A Study of Barrier and Challenges of Electric Vehicle in India and Vehicle to Grid Optimization

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Abstract

Electric cars not only reduce fossil fuel reliance, but also minimise ozone damaging compounds and enable large-scale renewable deployment. Despite extensive study on the qualities and properties of electric cars, as well as the nature of their charging infrastructure, electric vehicle manufacturing and network modelling continue to change and be restricted. The study addresses the numerous modelling approaches and optimization strategies used in the studies of Electric Vehicle, Hybrid Electric Vehicle, Plug-in-Hybrid Electric Vehicle, and Battery Electric Vehicle market penetration rates.. When renewable energy sources are unavailable, the development of the new Vehicle-to-Grid concept has offered a backup power source. We conclude that electric cars' unique qualities are critical to their mobility. The purpose of this research article is to investigate a strategy for charging electric automobiles. This patent-pending method entails installing electric generators to provide a portion of the energy required by the electric vehicle. The effects on the speed of the electric vehicle, regenerative braking, and the amount of energy that can be provided through this innovation have all been studied in this research paper, and there are a number of important things to consider when dealing with this topic. The most important things that have been studied are the effects on the speed of the electric vehicle, regenerative braking, and the amount of energy that can be provided through this innovation. The design of a DC-DC Boost converter with two loops PID controllers, as well as the design of a Field.

Keywords: Battery, DC-DC, Electric car, Hybrid, Power source.

INTRODUCTION

Electric Vehicles (EVs) are becoming a viable conduit for improving air quality, energy security, and economic opportunity in India, thanks to the tremendous growth of the automobile sector. The Indian government acknowledges the need to investigate sustainable mobility options in order to minimise reliance on imported energy sources, reduce greenhouse gas emissions, and offset negative transportation effects such as global warming. Carbon dioxide emissions can be lowered by implementing preventive steps to avoid catastrophic climate change, which poses a threat to the planet's biodiversity. Major efforts have been made to use fossil fuels as little as possible for power production, transportation propulsion, energy conservation, and carbon sequestration. Electric vehicles (EVs) may be a viable option for reducing carbon dioxide emissions [1].

Even if the adoption of electric vehicles has begun, people continue to rely on fossil fuel-powered automobiles. EVs, on the other hand, have difficulties on the road.Compared to typical fossil-fueled automobiles in terms of life cycle assessment (LCA), charging, and driving range. Electric car manufacture emits 59 percent more CO2 than conventional vehicle production. On a tank-to-wheel basis, the ICEV emits 120 g/km of CO2, however this rises to 170–180 g/km when viewed through the lens of the LCA. While electric vehicles emit zero CO2 from tank to wheel, we estimate that average CO2 is measured across a vehicle's life cycle rather than over a single vehicle. The total CO2 emissions from a vehicle during its entire life cycle vary greatly depending on the power source used at the time of production and operation [2]. Due to harmful emissions from the transportation industry and investments by various OEMs, there is worry about the growth of more and lower-cost EVs in the coming years. Several variables, including technology advancements, lower car costs, government policy support, vehicle purchase incentives, parking benefits, and adequate public charging infrastructure, might lead to an increase in EV adoption in India. Because EV production is modest, the overall proportion of EVs in the Indian market is small.

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 automobiles. The Reva Electric Vehicle, India's first electric automobile manufacturer, launched its car in the early 2000s with the goal of producing inexpensive cars using modern technology. Mahindra Electric Mobility Ltd, India's lone BEV producer, is the market leader. Toyota Kirloskar Motor Pvt. Limited, BMW AG, Volvo Car Corporation, and Honda Motors Co. Ltd. are other significant HEV manufacturers with operations in India. The Mahindra e2oPlus, Mahindra e-Verito, Mahindra e-KUV 100, Eddy Cur- rent Controls Love Bird, Atom Motors Stellar, and Tata Tiago Electric were among the other models [3]. India's entire greenhouse gas emissions in 2014 was 3202 million metric tonnes of carbon dioxide equivalent, accounting for 6.55 percent of world emissions. The energy sector accounts for 68 percent of greenhouse gas emissions in India, with agriculture, manufacturing processes, improvements in land use and forestry, and waste accounting for 19.6 percent, 6.0 percent, 3.8 percent, and 1.9 percent, respectively [4]. With a significant percentage of fluctuating renewable energy generation, an electric car may be employed as a flexible load to help standardise the grid [5]. Due to the limited power of a single transaction, the owners of electric vehicles do not have a transaction in the electricity market [6]. Some writers [7–12] proposed a contemporary approach for estimating current smart policies, which are exogenous and were designed in preparation for changing circumstances. Flexible load and smart charging procedures should be implemented to fully utilise an EV's capabilities. Another research [13] found that EV users organised themselves to provide information to the aggregator in terms of time and energy usage. The timeliness requirement specifies how quickly a charging operation must be finished, whereas the energy need is supported by the battery level. According to [14], a de-centralised framework and a central body should deliver the pricing signal to electric car owners, with the centralised and de-centralised frameworks expected to overlap.

Brady and Mahony, 2016 [15], investigated an electric vehicle's stochastic simulation approach for producing a dynamic trip itinerary and charging profile for EV propulsion in the real world. They came to the conclusion that if the parking time distribution circumstances were modified, the parking time distribution accuracy, as well as the model's overall accuracy, would improve. Morrissey et al., 2016 [16] conducted a study of electric car owners and discovered that they prefer to charge their vehicles at home during peak electricity demand in the evening. Foley et al., 2013 [17] investigated the impact of EV charging in a single large power market in Ireland under peak and off-peak charging scenarios and discovered that peak charging is more harmful than off-peak charging. Doucette and Mcculloch (2011) [1] did a research on BEVs and PHEVs to determine their carbon dioxide emissions and compared their findings to CO2 emissions from Ford Focus. By examining critical impediments to an EV in two nations, Steinhilber et al., 2013 [18] investigated the necessary tools and strategies for introducing new technology and innovation. Yu et al., 2012 [19], based on the trip segment partitioning method, proposed a driving pattern recognition technique for estimating the driving range of EVs. Hayes et al., 2011 [20] built a vehicle model to study different driving circumstances and topographies. Salah et al., 2015 [21], investigated the influence of electric vehicles (EVs) on Swiss distribution substations and discovered that higher penetration levels and dynamic tariffs increase the danger of overloading at specific areas. The range type of these parameters is then used to compare them to one another. [22–26] examined the model-based non-linear observers for estimating the torque of permanent magnet synchronous motor for hybrid electric cars and provided the influence of various classes of charging methods of electric vehicles on the national grid and storage usage. [27–28] found the maximum transmissible torque approach for enhancing torque control antiskid execution. structure, as well as to increase the electric vehicle's stability. A overview of important difficulties for Li-ion battery management in an electric vehicle was published by Lu et al., 2013 [29]. Issues such as battery cell voltage, battery state estimate (battery SOC, SOH, DOD, and SOF), battery equalisation and uniformity, and battery fault diagnosis can give impetus for battery management system research and design. [30–33] investigated reviews on optimum management techniques, energy management systems, and modelling approaches for electric vehicles.

A recent year e-bike became more attractive and less maintenance cost. But only drawback of e-bike is requires frequent charging form EB supply. Market available e-bike batteries are designed to spent 6-8 hours/charge by using EB supply.

The existing project related to our project is having following methodology. The existing project is self generating electric bicycle. It has a generator which is connected through chain with rear wheel. When the bicycle is in motion the chain link with the rear wheel and generator will work. But this system havig a huge drawback of nearly 50% of loss through chain or belt drive.

The goal of this research is

- To determine the necessary procedures, obstacles, and problems of employing a battery-powered vehicle in a developing nation like India.
- To figure out why electric vehicles haven't gotten a lot of attention in India.
- To raise awareness in India about the benefits of battery-powered automobiles over traditional fossil-fueled vehicles.
- To investigate the many government efforts aimed at boosting electric/hybrid vehicles.

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 electric motor uses 90–95 percent of the energy input to power the vehicle, making it extremely efficient. The battery, charging port, charger, DC/DC converter, power electronics controller, regenerative braking, and drive system are the main components of an electric automobile.

The electric motor's role is to power the electric vehicle by utilising the electrical energy stored in batteries. Because they are recharged with low-emission power sources, EVs are environmentally favourable. The electric grid is used to charge the cells. The primary role of the battery is to supply electricity to the electric automobile in order for it to run. Lithium-ion batteries are used in most electric vehicles because they are more efficient than other cells and need less maintenance. 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 schedule. The charging port is the location at which the vehicle may connect to an external power supply system and charge the battery using a charger.

The charger's job is to accept AC electricity from a power source and convert it to DC power for charging the battery through a charge connector. While charging, it also keeps track of the battery's voltage, current, temperature, and state of charge.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 regulate the traction motor's speed and torque.

Regenerative braking is critical for preserving vehicle strength and increasing 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 may be utilised 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 car.

The drive system's job is to get things moving by delivering mechanical energy to the traction wheel. The electric car has many internal configurations based on the components used and does not require a traditional gearbox. For instance, some designs employs a series of tiny motors to power each wheel independently. A huge electric motor, on the other hand, might be linked to the back wheels through differential housing. When compared to the components of a gasoline-powered automotive engine, an electric vehicle's components are simpler. Electric cars, on the other hand, would not be able to go as quickly as a gasoline-powered vehicle.

TYPES OF ELECTRIC VEHICLES

Electric cars are classified into four types:

BEV (Battery Electric Vehicle):

Powered entirely by electricity. When compared to hybrids and plug-in hybrids, these are more efficient. BEVs are often referred to as All-Electric Vehicles (AEV). BEV-powered electric vehicles rely fully on rechargeable batteries electric powertrain. The electricity needed to power the vehicle is collected in a big battery pack that can be refreshed by connecting to the power grid. The recharged battery pack then powers one or more dc motors, allowing the electric automobile to run.

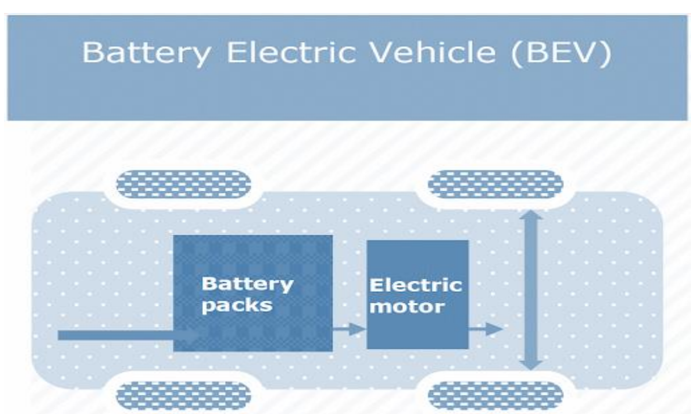

Fig 1 BEV

BEV Operating Principles:

The electricity for the power source is transformed from a DC battery to an alternating current (AC). When you push the accelerator, a signal is delivered to the controller. The controller utilizes the principle of the AC from the converters to the motor to regulate the vehicle's speed. The motor then interfaces and drives the wheels through a gear. When the brakes are applied or the electric vehicle is applying the brakes, the motor converts to an alternator and generates electricity, which is then returned to the battery.

Hybrid Electric Vehicle:

The vehicle employs both an internal combustion (often gasoline) engine and a battery-powered motor drive train. When the battery is depleted, the gasoline engine is utilized to both drive and charge. These cars do not have the same efficiency as purely electric or connected hybrid automobiles. HEVs are sometimes referred to as series hybrids or parallel hybrids. HEVs are powered by both an engine and an electric motor. The engine is powered by fuel, while the motor is powered by batteries. Both the engine and the electric motor rotate the gearbox at the same time. This, in turn, drives the wheels.

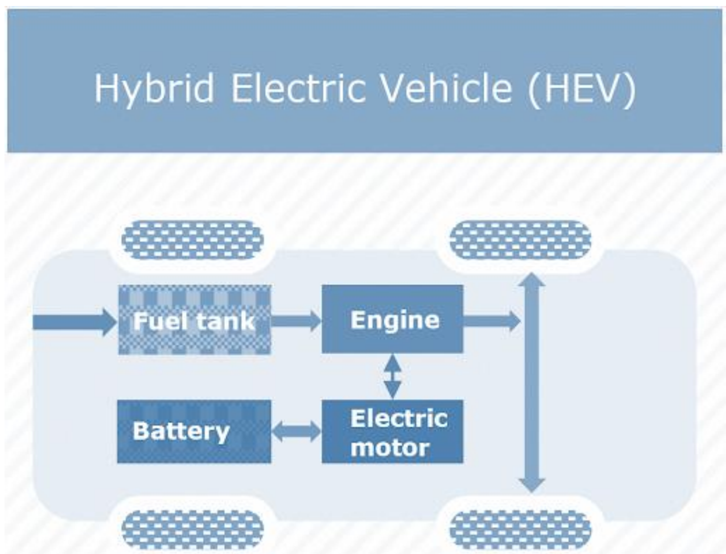

Fig 2 HEV

HEV Operating Principles:

Like a typical automobile, the gasoline tank provides energy to the engine. An electric motor powers the batteries. Both engine and the electric motor can turn the gearbox at the very same time.

4.3 Plug-in Hybrid Electric Vehicle (PHEV):

Has an internal combustion engine as well as a battery that is charged via an external socket (they have a plug). This implies that the vehicle's battery, rather than the engine, may be charged with electricity. PHEVs are more fuel-efficient than HEVs yet less so than BEVs. PHEVs are also referred to as series hybrids. They have an engine as well as a motor. You have the option of using traditional fuel (such as gasoline) or alternative energy (such as bio-diesel). It is also capable of being charged by a renewable battery pack. External charging is possible for the battery.

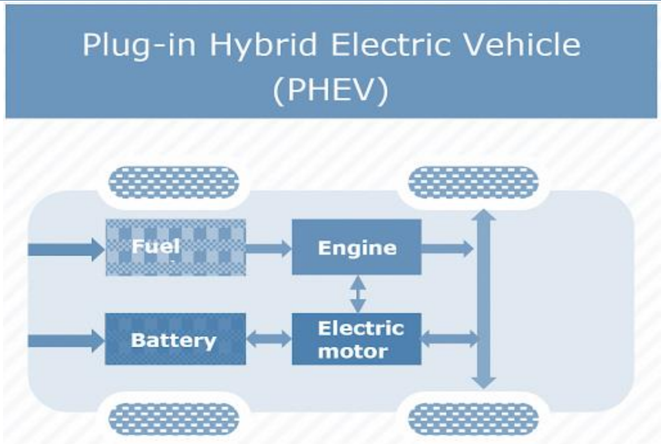

Fig 3 PHEV

PHEVs can operate in at least two modes:

- All-electric Mode, wherein the motor and batteries provide all of the energy for the vehicle.
- Hybrid Mode, which uses both electricity and gasoline/diesel.

PHEV Operating Principles:

PHEVs start in a certain modes and run on energy until their rechargeable battery runs out. When the battery is depleted, the engine needs over and the car works as a standard, non-plug-in hybrid. PHEVs can be charged by connecting to an external electric power source, using a powertrain, or regenerative braking. When the brakes are engaged, the electric motor serves as a generator, transferring energy to the battery. The electric motor supplements the engine's power; as a consequence, smaller engines may be employed, boosting the car's fuel economy without sacrificing performance.

4.4 The Fuel Cell:

Chemical energy is converted into electric energy. As an example, consider a hydrogen FCEV. FCEVs are sometimes referred to as Zero-Emission Vehicles. They use 'fuel cell technology to produce the electricity needed to power the car. The energy released from gasoline is instantly transformed into electrical energy.

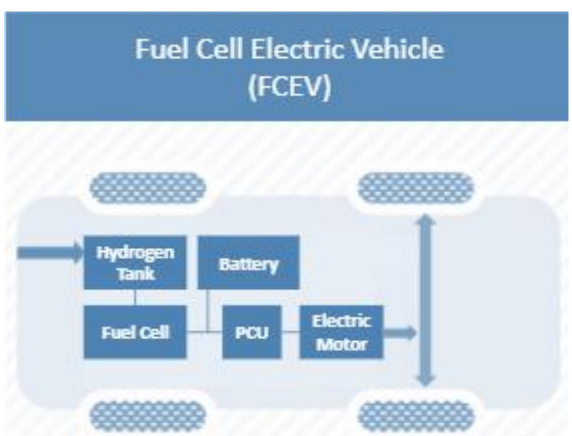

Fig 4 FCEV

Table 1. Comparison of different vehicle types

EV TYPE	DRIVING COMPONENT	ENERGY SOURCE	FEATURES	PROBLEMS
BEV	• Electric motor	• Battery • Ultracapacitor	No emission • Not dependent on oil • Range depends largely on the type of battery used • Available commercially	• Battery price and capacity • Range • Charging time • Availability of charging stations • High price
HEV	• Electric motor • ICE	• Battery • Ultracapacitor • ICE	• Very little emission • Long range • Can get power from both electric supply and fuel • Complex structure having both electrical and mechanical drivetrains • Available commercially	• Management of the energysources • Battery and engine size optimization
FCEV	Electric motor	• Fuel cell	• Very little or no emission • High efficiency • Not dependent on supply of electricity • High price • Available commercially	• Cost of fuel cell • Feasible way to produce fuel • Availability of fueling facilities

BATTERY THERMAL MANAGEMENT SYSTEM

Because the usage of electric vehicles is expected to grow in the near future, producing effective batteries is a top priority. Thermal deterioration of the batteries is a significant barrier for improving BTMS, which has an impact on the EV's range. The BTMS' main goal is to regulate the temperature of the battery cell and so extend the battery's life. Lithium-ion batteries are commonly used in electric vehicles to store energy. There are several obstacles, including low efficiency at high and low temperatures, decreased electrode life at high temperatures, and direct effects on vehicle performance, dependability, cost, and protection, as well as safety concerns connected to thermal runaway in lithium ion batteries. As a result, an effective thermal battery management system is one of the most important technologies for an electric vehicle's long-term success. Temperatures between 25 and 40 degrees Celsius are ideal working conditions for Li-ion batteries. When the temperature of these batteries rises over 50 °C, the battery's life is reduced.

Table 2. Common battery types, their basic construction components, advantages and disadvantages

attery Type	Components	Advantage	Disadvantage
Lead-acid	• Negative active material: spongy lead • Positive active material: leadoxide • Electrolyte: diluted sulfuric acid	• Available in production • volume • Comparatively low incost • Mature technology as used for over fifty years	• Has a limited life cycle if operated on a deep rate of SOC(state of charge) • Low energy and power density • Heavier • May need maintenance
NiMH (Nickel- Metal Hydride)	• Electrolyte: alkaline solution • Positive electrode : nickel hydroxide • Negative electrode: alloy of nickel, titanium, vanadium and other metals	• Double energy density compared to lead-acid • Harmless to the environment • Recyclable • Safe operation at highvoltage • Can store volumetric power and energy • Cycle life is longer • Operating temperature range is long • Resistant to over-chargeand discharge	• Reduced lifetime of around 200–300 cycles if discharged rapidly on high load currents • Reduced usable power becauseof memory effect
Li-Ion (Lithium-Ion)	• Positive electrode: oxidized cobalt material • Negative electrode: carbon material • Electrolyte: lithium salt solutionin an organic solvent	• High energy density,twice of NiMH • Good performance athigh temperature • Recyclable • Low memory effect • High specific power • High specific	• High cost • Recharging still takes quite a long time, though better than most batteries

		energy • Long battery life, around 1000 cycles	
Ni-Zn (Nickel- Zinc)	• Positive electrode : nickel oxyhydr oxide • Negative electrode: zinc	• High energy density • High power density • Uses low cost material • Capable of deep cycle • Friendly to environment • Usable in a wide temperature range from • −10 °C to 50 °C	• Fast growth of dendrite, preventing use in vehicles • Cadmium can cause pollution
Ni-Cd (Nickel-Cadmium)	• Positive electrode : nickel hydroxid e • Negative electrode: cadmium	• Long lifetime • Can discharge fully without being damaged • Recyclable	in case of not being properly disposed of • Costly for vehicular application

ELECTRIC VEHICLE SCENARIO IN INDIA

In India, the electric vehicle market is still quite modest. Electric car sales have been stagnant at 2000 units per year for the past two years [34]. However, there is a goal of selling 100 percent electric vehicles by 2030, with a compound annual growth rate of 28.12 percent [35] since 2020. Reva (Mahindra), India's first electric automobile, was unveiled in 2001 and has only sold a few units since then. Toyota launched the Prius hybrid car in 2010, followed by the Camry hybrid in 2013. Electric buses and hybrid cars have been tested in a few places as a pilot project. Bangalore Municipal Transport Corporation has begun operating electric buses on a busy street in the city. According to a poll conducted in the city of Ludhiana, 36% of present automobile and two-wheeler owners are excited about switching to electric vehicles [42]. The state government of Telangana is likewise pushing the usage of electric vehicles, announcing that EV owners would not have to pay any road taxes. The Telangana State Electricity Regulatory Commission (TSERC) established a charging tariff for electric vehicles of INR 6 in 2018. In addition, the TSERC set the service rate for the whole state at INR 6.04/kWh. The Hyderabad metro rail system has also partnered with Power Grid Corporation of India Ltd to provide electric vehicle charging stations at metro stations. The Hyderabad metro rail will be the country's first to incorporate electric vehicle charging stations that are controlled and operated by the power grid [46]. The government of Hyderabad is also considering replacing diesel-powered public transportation vehicles with electric ones. The New Delhi government received authority last year to build 131 public charging stations around the city. The Delhi government announced a draught strategy in November 2018 with the goal of converting 25% of their vehicles to electric vehicles by offering different incentives and installing charging infrastructure in both residential and non-residential locations. By 2023, this strategy aims to build a charging outlet every 3 kilometres by providing a 100 percent subsidy (up to INR 30,000) and waiving the road tax, parking fees, and registration cost for electric vehicles. A private company called Magenta Power is also working to provide EV charging infrastructure on the Mumbai-Pune route [45].

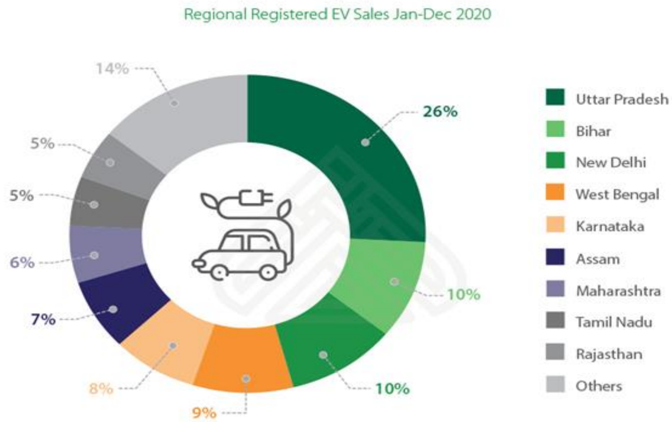

FIG 6 EV Sales Chart

SPECIFICATIONS

The technical criteria for electric car chargers vary by country for Level 1, Level 2, and Level 3 charging stations. The mapping of different charger specifications in India is shown in the table below:

Table 3 Different charger specifications in India

S. NO	CHARGING STATION	VOLTAGE (V)	POWER (KW)	TYPE OF VEHICLE	TYPE OF COMPATIBLE CHARGER
1	Level 1 (AC)	240	<=3.5 kW	4w ,3w,2w	Type 1, Bharat AC-001
2	Level 1 (DC)	>=48	<=15 kW	4w,3w,2w	Bharat DC-001
3	Level 2 (AC)	380-400	<=22 kW	4w,3w,2w	Type 1, Type 2, GB/T ,Bharat AC-001
4	Level 3 (AC)	200-1000	22 to 4.3 kW	4w	Type 2
5	Level 3 (DC)	200-1000	Up to 400 kW	4w	Type 2, CHAdeMO,CCS1,CCS2

BARRIERS FOR EV'S IN THE INDIAN MARKET

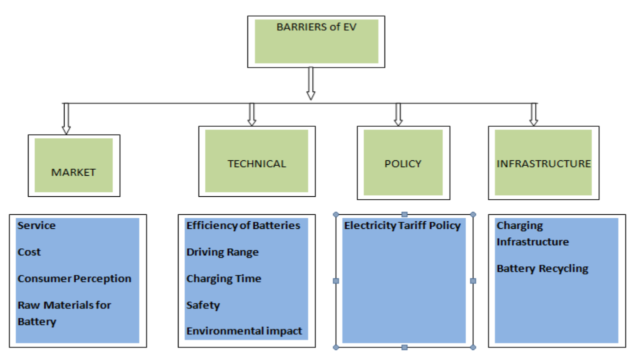

FIG 7 Barriers for EV in India

The future has arrived, and some of us are already rushing to join it! When Maini introduced the Reva in India in 2001, hardly one gave it a second thought. It was a small, Tata Nano-like car. Due to its early debut in India, the Reva made headlines but failed to make a dent in the market.Let's fast forward to the year 2021. State governments are implementing FAME II subsidies, multinational car OEMs are expanding into India, and the air is thick with the anticipation of electric vehicles becoming the automotive industry's future. Out with the ICE cars and in with the EV brigade's "charge"!

No Dedicated Parking Spots

The EV charging dilemma is really a parking issue. Not every four-wheeler owner in India has access to a designated parking space. Many residents, even in a huge residential complex, have chosen open or uncovered parking spaces. So, how do they set up the charging station or charger that was provided by the OEM?

This will be a problem for organizations who do not have designated parking spaces. State governments are enacting regulations requiring EV chargers to be installed in most residential, commercial, and workplace facilities. Even our public roadways lack a controlled parking system that allows the government or private entities to set up bulk charging stations. However, there is a sector that is now served by Charge Point Operators that operate a system similar to a fuel station, but with EV charging.

Lack of EV charging infra

Range anxiety is one of the most prevalent issues that come with owning an electric vehicle. The lack of a reliable and extensive charging infrastructure just adds to an EV owner's unhappiness. Even though electric vehicle sales have increased recently, they are still mostly utilised for intra-city transport. Long-haul travel, on the other hand, will need to be solved quickly in order to boost fleet utilisation limitations and allow individuals to go over city boundaries.Several Indian state governments have issued aggressive bids for the construction of public EV charging stations, and dozens of CPO start-ups have sprung up around the nation. The majority of this infrastructure development, however, is restricted to Tier 1 cities and within city bounds.

Lack of Standardization

You've probably heard of several charger connector types if you're familiar with EV jargon. The most typical are:

- CCS / CCS Type 2
- Bharat AC-001/Bharat DC-001
- CHAdeMO
- GB/T
- Tesla Chargers

The EV connection type is available on both the automobile and the EV Charger. In India, all requirements are now being implemented, which is causing a shortage of EV charging points. The CCS/CCS Type 2 charging connector standard is supported by most automobiles, while certain models adhere to the GBT or Bharat AC/DC 001 specifications. If the government agrees to establish a single standard, automakers and EVSE suppliers will be able to concentrate on producing only one sort of product. As a consequence, production is faster, lead times are shorter, and a standardised charging network system that is compatible with all EVs is created.

Power infra upgrades

So, what does it take to get an EV charger installed at your business? It may be as simple as pulling the charger out of the box, installing it, and turning it on if all infrastructural requirements are satisfied. However, you must also consider the power needs. Most home users must first calculate their sanctioned load, spare capacity, and the EV charger's power input requirements. They will need to ask for greater load if there is a mismatch. This is a financial investment. If your sanctioned load is 5kW and you wish to install a 15kW DC charger, your current load will be insufficient to meet the charger's power needs.

However, there is a solution. Residential complexes and other structures might consider installing public charging stations on their property. A complex's sanctioned load will be substantial, and it will be able to allow EV charging. Aside from that, there's no need to build charging stations in hundreds of parking spaces for everyone. Another issue for an EV owner is living in a home with no backup power and frequent power outages. You won't be able to charge the EV if there is a power outage. You may address this by considering solar power plants as a source of energy. A diesel generator may also be utilized to power the EV charger in an emergency.

Lack of service options

Most of us have experienced a car breakdown at some point in our lives. The problem would have been solved owing to the enormous number of experienced and unskilled vehicle service experts available. However, with the advent of electric vehicles, this method is no longer necessary. Yes, an electric car has less moving parts than an ICE vehicle, but our informal service network is unaware of the technology. Being stuck in the middle of nowhere might put you in an awkward situation. Despite the fact that most auto OEMs have vast service and dealer networks across India, their electric vehicle service network has yet to grow significantly.

Vehicle service, repair, and maintenance will be a continual requirement for logistics organizations with big EV fleets. Most fleet firms would delay EV adoption if there was no effective service network. To address this issue, several automakers are providing roadside assistance, towing services, and some are even considering portable, on-the-go charging alternatives for their customers. There will always be obstacles with everything new. In India, the electric vehicle sector is still in its infancy, but it is growing quickly. Infrastructure requirements to meet the EV demand are also catching up. Despite the obstacles, electric cars have enormous promise to lower our carbon footprints while also providing a cost-effective mode of transportation.

CONCLUSION

Hybrid, Plug-in Hybrid, and Electric Automobiles can improve fuel efficiency 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. This article presents a comprehensive review of the literature, as well as an overview and recommendations for HEV, PHEV, and BEV penetration rate studies in the Indian market. 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 development of a new Vehicle-to-Grid idea can either send electricity to the grid or be utilised to charge the battery. This technology is essential in terms of energy security, renewable energy, and the ability to address global warming challenges. This paper's key innovation is that it presents an overview of electric vehicle upgrade parameters also improve the recharge as at running condition KERS (Kinetic Energy Recovery System) of vehicle as initiated with help of enhance the recharge equipment.

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REFERENCES

[1] Akhavan-Rezai, E., Shaaban, M.F., El-Saadany, E.F. and Karray, F. (2015) 'Demand response through interactive incorporation of plug-in electric vehicles', Power & Energy Society General Meeting, IEEE, July, pp.1–5.

[2] Al Baghdadi, M.A.R. (2005) 'Modelling of proton exchange membrane fuel cell performance based on semi-empirical equations', Journal of Renewable Energy, Vol. 30, pp.1587–1599.

[3] Amjad, S., Neelakrishnan, S. and Rudramoorthy, R. (2010) 'Review of design considerations and technological challenges for successful development and deployment of plug-in hybrid electric vehicles', Renewable and Sustainable Energy Reviews, Vol. 14, pp.1104–1110.

[4] Arora, S., Shen, W. and Kapoor, A. (2016) 'Review of mechanical design and strategic placement technique of a robust battery pack for electric vehicles', Renewable and Sustainable Energy Reviews, Vol. 60, pp.1319–1331.

[5] Basu, S. (2007) Recent Trends in Fuel Cell Science and Technology, Springer, New Delhi.

[6] Burke, A. (2000) 'Ultracapacitors: why, how and where is the technology', Journal of Power Sources, Vol. 91, pp.37–50.

[7] Chakraborty, A. (2011) 'Advancements in power electronics and drives in interface with growing renewable energy resources', Renewable and Sustainable Energy Reviews, Vol. 15, No. 4, pp.1816–1827.

[8] Chan, C.C. and Chau, K.T. (2001) Modern Electric Vehicle Technology, Oxford University Press, Oxford.

[9] Chau, K.T. (2009) 'Electric motor drives for battery, hybrid and fuel cell vehicles', in Raines, G.B. (Ed.): Electric Vehicles: Technology, Research and Development, Nova Science, New York, pp.1–40.

[10] Chau, K.T. (2010) 'Hybrid vehicle', in Ramadhas, A.S. (Ed.): Alternative Fuels for Transportation, CRC Press, Boca Raton, FL, pp.361–391.

[11] Chau, K.T. (2014) 'Pure electric vehicles', in Folkson, R. (Ed.): Alternative Fuels and Advanced Vehicle Technologies for Improved Environmental Performance: Towards Zero Carbon Transportation, Elsevier, Woodhead Publishing, pp.655–684.

[12] Chau, K.T. and Li, W. (2014) 'Overview of electric machines for electric and hybrid vehicles',

[13] (Invited Paper) International Journal of Vehicle Design, Vol. 64, No. 1, pp.46–71.

[14] Chen, M. and Rincon-Mora, G.A. (2006) 'Accurate electrical battery model capable of predicting runtime and I–V performance', IEEE Transactions on Energy Conversion, Vol. 21, pp.504–511.

[15] Chiu, L.Y., Diong, B. and Gemmen, R.S. (2004) 'An improved small-signal model of the dynamic behavior of PEM fuel cells', IEEE Transactions on Industry Applications, Vol. 40, pp.970–977.

[16] Clement, K., Haesen, E. and Driesen, J. (2009) 'Coordinated charging of multiple plug-in hybrid electric vehicles in residential distribution grids', Power Systems Conference and Exposition, 2009. PSCE'09, IEEE/PES, March, Seattle, USA, pp.1–7.

[17] Correa, J.M., Farret, F.A., Canha, L.N. and Simoes, M.G. (2004) 'An electrochemical-based fuel- cell model suitable for electrical engineering automation approach', IEEE Transactions on Industrial Electronics, Vol. 51, pp.1103–1112.

[18] D'Souza, B.L., Rawlins, H.E., Machuca, J.C., Larson, C., Shuck, M., Shaffer, B., Maxwell, T., Parten, M., Vines, D. and Jones, J. (1999) Texas Tech University Develops Fuel Cell Powered Hybrid Electric Vehicle for Future Car Challenge 1998 (No. 1999-01-0612), SAE Technical Paper.

[19] Debnath, S.C. (2015) 'Environmental regulations become restriction or a cause for innovation – a case study of Toyota Prius and Nissan Leaf', Procedia – Social and Behavioral Sciences, Vol. 195, World Conference on Technology, Innovation and Entrepreneurship, pp.324–333.

[20] Ehsani, M., Gao, Y. and Emadi, A. (2010) Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, Boca Raton.

[21] Emadi, A., Lee, Y.J. and Rajashekar, K. (2008) 'Power electronics and motor drives in electric hybrid electric and plug-in hybrid electric vehicles', IEEE Trans Ind. Electron, p.55.

[22] Fajri, P. and Asaei, B. (2008) 'Plug-in hybrid conversion of a series hybrid electric vehicle and simulation comparison', 11th International Conference on Optimization of Electrical and Electronic Equipment, 2008. OPTIM 2008, IEEE, May, pp.287–292.

[23] Farcas, C., Petreus, D., Ciocan, I. and Palaghita, N. (2009) 'Modeling and simulation of supercapacitors', Design and Technology of Electronics Packages (SIITME), Gyula, Hungary.

[24] Fernández, R.Á., Cilleruelo, F.B. and Martínez, I.V. (2016) 'A new approach to battery powered electric vehicles: a hydrogen fuel-cell-based range extender system', International Journal of Hydrogen Energy, Vol. 41, No. 8, pp.4808–4819.

[25] Gao, F., Blunier, B., Simoes, M.G. and Miraoui, A. (2011) 'PEM fuel cell stack modeling for real- time emulation in hardware-in-the-loop applications', IEEE Transactions on Energy Conversion, Vol. 26, pp.184–194.

[26] Gieras, J.F. (2010) Permanent Magnet Motor Technology: Design and Applications, n.p.: CRC Press, Boca Raton, c2010.

[27] Green, A. (1999) 'The characteristics of the nickel–cadmium battery for energy storage', Journal of Power Engineering, Vol. 13, No. 3, pp.117–121.

[28] Guille, C. and Gross, G. (2009) 'A conceptual framework for the vehicle-to-grid (V2G) implementation', Energy Policy, Vol. 37, pp.4379–4390.

[29] Hajimiragha, A., Canzares, C.A., Fowler, M.W. and Elkamel, A. (2010) 'Optimal transition to plug-in hybrid electric vehicles in Ontario, Canada, considering the electricity-grid limitations', IEEE Trans. Ind. Electron, Vol. 57, No. 2, pp.690–701.

[30] Hannan, M., Azidin, F. and Mohamed, A. (2012) 'Multi-sources model and control algorithm of an energy management system for light electric vehicles', Energy Conversion and Management, Vol. 53, No. 1, pp.123–130.

[31] Hannan, M., Azidin, F. and Mohamed, A. (2014) 'Hybrid electric vehicles and their challenges: a review', Renewable and Sustainable Energy Reviews, Vol. 29, pp.135–150.

[32] Hermance, D. and Sasaki, S. (1998) ‘Hybrid electric vehicles take to the streets’, IEEE Spectrum, Vol. 35, pp.48–52.

[33] Fenton, J. and Hodkinson, R. (2001) Lightweight Electric/Hybrid Vehicle Design, Elsevier.

[34] Hutchinson, T., Burgess, S. and Herrmann, G. (2014) ‘Current hybrid-electric powertrain architectures: applying empirical design data to life cycle assessment and whole-life cost analysis’, Applied Energy, Vol. 119, pp.314–329.

[35] Ibrahim, H., Ilinca, A. and Perron, J. (2008) ‘Energy storage systems – characteristics and comparisons’, Renewable and Sustainable Energy Reviews, Vol. 12, pp.1221–1250.

[36] Jorgensen, K. (2008) ‘Technologies for electric, hybrid and hydrogen vehicles: electricity from renewable energy sources in transport’, Utilities Policy, Vol. 16, Vol. 2, pp.72–79.

[37] Kaygusuz, K. (2009) ‘Environmental impacts of the solar energy systems’, Energy Source Part A., Vol. 31, pp.1376–86.

[38] Lee, M., Lim, D. and Kim, S. (2015) ‘Evaluation of the effect of operating parameters on thermal performance of an integrated starter generator in hybrid electric vehicles’, Energies, Vol. 8, No. 8, pp.8990–9008.

[39] Li, J., Wang, Y., Chen, J. and Zhang, X. (2016) ‘Study on energy management strategy and dynamic modeling for auxiliary power units in range-extended electric vehicles’, Applied Energy.

[40] Lovatt, H.C., Ramsden, V.S. and Mecrow, B.C. (1998) ‘Design of an in-wheel motor for a solar- powered electric vehicle’, IEEE Electronics Power Application, Vol. 145, No. 5, pp.402–408.

[41] Lund, P.D., Lindgren, J., Mikkola, J. and Salpakari, J. (2015) ‘Review of energy system flexibility measures to enable high levels of variable renewable electricity’, Renewable and Sustainable Energy Reviews, Vol. 45, pp.785–807.

[42] Mania, E., Nasiri, A., Rentel, C. and Hughes, M. (2010) ‘Modeling of zinc bromide energy storage for vehicular applications’, IEEE Transactions on Industrial Electronics, Vol. 57, No. 2, pp.624–632.

[43] Mierlo, J.V., Maggeto, G. and Lataire, P. (2006) ‘Which energy source for road transport in the future? a comparison of battery, hybrid and fuel cell vehicles’, Energy Conversion and Management, Vol. 47, No. 17, pp.2748–2760.

[44] Newcomb, D. (2016) ‘Best new cars for your next road TRIP’, PC Magazine, pp.119–125. Nikowitz, M. (2016) Advanced Hybrid and Electric Vehicles: System Optimization and Vehicle

[45] Integration, Springer, Discovery eBooks, Switzerland.