International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

E- Mobility and India

Ritesh Shukla[a*],Vaibhav Kate[b], Surhud Patil[c], Manupratap Singh Parmar[d]

[a*]Department of Electronic and Telecommunication Engineering, SSBT College of Engineering and Technology, Jalgaon, India, shuklaritesh28@gmail.com
[b]Department of Mechanical Engineering, SSBT College of Engineering and Technology, Jalgaon, India,katevaibhav03@gmail.com
[c]Department of Chemical Engineering, SSBT College of Engineering and Technology, Jalgaon, India, patilsurhud@gmail.com
[d]Department of Mechanical Engineering, Motilal Nehru National Institute Of Technology, Allahabad, India
parmar.manu.3232@gmail.com

A B S T R A C T

Electric vehicles are an effective way to reduce greenhouse gas emissions. Electric vehicles minimise fossil fuel dependency while also reducing ozone-depleting chemicals and facilitating large-scale renewable deployment. With the ongoing depletion of fossil resources and their rising prices, an alternative energy source to power the vehicle is required. Electric Vehicles (EVs) are becoming a promising conduit for improving air quality, energy security, and economic opportunity in India, thanks to the tremendous growth of the automobile sector. The Indian government recognises the need to investigate sustainable mobility options in order to reduce reliance on imported energy sources, reduce greenhouse gas emissions, and offset negative transportation effects such as global warming. The simplicity of electric vehicles in India will be investigated in this article, as well as the compatibility of EVs in India. Even if the adoption of electric vehicles has begun, people continue to rely on fossil fuel-powered automobiles. However, as compared to conventional fossil-fueled vehicles, EVs face issues in terms of life cycle assessment (LCA), charging, and driving range.

Keywords: Convectional vehicles, Electric vehicles Vehicle to grid Optimisation technique CO2 reduction.

1) INTRODUCTION

Due to harmful emissions from the transportation sector and investments by various OEMs, there is concern that the number of low-cost EVs will increase in the future years. Several variables, including technology advancements, lower car costs, government policy support, vehicle purchasing incentives, parking benefits, and enough public charging infrastructure, may contribute to the proliferation of electric vehicles in India. With the largest road network, India is ranked third in the world. For Indians, travelling by road is the preferred mode of transportation. Almost 60% of the population travelled by personal or shared vehicle (Statista,2020) Petrol and diesel are significant contributors to global warming and air pollution. In India, diesel vehicles are responsible for 66% of air pollution-related deaths. This research has revealed substantial health concerns associated with transportation emissions in India, notably diesel pollutants. (Environmental Expert Study) Because electric vehicles are produced in such small quantities, their overall market share in India is insignificant. Electric vehicles (EVs) include I electric two-wheelers (E2Ws) such as electric bicycles and scooters, ii) three-wheelers such as E-rickshaws, and iii) four-wheelers such as electric cars. The Reva Electric Car, India's first electric car manufacturer, launched its car in the early 2000s with the goal of producing inexpensive cars using modern technology. The Indian government has made a number of steps to promote manufacturing and electric vehicle usage. As a result, the market for electric vehicles in India has grown. The government wants India to be a 100% electric vehicle nation by 2030. It has recommended that all two-wheelers and three-wheelers sold in the country after March 31, 2025, and all three-wheelers sold after March 31, 2023, be electric vehicles. (Policy on transportation) The National Electric Mobility Mission Plan includes FAME India. FAME's major goal is to stimulate the use of electric vehicles by giving financial incentives. The goals of FAME Schemes are to encourage faster adoption of electric and hybrid vehicles by providing upfront incentives on electric vehicle purchases. The key originality of this study is that it provides an overview of the barriers and constraints of an electric car in the Indian setting.As the electric vehicle market grows, the focus should shift from intervention to actual adoption. In addition, the difference between purpose and actual behaviour must be considered. The current study's key research gap is consumer knowledge and abilities for assessing and comparing the financial benefit and cost of electric vehicles. Future research on how to best inform customers could have ramifications for policymakers and marketers seeking to understand the financial benefits and costs of electric vehicles.

Ritesh Shukla. Tel.:7875916983;
E-mail address- shuklaritesh@gmail.com

2) OBJECTIVES

1) To determine the most important approaches, barriers, and challenges of employing a battery-powered car in a developing country such as India.

2) To raise awareness in India about the benefits of battery-powered vehicles over traditional fossil-fuel vehicles, as well as to analyse the reasons why electric vehicles have received little attention in India and future opportunities.

3) ELECTRIC VEHICLE OVERVIEW

The holy grail of electric vehicles is to replace internal combustion engines with electric motors that are driven by battery energy via a power electronic traction inverter. The car is powered by an electric motor that utilises 90–95 percent of the input energy, making it a very efficient vehicle. The battery, charging port, charger, DC/DC converter, power electronics controller, regenerative braking, and drive system are the main components of an electric car.

When compared to nickel-metal hydride and lead-acid batteries, Li-ion batteries are more expensive to produce. Li-ion batteries can live for up to 12 years, depending on the climate and maintenance plan.

The DC/DC converter transforms high-voltage DC power from the battery into low-voltage DC power that powers the vehicle's accessories. The power electronics controller manages the flow of electrical energy from the traction battery to control the traction motor's speed and torque.

Regenerative braking is critical for maintaining vehicle strength and attaining increased energy efficiency. This braking method leverages the motor's mechanical energy to convert kinetic energy into electrical energy, which is then returned to the battery. Because regenerative braking extends the range of an electric vehicle, it is frequently used in hybrid and battery electric vehicles. When the car travels ahead, the electric motor provides forward momentum, and when the brake is applied, it can be used to charge the batteries, a process known as regenerative braking. It can reclaim 15% of the energy it has consumed for acceleration. Despite its effectiveness, it is unable to fully recharge the electric vehicle. [1] The replacement of internal combustion engines (ICE) with electric engines will significantly reduce pollution while also providing a financial benefit to consumers. Many countries have adopted this technology and are benefiting the environment as a result. The study observed the advantages and disadvantages of EV implementation in India. Government initiatives, batteries, industries, and the environment have all been taken into account. These issues, such as the cost of EVs, the efficiency of EVs in India, and EV demand, were all taken into account. In India, the usage of electric vehicles is largely intended to reduce greenhouse gas emissions and oil costs. The government should make the most of the opportunities offered and identify appropriate solutions to the issues. (2018, Mohamed M) [2]

4) HOW ENGINEERS ARE IMPLEMENTING BETTER, STRONGER, AND MORE AFFORDABLE [4]

Engineers working in mechanical, chemical, electrical, and other fields are resolving issues that previously made mass adoption of electric vehicles difficult. One of the most significant roadblocks, according to Dalal, is the expense of batteries. The total amount of energy accessible in batteries is measured in kilowatt-hours (kWh), and the cost per kWh ($/kWh) is a typical indicator. According to Dalal, if the market price per kWh is $1000, a Tesla Model S P100D with a 100 kWh battery will theoretically cost $100,000. The average (cost) is now between $300-500 / kWh, which is nearly half of what it was less than five years ago, thanks to breakthroughs in battery technology. This is an example of EV demand and hybrid/electric technology adoption. ― Recent technological advancements that have made electric vehicles more affordable are a result of an engineer's capacity to study and use knowledge from a number of engineering disciplines. A chemical engineer is rarely just a chemical engineer, and a mechanical engineer is rarely just a mechanical engineer, according to Dalal.Chemical engineers study the qualities, content, and structure of matter, as well as the principles that govern chemical reactions.Chemical engineers working on electric vehicles use this expertise to discover novel compounds to employ in batteries or ways to improve the performance and safety of existing batteries. To create new batteries and related technologies, they collaborate closely with other engineers and scientists.For these vehicles, electronic engineers design, develop, and test electronic components and systems.
These engineers are primarily concerned with the vehicle's control systems and other electronic components. They don't normally concentrate on electricity generation and distribution. Tools, engines, machineries, and other mechanical devices utilised in electric cars are designed, developed, and tested by mechanical engineers. Components of electric vehicles or machineries used in the manufacture or repair of these vehicles are examples of devices. Engines, electric motors, and other mechanical devices such as transmissions, drivetrains, and steering systems may be the focus of these engineers. Additionally, they may assist in the packaging of the EV's electronic circuitry as well as the design of its internal wires.
Materials engineers research the structural and chemical properties of diverse materials in order to produce new goods or improve existing ones. Materials engineers are significantly involved in battery research and development for electric vehicles, as well as developing materials for other sections of the vehicle. To make automobiles more fuel-efficient and dependable, structural and mechanical components

made of lighter or stronger materials will be required. The materials may potentially improve vehicle safety and reduce their environmental impact.

5) RECENT TRENDS IN THE TESLA ADAPTIVE SUSPENSION (RAVEN)

While the change in ride comfort is noticeable at certain speeds, the two aren't dramatically different, according to vibration measurement charts comparing the action of the old coil spring suspension with the Smart Air Suspension on the Model S. The new Raven Adaptive Suspension, on the other hand, has them both beat in terms of ride comfort, with road analysis and cushioning changes that almost eliminate potholes. The automatic lowering of the suspension at a pre-set speed to reduce drag improves economy at highway speeds, and Tesla has been constantly developing this technology to get the height and levelling of the suspension to best suit the driving conditions.

When combined with Tesla's over-the-air updates, the future of this technology should be bright. The display of the Adaptive Suspension's compression and rebound right on the instrument cluster is one of the most useful enhancements thus far. With data readouts on the Touchscreen Control Panel, drivers can see a graphic of their vehicle's air suspension changes in real time. So, how does the Raven Adaptive Suspension stack up against earlier Model X and Model S suspension iterations? Smart Air Suspension, a suspension system that was previously standard on the Model X and various years and trims of the Model S, gave the driver precise control over the vehicle's ride height. One of the system's main selling features was the ability to alter the vehicle's height, and many drivers appreciated having control over the suspension height for known issue portions of road or better interstate performance. Smart Air Suspension, like Adaptive Suspension, changed height automatically based on GPS position and speed, although it did so without any road-sensing dampening, unlike its Raven counterpart.

Is the new suspension a step forward in every way? We believe so: the Raven Adaptive Suspension system's performance in terms of better efficiency and improved ride comfort speaks for itself. Furthermore, there is no comparison in ride quality between the Adaptive Suspension and the Model S's even older coil spring suspension. Finally, the Model S or Model X with the Raven upgrade may switch from a marshmallowy comfort ride to a lean, mean, corner-gripping monster with the touch of a control panel owing to the Adaptive Suspension's Sport option. Apart from lower maintenance and repair costs, coil spring technology has minimal advantage over Adaptive Suspension in Sport mode.

5.1) Tesla Smart Air Suspension 101 – Pros, Cons & More

Drivers can anticipate the car to save the GPS location of the vehicle for each change, in addition to the option to manually alter the height of the car through the vehicle's control panel. When the automobile encounters a saved data point, such as a steep driveway, a carwash, or a bumpy dirt road, Tesla's SmartAir Suspension software automatically changes the car's height. Note that these data points can be deleted subsequently, so you don't have to go to Low every time you go up to visit.

Automatic height adjustments are made for different speeds in addition to data point adjustments to reduce drag and improve ride stability. Due to over-the-air upgrades, the speed thresholds for these adjustments have altered over time; now, Tesla's Smart Air Suspension will lower the height from Very High to High at 22 mph, and from High to Standard at 35 mph.

One of the reasons that a pre-2017 Model S with a coil spring suspension would be worth looking for is that coil springs are quite cheap to replace if there is a suspension problem. Air suspension, on the other hand, can be a costly maintenance operation that isn't always worth it, even on a cheap secondhand Model S.

For those wondering what kind of damage the bottom of a Model S could take if the suspension is set too low for the driving conditions, Tesla added a titanium shielding panel (along with a few other structural elements) to the underside of the Model S that was capable of shattering a concrete block at highway speeds after receiving feedback on battery safety concerns. It just goes to demonstrate that the damage caused by scraping the bottom of a Model S is nothing compared to the damage caused by scraping the bottom of a Prius under the identical conditions. Ouch.

5.2) Replacement of the Tesla Smart Air Suspension

Tesla changed the air suspension to what they named Adaptive Suspension when they finished developing their new Raven drivetrain, which is currently standard on the Model S and Model X as of 2019. In a future blog article, we'll go over Adaptive Suspension in greater length; for now, suffice it to say that the improvement primarily increased ride comfort, adjustability, and visual display features.

As we have seen the various trends in particular, and how this new technology will change the face of how we commute, there is a fact that revolves around this, and it is extremely significant for the various engineers working in various sectors. All of their knowledge and experience will be put to use in the creation of E-Vehicles. Some future occupations are most likely to be developed in this domain, and some of the tasks and requirements are described below, divided into the sort of work and talents necessary from a specific engineer[3] based on the category and correct segment of work.

6) VEHICLE TO GRID TECHNOLOGY

The notion of V2G was first proposed by. The parked EV can offer electrical power to the grid and has a bi-directional charger, which means it can either deliver power to the grid or charge the battery, according to this notion. The influence of bidirectional charging of Li-ion cells has been proposed in V2G and Grid to Vehicle to find its cell performance. The author gives an overview of how to use energy storage technology in the planning and operation of a distribution system. They looked at V2G technology's battery technology and policy. They established an approach for managing battery degradation that can be utilised to increase the life of an electric vehicle's battery. Kester et al. (2018) conducted a comparative analysis in the Nordic nations to see how hundreds of electric mobility specialists replicate policy recommendations for V2G and EVs. Dubarry et al., 2017 conducted an experiment to see how a Li-ion battery degrades due to V2G operation. [4,5,6,7,8,9]

Using commercial Li-ion cells, they also discovered the impact of bi-directional charging on optimising the profit of EV consumers. Below is a diagram of the Vehicle to Grid charging system.

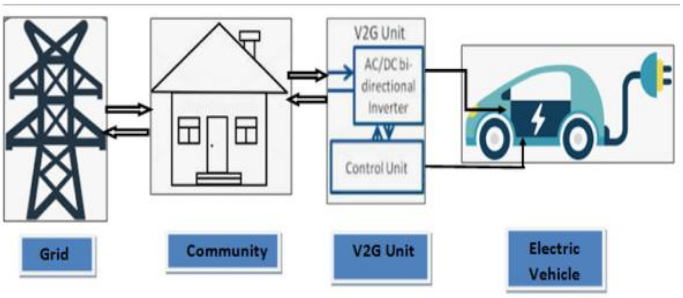

Figure 1: Vehicle-to-Grid (V2G) technology

7)) SCHEMES TO PURCHASE ELECTRIC VEHICLES IN INDIA

Various programmes and incentives have been created by the central and state governments in India to promote electric mobility.

The following are some of the schemes.

The Government of India announced the National Electric Mobility Mission Plan (NEMMP) 2020 to improve national energy security, mitigate the detrimental effects of fossil fuel power cars on the environment, and build domestic manufacturing skills (GoI, 2012). The NEMMP 2020 might aid in the sale of 6–7 million electric vehicles, saving 2.2–2.5 million tonnes of fossil fuel. As a result of this new approach, vehicular emissions and CO2 emissions could be reduced by 1.3–1.5 percent by 2020. By the end of 2020, 5–7 million electric vehicles might be on the road, according to this plan. It also emphasises the necessity of government incentives and industry-academic collaboration. The Indian government is also planning to build 100 GW of solar-based power by 2022, which might boost the stability and utilisation of renewable energy, which will be beneficial for EV charging stations.

Similarly, with the advancement of EV technology and the need to reduce energy demand in the automobile sector, the NITI Aayog's transformative mobility report of 2017 established a pathway for adopting 100% electric vehicles. It is estimated that India can become completely electric by 2030 if it adopts a transformative solution of shared networked electric mobility, with 100% public transportation cars and 40% private automobiles [3]. This concept must be shared widely in order for all electric vehicles to be available in the near future. [10]

8) BARRIERS

8.1) Vehicle maintenance

A trained technician should be accessible to repair, maintain, and troubleshoot the electric vehicle in order to take adequate care of it. They must be able to apply their expertise as rapidly as possible to solve the problem.

8.2) High Price Of Electric Vehicles Further,

the average cost of an electric automobile in India is around INR 13 lakh, significantly higher than the average cost of an affordable car running on traditional gasoline, which is around INR 5 lakh. In addition, the cost of electric scooters and motorcycles in India ranges from INR 70K to INR 1.25 Lakh, compared to INR 30K to INR 40K for ICE bikes and much less for scooters. When compared to electric automobiles, gas-powered cars are less expensive.

8.3) Raw materials for batteries

Lithium, nickel, phosphate, and manganese, as well as graphite and cobalt, are rare earth elements used in EV batteries. Aluminium, copper, and steel are necessary for an internal combustion engine. To filter harmful gases, catalysers for combustion cars require platinum, rhodium, and palladium. All of this is scare material, and the supply of this material may be insufficient for battery production. Lithium-ion batteries alone need 5 million tonnes of nickel per year, which could lead to 10–20 times greater lithium and cobalt usage in the future.

8.4) Range Anxiety

Consumers experience range anxiety when they realise their electric vehicle may not have enough range to get them to their destination. This is due to a lack of charging infrastructure in the country; although conventional vehicles may be refuelled at gas stations, EVs do not yet have access to such regularised infrastructure.

8.5) Charging time

The issue of charging time is inextricably linked to the issue of driving range. Using a 7 kW charging station and a sluggish charger, the EV can take up to 8 hours to fully charge from empty. The length of time it takes to charge a battery is mostly determined by its size. The longer it takes to recharge an automobile battery from empty to full, the larger the battery is. In addition, the battery's charging time is directly proportional to the charging rate of the charge point. The battery will take less time to fully charge if the charging price of the charge point is higher. Rapid chargers are already being utilised to charge vehicles more quickly, lowering the amount of time necessary. Commercially available electric vehicles can use charge stations with a higher maximum charge rate than they can handle. This implies that the battery can be charged at its maximum rate without experiencing any problems. The charging rate of the battery with a rapid charger, on the other hand, decreases as the temperature drops or as the temperature drops. The charging speed at which an electric vehicle's battery is recharged is used to categorise the chargers.

8.6) Environmental impact

Electric vehicles do not pollute the environment in general, but the components of the batteries are mined or harvested from brine in the desert. Mining has a low environmental impact with this extraction.

8.7) Battery recycling

The batteries in electric vehicles are designed to endure for a specific amount of time, but they will ultimately wear out. Manufacturers do not provide accurate pricing for battery replacement, however if a replacement is required outside of the warranty period, the costs are increased by replacing the old battery with a new one. The chemical constituents of batteries, such as Lithium, Nickel, Cobalt, Manganese, and Titanium, not only improve the supply chain's cost-effectiveness, but also pose an environmental risk when scrapping.

9) CONCLUSION

Hybrid, Plug-in Hybrid, and Electric Automobiles can improve vehicle fuel economy while also increasing the cost of ownership when compared to standard vehicles. In general, their lower petroleum consumption and improved productivity provide long-term economic benefits to purchasers, society, automakers, and governments. Furthermore, the realisation and success of this business are strongly reliant on the global public, and we expect that through mass marketing and environmental education initiatives, people will be motivated and empowered to drive an electric vehicle. However, this technology has immense potential, and if the aforementioned problems can be mitigated to some extent, it may blossom in India. This option still has a lot of work to do in order to take over the existing car market in India and prove its usefulness in a variety of areas, including cost and range. If this is secured by technology improvements, as well as the charging ports for vehicles are considered and how they may be implemented in India, which has numerous topographical obstacles, this will undoubtedly contribute to a better and more sustainable green future. The Indian government's latest measures and numerous incentives will aid in the country's e-mobility push. When non-conventional energy sources are unavailable, the creation of a new Vehicle-to-Grid idea can either send power to the grid or be utilised to charge the battery. This technology is crucial for energy security, renewable energy, and addressing global warming concerns.

REFERENCES

[1] A review on barrier and challenges of electric vehicle in India and vehicle to grid optimisation SonaliGoel RenuSharma Akshay Kumar Rathore

[2] Study on Electric Vehicles in India Opportunities and Challenges: by Mohamed M, G Tamil Arasan, and G Sivakumar.

[3] FIND MY ELECTRIC: The Ultimate Tesla Marketplace

[4]Kempton, W., Tomic, J., Letendre, S., Brooks, A., & Lipman, T. (2001). Vehicle-to-Grid Power: Battery, Hybrid, and Fuel Cell Vehicles as Resources for Distributed Electric Power in California. UC Davis: Institute of Transportation Studies. Retrieved from https://escholarship.org/uc/item/0qp6s4mb

[5]M. Dubarry, A. Devie, K. McKenzie Durability and reliability of electric vehicle batteries under electric utility grid operations: bidirectional charging impact analysis J. Power Sources, 358 (2017), pp. 39-49

[6]M.A. Awadallah, B. Venkatesh Energy storage in distribution system planning and operation: current status and outstanding challenges Can. J. Electr. Comput. Eng., 42 (1) (2019), pp. 10-19

[7]K. Uddin, M. Dubarry, M.B. Glick The viability of vehicle-to-grid operations from a battery technology and policy perspective Energy

Policy, 113 (2018), pp. 342-347
[8]J. Kester, L. Noel, G.Z. de Rubens, B.K. Sovacool Promoting Vehicle to Grid (V2G) in the Nordic region: expert advice on policy mechanisms for accelerated diffusion Energy Policy, 116 (2018), pp. 422-432
[9]M. Dubarry, A. Devie, K. McKenzie Durability and reliability of electric vehicle batteries under electric utility grid operations: bidirectional charging impact analysis J. Power Sources, 358 (2017), pp. 39-49
[10] Society of Indian Automobile Manufacturers _White paper on electric Vehicle_dec, 2017 report.