant force in both the global economy and research and development (R&D). Vehicles now have systems that put the safety of both passengers and pedestrians first thanks to the ongoing improvement of technology. As a result, there are now more cars on the road, giving us the convenience of comfortable and speedy travel. But there is a price for this advancement. Vehicles that are propelled by one or more electric motors are referred to as electric vehicles. These cars often run entirely on batteries, making them self-sufficient. We have been racing to build more electric cars ever since they first appeared in the middle of the 19th century. Efforts to reduce environmental impacts and reliance on fossil fuels are aided by electric automobiles. Electric motorcycles, electric bicycles, electric automobiles, and other vehicle types can be examples of them. In India, 90% of people and 64.4% of all commodities are transported by road thanks to a steady increase in infrastructure and improved road connections. The expansion of the Indian car industry may be explained by the rising demand for vehicles. In a country with the second-largest population in the world—nearly 130 million people, or 17.7% of the world's total population—air pollution is one of the major threats in the globe —people are having trouble breathing in the majority of the major cities. Other pollutants that autos release are source emissions and fugitive fuel; the quantity of emissions fluctuates according on the kind of vehicle, maintenance, and other variables. Due to greenhouse gas (GHG) emissions, the transportation industry contributes significantly to air pollution and climate change, mostly in metropolitan areas; This has made road transport electrified, requiring new energy cars to replace internal combustion ones. For example, electric cars appear to be a promising step in the direction of urban sustainability.

Due to the rapid expansion of the Indian car industry, electric vehicles (EVs) are emerging as a practical way to enhance economic opportunity, energy security, and air quality. The greenhouse gas problem has been getting worse every day in recent years, and the price of gasoline has increased by around 90 rupees per liter. Public transit is crucial to everyday living, yet because of the high cost of gasoline, some individuals choose not to use automobiles or bikes. In order to turn conventional vehicles into dependable electric vehicles, several automakers and startups have made an effort. An electric vehicle is one that is powered by an internal electric source and driven by electric motors. India has

http://doi.org/10.63766/spujstmr.24.000032

the third-largest road network in the world. For Indians, taking the street is the better option. Nearly 60% of people traveled in their own or other people's cars (Statista, 2020). Two of the main contributors to environmental air pollution and global warming are gasoline and diesel. Sixty-six percent of air pollution-related deaths in India are caused by diesel vehicles. This study has shown that India's transportation emissions, especially those from diesel, cause major health concerns. (Research by an Environmental Specialist) The Indian government has undertaken a variety of schemes to promote the development and usage of electric vehicles. As a result, EVs are now more widely available in the Indian market. The government wants to see India completely powered by electric vehicles by 2030. It has been recommended that all two-wheelers sold in the country after March 31, 2025, with engines less than 150cc, and all three-wheelers sold after March 31,

2023, be electric vehicles (EVs). (Policy for transportation) FAME India is part of the National Electric Mobility Mission Plan. FAME's primary goal is to promote electric automobiles by offering financial incentives. By giving upfront incentives for purchasing electric automobiles, FAME Schemes aim to promote the quicker adoption of Hybrid and electric automobiles. As old as the automobile it is the history of electric vehicles, or EVs. Actually, light-weight electric vehicles (EVs) were the most popular vehicle type in the United States at the beginning of the twentieth century, with the first experimental models appearing as early as the mid-1830s. However, they had fallen behind the internal combustion engine (ICE) vehicle and vanished from the market before the conclusion of World War I. Since the beginning of the twenty-first century, several nations have engaged in extensive discussions over the problems of climate change and global warming. Numerous pertinent studies have demonstrated the detrimental effects of climate change that is mostly caused by human activity. Air pollution has become a serious issue as a result of numerous enterprises using fossil fuels as a result of the world's growing industrialization and civilization (Wee, 2010). At the same time, it is impossible to overlook the exhaust emissions from automobiles. Vehicle emissions have been identified as the primary cause of the effects of greenhouse gases, contributing to the rise in many types of cancer and other severe illnesses. These emissions mostly consist of CO2, CO, NO_2, and particulate matter (PM10 and PM2.5).

II. LITERATURE REVIEW

The results and methodological and theoretical developments of the most recent research on a subject are examined in a review of the literature. The literature study makes use of secondary sources rather than the most recent or innovative experimental work. G Tamil Arasan, G Sivakumar, and Mohamed M. conducted a study on the opportunities and challenges of electric vehicles in India. Electric engines will significantly cut pollution and benefit customers when they replace internal combustion engines. Numerous nations have adopted this technology and are helping to better the environment. The study observed the potential and difficulties associated with EV implementation in India. Opportunities from industries, the environment, batteries, and government initiatives have all been taken into account. These issues were taken into account, including the demand for EVs, their cost, and their efficiency in India. The main goals of EV adoption in India are to reduce greenhouse gas emissions and oil costs. The government should take full use of the possibilities and identify appropriate solutions to the problems. (Mohamed M, 2018) Figure 1 illustrates how an electric automobile operates, with the motor receiving power from a controller that draws electricity from a battery. The electric principle powers the e-vehicle.

The electric motor is powered by a battery pack. In order to spin the transmission system, the e-motor uses the energy from the rechargeable battery. A potentiometer attached to the car's accelerator pedal tells the controller how much power should be sent to the electric motor. In order to power an electric motor that rotates the wheels, electric vehicles (EVs) store electricity in a rechargeable battery pack. A major departure from conventional gasoline-powered automobiles is represented by an electric vehicle. Fundamentally, an electric vehicle (EV) is propelled by energy that is stored in batteries as opposed to burning fossil fuels. This essential distinction changes how EVs function and makes them more environmentally friendly. Electric motors provide a greater portion of the propulsion for electric cars. These motors transform electricity into motion by drawing power from the car's battery pack. Electric vehicles (EVs) operate on the basis of converting electrical energy that is generated or stored in batteries into mechanical energy that powers the vehicle. An electric automobile is a vehicle that uses energy stored in rechargeable batteries to power its electric motors, either totally or partly.

According to Bhattacharyya and Pradhan (2023), the main contribution of this study is a summary of the challenges and problems associated with electric cars in India. The EV sector is impacted by a variety of obstacles and bottlenecks in emerging nations; some are small annoyances, while others have a big impact on growth. Social issues must be handled in addition to specialized solutions, and new difficulties are always coming up. One of the main instances that encourage

companies to look for a solution to these challenges is India's highly ambitious objective of having 100% electric portability by 2030. Countries all across the world were encouraged to transition to electric vehicles by the Paris Declaration on Electro mobility.

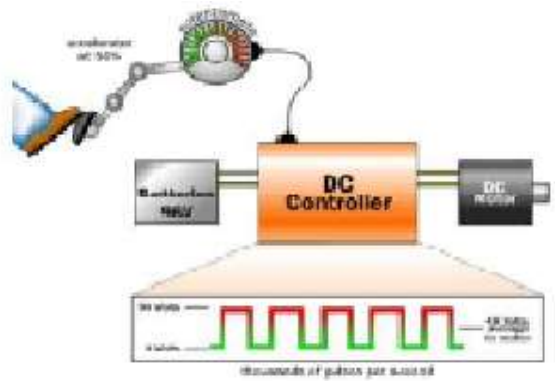

Fig. 1. Principle of Electric Car

III. EV BENEFITS

EVs can serve as a substitute mode of transportation, offering users a number of benefits, some of which are listed below:

A. Electric vehicles are environmentally beneficial.

Since EVs don't emit smoke, they don't contribute to pollution like ICE vehicles do. Thus, they aid in lowering CO2 emissions. Even when utilizing fossil fuels, EVs produce fewer pollution than cars with internal combustion engines (ICEs). Air pollution is decreased by pure EVs as they have no tailpipe emissions. Because the EV's electric motor runs on a closed circuit, it doesn't release any dangerous gasses. Since pure electric vehicles don't need gasoline or diesel, they are very environmentally friendly. EVs emit no direct emissions and have no tailpipes.

B. Low maintenance expenses.

Vehicles that run on gasoline or diesel need routine maintenance since they have a lot of moving parts. Since electric cars have fewer moving components than conventional cars, it isn't the case. This implies that the long-term maintenance costs of your electric vehicle will probably be reduced.

C. Reduced operating expenses

You save a lot of money on fuel since you don't have to pay for gasoline or diesel to keep your EV operating. When compared to the cost of gasoline or diesel, charging an electric car is far less expensive. By using sustainable energy sources like solar, you may further lower your electricity costs.

D. Reduced expenses for gasoline

Gas costs are reduced because EVs don't need gasoline. Compared to traditional cars, EVs are more efficient. EVs are less expensive per kilometer than ICE cars.

E. Zero emissions from the tailpipe

Since EVs have no exhaust emissions, they contribute to a smaller carbon impact. You may lessen your carbon footprint even further by charging your EV using renewable energy. All-electric vehicles have zero tailpipe emissions, while plug-in hybrid electric vehicles (PHEVs) likewise have no tailpipe emissions when operating in all-electric mode. The benefits of HEV emissions vary by car model and hybrid power type. The source of the electricity required to charge an electric vehicle impacts its life cycle emissions, which vary by region. In places where electricity is generated using comparably low-polluting energy sources, electric vehicles frequently outperform equivalent conventional vehicles fuelled by gasoline or diesel in terms of life cycle emissions. Nitrogen dioxide (NO_2), carbon dioxide (CO_2), and exhaust pollutants are not produced by these automobiles. The manufacturing processes for batteries are often more ecologically friendly, despite the fact that the creation of batteries has a negative influence on the carbon footprint compared to other manufacturing.

F. Environmentally Friendly

EVs are less polluting cars since they don't emit any exhaust. You may reduce greenhouse gas emissions even further if you choose to charge your EV with renewable energy. Some EVs are built using components that are good for the environment. For instance, old vehicle components, biobased materials, and recycled plastic bottles make up a portion of the Nissan Leaf and Ford Focus Electric.

IV. DIFFICULTIES AFFECT ELECTRIC VEHICLES (EVS)

There are still a lot of obstacles to overcome until the future of electric vehicles is established. Power generation is essential to the operation of electric vehicles in India. We cannot see the future of electric vehicles without power. Therefore, the distribution network's obligation to consistently deliver the right amount of electricity has increased.

A. Absence of infrastructure for charging

One of the biggest obstacles is the absence of a comprehensive and effective charging infrastructure. Slow charging rates, a lack of charging standards, and the expense of chargers are all potential problems for drivers. Owners of electric vehicles may worry that they could run out of fuel before arriving at their destination because these vehicles typically have a lower driving range than conventional automobiles. It is difficult to predict where electric vehicle- related technologies will go in the future because they are always undergoing development. For instance, one of the main variables influencing the adoption of EVs is battery performance, which is presently subpar. Even with recent improvements in infrastructure development, charging stations are still not as convenient or accessible as traditional gas stations.

B. Prices are expensive.

EVs can be expensive. One of the most significant barriers to the mainstream adoption of electric vehicles (EVs) is their high initial cost. The most significant impediment to the EV market is the high cost of vehicle acquisition. Because of battery technology, electric automobiles are more expensive to build than gasoline-powered vehicles. The battery is the most costly component of an electric vehicle, whose cost has been falling but is still considerable. The majority of EV batteries in India are imported from China, which raises the price.

C. Fear of the range

The restricted driving range per charge is one of the main issues causing range anxiety. EVs have always had limitations on how far they can travel on a single charge, despite tremendous advancements in battery technology. Continuous improvements in battery technology hold the key to the answer. The dread of running out of energy when operating an electric vehicle (EV) is known as range anxiety. In the past, EVs' driving range between charges has been constrained. Concerns over the vehicle's range on a single charge may arise among drivers. With a range of 370 miles between charges, The Tesla Model S currently has the greatest range of any electric vehicle on the market. In India, EVs typically have a range of 120 km when completely charged, making them unsuitable for long travels. The sluggish pace of EVs in India might put off buyers. The top two electric vehicles produced in India have top speeds of 85 km/h.

ISSN: 3049-1479(Online)

D. Battery Supply Chain and Technology

Certain minerals and rare earth elements are required to make lithium-ion batteries, which are an essential component of electric cars. India is now experiencing supply chain challenges as a result of its reliance on imported batteries for manufacturing's' convenience and usefulness are impacted by the fact that charging takes longer than refilling for traditional cars.

V. OPPORTUNITES AHEAD

The Indian government may support electric cars (EVs) in a number of ways. To promote the purchase of EVs, the government provides incentives. The government has expanded the exemption from customs duties to include the importation of capital goods and equipment used in the production of lithium-ion batteries. The government has waived road tax on EVs. The 12% GST on EVs has been lowered to 5%.The government is expanding the public charging infrastructure for EVs. The PM E-DRIVE scheme will subsidize charging stations for two- and three-wheelers. Additionally, the program requires 50% domestic value addition in chargers and gives priority to solar charging throughout the day.

VI. INDIA'S ELECTRIC VEHICLE (EV) POLICY

India's electric vehicle (EV) policy aims to promote local manufacturing and attract investments from global EV companies. In 2012, the idea for the National Electric Mobility Plan (NEMP) was developed. It was started with the goal of increasing the number of electric cars (EVs) that are purchased and used while also lowering the number of vehicles that run on fossil fuels. India's primary project to encourage electric transportation is known as FAME, or Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles. It was introduced by DHI in 2015. Presently in its second phase of execution, FAME-II is being carried out for three years, starting on April 1, 2019, with a budget of 10,000 Cr, which includes Rs 366 Cr in overflow from FAME-I. Two-wheeler: up to 40% of the vehicle's cost, or Rs 15,000 per kWh. KWh for a three-wheeler: Rs 10,000. Per kWh, four-wheeler: Rs 10,000. E-buses: 20,000 rupees per kWh. The National Electric Mobility Plan (NEMP) sought to attain 30% EV adoption in India by 2030 and sell 6–7 million EVs by 2020. In 2013, the Indian government unveiled the National Electric Mobility Mission Plan (NEMMP) 2020.By encouraging hybrid and electric cars across the nation, it seeks to achieve national fuel security. The Vehicle Scrap page Policy, This program provides incentives for the acquisition of new electric vehicles and the disposal of old vehicles. the Production Linked Incentive (PLI) program, which provides financial incentives for manufacturing electric vehicles and their components. Raising awareness of the advantages of EVs and EV charging infrastructure is the goal of the Go Electric campaign. The Ministry of Power's most recent suggestions for charging infrastructure (MoP recommendations), there should be a minimum of one charging station on either side of the highway, spaced three kilometers apart and at intervals of twenty-five kilometers. The National Mission on Transformative Mobility and Battery Storage seeks to promote the development of giga-scale battery manufacturing facilities in India. and develop a comprehensive ecosystem for EV adoption. Furthermore, the Ministry of Housing and Urban Affairs amended the Model Building Bye-laws, 2016 (MBBL) to mandate that 20% of parking spots in residential and commercial buildings be set aside for EV charging stations.

VII. LITHIUM RESERVES IN INDIA COULD REVOLUTIONIZE THE (EV)

India currently imports all of its lithium, cobalt, and nickel. Discovering lithium reserves in India could reduce the countries reduce the price of EV batteries and reduce reliance on imports. Lowering the cost of EV batteries could make EVs more affordable for Indian consumers. The lithium reserves could transform India from being just an EV consumer market to a global supplier. The reserves were found in a small area of land in the Mandya district, about 100 kilometers from Bengaluru. The reserves were estimated to be 14,100 tones of lithium metal Researchers from the Atomic Minerals Directorate, a part of India's Atomic Energy Commission, estimated that lithium resources in a small area of land surveyed in the Southern Karnataka district totaled 14,100 tones. Batteries for electric vehicles are largely made of lithium. With 9.3 million metric tons, Chile has the world's largest lithium deposits. About 33 percent of the world's lithium resource base is found in the country's Salar de Atacama, which is said to contain the majority of the world's "economically extractable" lithium deposits.

VIII. FINAL SUMMARY

One of the factors deterring consumers from buying EVs is their high cost. After I've presented all of the facts, I'll be able to make some conclusions. As technology develops, electric cars are becoming more and more viable for long-distance driving. Numerous high-end electric cars, such the Tesla Model S and Tata, are able to travel great distances while on home electricity. In addition to being able to travel great distances, these premium electric cars also save petrol costs and support environmentally friendly transportation. However, the high price of these cars may be out of reach for the majority of working-class families. However, everyone will ultimately accept electric vehicles since they are good for the environment and society. In order to address this, the government has promoted a broader adoption of EVs by offering incentives for corporate automobiles. However, foreign batteries are the fundamental reason why electric vehicles remain at least 30% more expensive.

The initial phase of the FAME program was initiated in 2015,to promote the adoption of hybrid and electric vehicles in India. It supported 2.8 lakh vehicles. In 2019, the FAME scheme's second phase was introduced to encourage the electrification of shared and public transportation. Electric two-wheelers, electric buses, electric three-wheelers, and electric four-wheeler passenger automobiles were among the electric and hybrid vehicles for which it offered incentives. Infrastructure for charging was also funded by it. The FAME program seeks to decrease vehicle emissions and lessen reliance on fossil fuels. Additionally, it backs legislative efforts including lowering the GST on EVs and facilitating state EV regulations. Over the last quarter, manufacturers have produced various new EV models that provide a higher range—some considerably more than the 80-90 km a EV delivers presently. Over 1.7 million EVs were sold in India annually in FY2025. Electric two-wheelers (E2W) accounted for almost 55% of these sales. By 2030, Deloitte projects that 31.1 million EVs will be sold annually worldwide, with 81% of those sales coming from BEVs. In India, EV sales are predicted to touch 1.644 million units by FY25 and increase to 15.331 million units by 2030. Tata Motors' Nexon EV and Altroz EV, as well as Maruti Suzuki's Futuro-e, are two EVs that have captured Everyone's curiosity in the expo. With the Ora R1, Great Wall Motors of China stole the spotlight. Another significant challenge for EVs in India is poor charging infrastructure. India's charging infrastructure requires rapid attention, since there are just 2,636 charging stations.

As stated by Rishabh Jain, manager of the public policy think tank CEEW, Centre for Energy Finance, India has plenty of energy producing capacity to power this vehicle. According to analysis, In 2017–18, 21.3 million tons of gasoline and diesel were used by four-wheeler passenger and commercial vehicles. If the distances driven by these cars be it is estimated that over 50 billion units of energy would have been required to charge the EVs over the corresponding EV-km. This is equivalent to 3.2% of the power produced during the same fiscal year. The Central Electricity Authority estimates that India has 31 GW of installed solar power producing capacity. This indicates that there is enough electricity for EVs. But all we need is a strategy to establish charging stations, which would require power distribution firms, for instance, to modify their transmission systems to accommodate the demand from EVs. Experts highlight this segment's business potential. There are several alternatives available for power and battery players. Even EV charging stations open up opportunities for small-scale commercial initiatives. This might boost the "Made in India" campaign and provide opportunities for Indian enterprises. India can reduce its dependence on imported gas and oil by expanding these markets. Another fantastic possibility which may be obtained is via storing extra solar power in EV batteries which can be sold back to the grid. In conclusion, the introduction of electric vehicles (EVs) represents a significant shift towards environmentally friendly transportation, offering a number of benefits including lower greenhouse gas emissions and a decreased need on fossil fuels.

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