CHALLENGES FACED BY HYBRID & ELECTRIC VEHICLES IN INDIA

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ABSTRACT

Electric vehicles are efficient in reducing emissions of greenhouse gases. Electric vehicles reduce the dependency on fossil fuels also reduce the impact of ozone-depleting substances. Despite comprehensive research on the attributes and characteristics of electric vehicles and the nature of their charging infrastructure, electric vehicle production, and network modeling continues to evolve and be constrained. In this paper, we are going to give an overview of the studies of Electric vehicles, Hybrid Electric vehicles, Plug-in-Hybrid Electric vehicles, Battery Electric vehicles, and different modeling approaches and optimization techniques. In this research, we are going to discuss the essential barriers and insufficient charging in India. The development of the new concept of Vehicle-to-Grid has created an extra power source when renewable energy sources are not available.

Keyword*: Plug-in hybrid electric vehicle(PHEV), Electric vehicle(EV), barriers faced by Electric vehicle, vehicle grid technology.*

1. INTRODUCTION :

The Indian Automobile Market Is Gearing Up For One Of The Biggest Revolutions Of The 21st Century. The Indian Automobile Industry Currently Ranked Fifth Largest In The World And Is Said To Be The Third Largest In 2030 Currently. The Ev Market Hold Less One Percent Of The Total Automobile Market But It Is Expected To Grow Multiple Times On The Next 10 Years. Naturally, Every Automobile Player Is Lager. To Capture The Market Share In India's Electric Vehicle Space Which Is Still In The Nascent Stage. The Carbon Dioxide Emission Can Be Reduced By using electrical vehicles we can reducing carbon dioxide Emission which is a major threatening issue to the plant. Taking Precautionary Measures to reduce the catastrophic climate change that threatens the species of this planet. Ev Could Be The Alternative To Decrease The Carbon Dioxide Gas Emission. Life Cycle Assessment (LCA), Charging, And Driving Range Compared To The Conventional Fossil Fueled Vehicles.[1] The CO 2 Emitted From Electric Vehicle Production Is (59%) More Than That Of The ICEV. The ICEV Gen- Emirates 120 G/Km Of CO 2 Emission On A Tank To Wheel Basis, But From The Point Of View Of The LCA, This Increases To 170–180 G/Km. While EV Has Zero Emissions Of CO 2 On A Tank To Wheel Basis, We Estimate That The Av- Erage CO 2 Is Measured Over The Life Cycle Of A Vehicle Rather Than Over A Vehicle. The Total CO 2 Emission Over Its Full Life Time Varies Significantly Depending On The Power Source Where The Vehicle Is Manufactured And Driven. In 2014, India's Overall Greenhouse Gas

Emission Amounted To 3202 Million Metric Tonnes Of Carbon Dioxide Equivalent, Which Accounted For 6.55% Of Global Greenhouse Gas Emissions. In India, 68% Of Greenhouse Gas Emission Come From The Energy Sector, Followed By Agriculture, Man U featuring Processes, Improvements In Land Use And Forestry, And Waste Adding 19.6%, 6.0%, 3.8% And 1.9% Relative To Greenhouse Gas Emission. Brady And Mahony, 2016 [2] Studied The Stochastic Simulation Methodology Of An Electric Vehicle For Generating A Dynamic Travel Schedule And Charging Profile For The Propulsion Of The Ev In This Real World. Morrissey Et Al., 2016 Studied Some Electric Vehicle Consumers And Revealed That They Prefer Charging Their Vehicles At Their Home During Peak Electricity Demand In The Evening. Foley Et Al., 2013 Studied The Impact Of EV Charging Under Peak And Off-Peak Charging Scenarios In A Single Extensive Electricity Market In Ireland And Found That The Peak Charging Is Detrimental Compared To Off-Peak Charging. Doucette And Mc CulLoch, 2011 Conducted A Study On The BEV And The PHEV To Deter- Mine Their Carbon Dioxide Emission Level And Compared Their Results With CO 2 Emission From Ford Focus. [3] Steinhilber Et Al., 2013 Studled The Essential Tools And Strategies For Introducing New Technology And Innovation By Exploring Key Barriers To An EV In Two Countries. Yu Et Al., 2012 Introduced A Driving Pattern Recognition Technique For Evaluating The Driving Range Of The Evs Based On The Trip Segment Partitioning Algorithm. Hayes Et Al., 2011 Investigated For Different Driving Conditions And Topographies By Building Up A Vehicle Model. Salah Et Al., 2015 Studied The Ev Charging Impact On Swiss DistriBution Substation And Found That Higher Penetration Level And Dynamic Tariffincreases The Risk Of Overloads At Some Locations. These Parameters are the range type Then Compared With Each Other By Their Range Type. The Impact Of Various Classifications Of Charging Methodology Of Electric Vehicles On The National Grid And The Storage Utilization Has Been Presented By Studied The Model-Based Non-Linear Observers For Estimating Torque Of motor in Hybrid Electric Vehicles. The Maximum Transmissible Torque Method Is Determined By For Increasing The Antiskid Execution Of The Torque Control.[4]

2. METHODOLOGY:

India's population in cities is rapidly to grow 200 million while the population is expected to grow by five times as compared to 2010. Due to huge growth has been a critical issue of keeping air and noise pollution in urban areas under control. It is expected to have 3 lakh electric vehicles on the roads by 2025, including three-wheelers, cars, and scooters, and significant health cost savings. 21 Smart cities are going to be built under the main objective of 3-Rs: recycle, reuse and reduce.[5]

3. ELECTRIC VEHICLE OVERVIEW:

The major moto behind the electric vehicle is to replace an internal combustion engine with an electric motor which is powered by the energy stored in the batteries through a power electronic traction inverter.[6] The Electric motor uses 90–95% of input energy to power the vehicle, which makes it a very efficient one. The major components of an Electric car are battery, charging port, charger, DC/DC converter, power electronics controller, regenerative braking, and drive system. The main use of the electric motor is that it utilizes the electrical energy stored in batteries for powering the Electric vehicle. [7]The EVs become environment-friendly as they are recharged with lower emission power sources. The electric grid is used to charge the cells. The primary function of the battery is to provide power to the Electrical car for making it in running condition. Generally, Ev uses lithium-ion batteries because they are more efficient than other cells due to their lightweight and negligible maintenance. The manufacturing of these Li-ion batteries is a bit expensive as compared to the nickel-metal hydride and lead-acid batteries.[8] Depending upon the climatic location and maintenance schedule, the Li-ion batteries last up to 8 to 12 years. Regenerative braking plays an essential role in maintaining vehicle strength and improves energy. This braking method uses the mechanical energy from the motor and converts kinetic energy into electrical energy to give back to the battery.[9] Re-gen braking also important in the range of the EV it is widely adopted in all hybrid and Battery Electric Vehicle models. the electric motor generates forward motion when the car moves forward, and when the brake is applied, it can be used to charge the batteries, which is known as regenerative braking. It can recover 15% of used energy for acceleration. Being an effective component, it is unable to recharge the electric vehicle fully shown in Fig:1

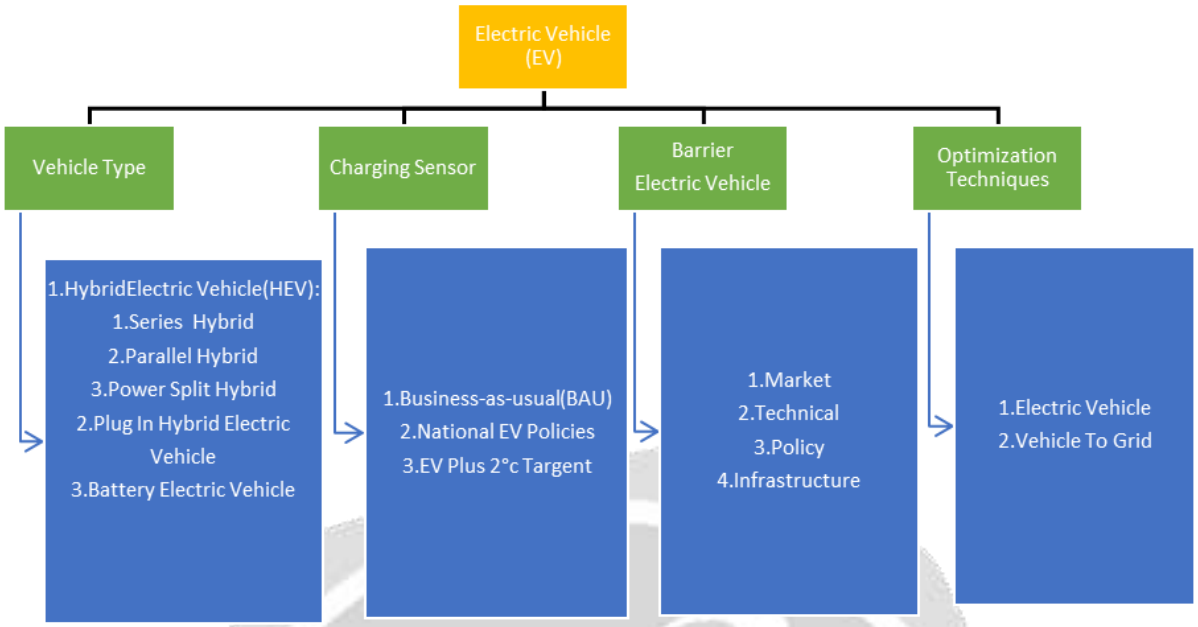

Fig:1 Overview of the Electric Vehicle

4. TYPES OF ELECTRIC VEHICLES:

Several countries are developed EVs, but many of the vehicles are manufactured by EVs come from China, UK, the USA, and Germany. The EV market is growing rapidly across the world. The vehicles can be arranged into three groups: Hybrid Electric Vehicles (HEV), Plug-in-Hybrid Electric Vehicle (PHEV), and Battery Electric Vehicle (BEV).[10]

5. HYBRID ELECTRIC VEHICLE:

A major component of the hybrid electric vehicle is the IC engine and electric motor. The batteries are getting charged by the engine and by the energy generated when decelerating and braking. In the current scenario, they are known as hybrid vehicles because they combine a combustion engine and an electric motor as a power converter. Hybrid electric vehicle technology is deployed worldwide as they have many advantages of offering contemporary performance with no worry about the charging infrastructure dependency.[11] They can also reduce fuel consumption through electrification of the powertrain. depending upon the type of hybrid system the HEV can be connected in many topologies. Some of the hybrid, parallel hybrid, and power-split hybrid. In a series hybrid, the only electric motor is used to provide power to the wheel. The motor gets the power either from the battery or from the generator.[12] as show in Fig:2.

6. KEY COMPONENTS OF HYBRID ELECTRIC CAR:

6.1 BATTERY (AUXILIARY):

In an electric vehicle, the auxiliary battery provides electricity to start the car before the traction battery is engaged and also powers vehicle accessories.

6.2 DC/DC CONVERTOR:

It is used to converts higher-voltage DC power from the traction battery pack to the lower-voltage DC power needed to run vehicle accessories and recharge the auxiliary battery.

6.3 ELECTRIC GENERATOR:

electricity is Generates from the rotating wheels while braking, transferring that energy back to the traction battery pack. Both Drive regeneration functions are only performed by some vehicles.

6.4 ELECTRIC TRACTION MOTOR:

Using power from the traction battery pack, this motor drives the vehicle's wheels. motor generators are used in some in vechicles that perform both the drive and regeneration functions.

6.5 EXHAUST SYSTEM:

The exhaust system channels the exhaust gases from the engine is channelized through the tailpipe. A reduce engine-out emissions within the exhaust system three-way catalyst is designed.

6.6 FUEL FILLER:

It is a nozzle used to fill gasoline diesel or petrol into a fuel tank.

6.7 FUEL TANK(GASOLINE):

It is the storage palace where the gasoline(petrol or diesel)

6.8 INTERNAL COMBUSTION ENGINE(SPARK-IGNITED):

In this type, fuel is injected into either the intake manifold .where it is combined with air, and the air/fuel mixture is ignited by the spark from a spark plug.

6.9 POWER ELECTRONICS CONTROLLER:

It is used to control manages the flow of electrical energy delivered by the traction battery, controlling the speed of the electric traction motor and the torque it produces.

6.10 THERMAL SYSTEM (COOLING):

This system maintains a proper operating temperature range of the engine, electric motor, power electronics, and other components.

6.11 TRACTION BATTERY PACK:

electric traction motor uses energy stored in the traction battery pack.

6.12 TRANSMISSION:

The transmission is used to transfers mechanical power from the engine or electric traction motor to drive the wheels.

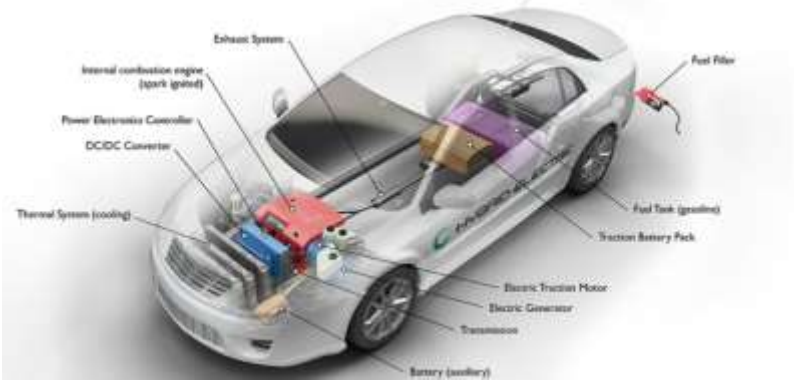

Fig:2 Hybrid Electric Car

7. PLUG-IN HYBRID ELECTRIC VEHICLE:

Plug-in hybrid electric vehicle (PHEV) comprises an internal combustion engine and an electric motor.[13]These vehicles are powered by gasoline and have a large rechargeable battery, which is charged up with electricity. The benefits of Plug-in Hybrid Electric Vehicles are:

7.1 LESS PETROLEUM USE:

PHEV uses about 30–60% less oil than a conventional vehicle. Since electricity is mostly produced from domestic sources, plug-in hybrid reduces the dependency on oil.[15]

7.2 GREENHOUSE GAS EMISSION:

compared to conventional vehicle PHEV emit less greenhouse gas. The amount of electricity produced depends upon gas emission Nuclear and hydropower plants .for example are cleaner than the coal-fired power plant.[16]

7.3 ESTIMATING FUEL ECONOMY:

Environmental Protection Agency provides a fuel economy estimate for gasoline only and for electric-only or, gas and electric operation both for combined city-highway driving as a plug-in can run on electricity, gasoline, or a combination of two.[17]

7.4 THE POWER, FUEL AND CHARGING INFRASTRUCTURE COMPANIES:

(leasing of batteries, swapping infrastructure, deploying fast chargers), making the economics of (fast) charging infrastructure work, providing stable power supply and grid stability, they can enable easy and rapid charging and drive EV adoption.[18]

8. BATTERY ELECTRIC VEHICLE:

The battery-electric vehicle also Know as BEV is a fully electric vehicle. It has no gasoline engine but consists of high-capacity rechargeable battery packs that can be charged from an external source. The battery-electric vehicle utilizes the chemical energy stored in rechargeable batteries to run the electric motor and all electronics involved internally. [19]The BEV could not only reduce the carbon dioxide emission from the light-duty vehicle fleet but also reduce the dependency on fossil-fueled vehicles. The BEVs are said to hold the largest share in the Indian market, contributing more than 70% of trade-in 2017, which is expected to grow in the coming years. [20]Though the BEVs dominated the sale over PHEV in many countries until 2014, there is a rapid growth of PHEV in the last two years, and the sale has gone almost equal with the BEV. Battery used Indian market can be classified as Lead-acid batteries, Nickel-metal hydride batteries, and Lithium-ion batteries. In India, the state of Maharashtra has the highest selling volume of Electric cars in 2017.[21] There are similar kinds of literature that study the comparative strategy for estimating the SOC and SOH of hybrid and battery electric vehicles. The observer-based fault estimation of battery in HEV application has been presented by and the algorithm for determining the temperature and thermal life of traction motor in commercial HEV has been discussed by [22].as show in Fig:3

Fig:3 battery electric vehicle

9. BATTERY THERMAL MANAGEMENT SYSTEM:

The use of EVs will be increased in the coming future and so priority is given to the need of developing effective batteries. [23]The thermal degradation of the batteries is a big challenge for better BTMS which affects the range of the EV. The main moto of the Battery thermal management system is to control the temperature of the battery cell and thus improve the battery life. Li-ion battery is usually preferred for their energy storage in the electric vehicle. [24]There are many challenges such as low efficiency at high and low temperature, decrease life of electrodes at high temperature, and the direct effect on the performance, reliability, cost, and protection of the vehicle, and safety issues related to thermal runaway in lithium-ion batteries.[25]

An effective thermal battery management system is one of the most crucial technology for the long-term success of an electric vehicle. Normally the temperature ranges from 25 °C to 40 °C are the optimal working conditions for the Li-ion batteries. When the temperature of these batteries is higher than 50 °C, it degrades the life of the battery.[26]

10. HYBRIDIZATION FACTOR:

The vehicles can also be classified depending upon their hybridization factor. The hybridization of vehicles helps in improving the mileage, generally communicated as mile per gallon (MPG) or miles per gallon gasoline-equivalent (MPGe). [27]MPGe can be utilized for Plug-in hybrid electric vehicles, where 33.7 kWh electrical energy is equivalent to the energy of one gallon of gasoline.

11. ELECTRIC VEHICLE SCENARIO IN INDIA CURRENTLY:

The EV market is extremely small in India. The sale of electric cars has become slow down to 2000 units per year for the last two years. [28]But there is a vision for 100% electric vehicle sales by 2030 and since we are in 2020, the compound annual growth rate is 28.12% .In the year 2001 Indias first electric car named REVA (MAHINDRA) was launched .it could able to sell a few units. Toyota began the Prius hybrid model in 2010, followed by the Camry hybrid in 2013. Electric buses and hybrid vehicles have been commenced as a pilot proposal in a few cities.[29]

12. THE REAL CHALLENGES AND OBSTACLES TO GOING ELECTRIC:

lack of specific pointers towards electrification, the EV Industry in India will still take another few years to evolve. [30]This does not owe to the Indian Government's ambitions targets and their resultant steps but simply because the automobile industry believes that India too will follow the low-carbon footsteps that are being taken by global big car markets like China, the US, and Japan.[31]Every major car-maker existing and planning to enter our market is getting into the act. So, while some domestic players already have EVs in their portfolio (though in very small numbers), other MNC OEMs are all testing and planning to launch their EVs within the next few years.[32] While each of these manufacturers understands the significance of the mass market prospects for EVs, they are hopeful that the policy push from the Government will translate into concrete steps that will eventually make EVs attractive even for buyers in the lower price segments.[33]

12.1 RANGE ANXIETY:

Potential EV customers are worried when it comes to the range that EV offers. They want to ensure that the vehicle would get them to their destination before the battery runs out.[34] This is closely linked to the lack of charging stations in the country. Therefore, there needs to be a stronger push for charging infrastructure and other solutions like battery swapping stations.[35]

12.2 CHALLENGES FROM THE GRID SIDE:

Most often, the EV discussion only veers around the non-existent charging infrastructure and about who will be responsible and when will this come up in India.[36] Another point that gets raised is how much of the power generated comes from old, coal-fired thermal power plants and about however may well be only displacing the pollution from the cities to the suburbs where these plants are located. [37]

13.OPTIMIZATION TECHNIQUE:

APPLICATION OF OPTIMIZATION TECHNIQUE FOR EVs:

In this paper, we had discussed the charging demand of EVs is characterized by various frameworks in different geographical locations. [38]The framework consists of Random utility model, Activity-based equilibrium scheduling, Driving pattern recognition, Stochastic model, Trip prediction model, Probabilistic model, Fuzzy based model and Data mining model, Forecasting model, Distributed Optimization, Hybrid particle swarm optimization, Ant colony optimization, and Household Activity Pattern, Particle swarm optimization, linear programming, the multi-objective and adaptive model which are summarised below. [39]The scope of this study was to investigate the potential benefit of charging characteristics of all EVs. Various studies were conducted worldwide by different authors for finding the optimization technique of Electric Vehicles.

14. VEHICLE TO GRID TECHNOLOGY:

The V2G concept was first introduced by Ruther. In this concept, the parked EV can supply electrical power to the grid and have a bi-directional charger, i.e., it can either deliver power to the grid or can be used to charge the battery. In V2G and Grid to Vehicle, the impact of bidirectional charging of Li-ion cells has been proposed to find its cell performance.[40]Overview of employing energy storage technology in the operation and planning of a distribution system is presented by. battery technology and policy of V2G technology are studied. They provided a methodology to manage battery degradation, which can be used for extending the life of the battery used in the electric vehicle.[41]

Application of optimization technique for V2G Various control strategies are proposed for optimal performance of V2G.

15. ACROSS THE GLOBE HAVE INVESTIGATED CHALLENGES TO V2G MANY BY AUTHORS:

The strategy was published by different authors across the globe. Tulpule et al., 2013 showed the feasibility study in a parking lot at a place of work in the USA, OH, Columbus, Los Angeles, and CA and compared it with the home charging system in terms of carbon dioxide emission and its expenditure.[42] A similar study performed also considered the parking lot in the USA, NJ, and New Jersey and a simple approach for determining the driving needs that could be met by solar power in summer but not in winter. Many authors have considered EV fleets at a different city or regional level. One such study made in Kansai Area, Japan, and combined 1 million EVs with 1 million heat pumps for reducing excess solar power.[43] using a smart charging method. The Batteries used in EVs do not have any significant impact on the grid due to their small size, as revealed by. However, V2G faces many socio-technical barriers due to its large-scale deployment. For evaluating V2G economics, Kempton and Tomic, 2005 expressed the lifetime of the battery energy as a function of battery capacity, battery cycle lifetime, and its DOD. The energy transfer of V2G has already been carried out in different countries to regulate varying, unpredicted energy demand or variation in supply availability.[44] Ekman, 2011 studied the cooperation between large EV fleets and high wind energy penetration in Denmark.V2G concept for Electric vehicles can either be hybrid, fuel cell, or pure battery vehicle. These hybrid vehicle drive trains, fuel cell, and battery EVs have been analyzed for various energy markets peak load, baseload, spinning reserve, and regulation services.[45] Several elements must be enabled V2G; some of them are i) the vehicle must have a connection with the grid for transfer of electrical power ii) communication either control or logical connection concerning grid operation and iii) onboard metering device of the vehicle.

Drude and Ruther, 2014 expressed the role of building-integrated grid-connected PV generation in a commercial building in a warm and sunny climate. Previously vehicles can only charge and that can be not discharged, so supporting the grid was not possible at that time. we have mentioned reviews of technology benefits, costs, and challenges of the vehicle in grid technology.[46]The optimal management of V2G system and a residential microgrid and [48]the feasibility of electric vehicle contribution to grid ancillary services have been presented by presented a case study in the US where the Plug-in Electric vehicle is compared with hybrid electric vehicles, where it is seen that the CO 2 emissions are reduced by 25% in the short term and 50% in the

long term basis by using a mix of generating power plants.[47] V2G capable vehicles provide possible backup for renewable power sources such as wind and solar power supporting efficient integration of intermittent power production. To maximize profit in the smart distribution system electric vehicle enables G2V and V2G.

16. CONCLUSION:

Hybrid, Plug-in Hybrid and Electric Vehicles are capable of increasing the fuel economy of vehicles but with an increase in the cost of buying compared to traditional vehicles. In general their decreased consumption of petroleum and increased productivity offers economic benefits to buyers, society, automakers, and policymakers over their lifetime. In this paper, we provide a detailed overview of the literature, overview, and guidelines for HEV, PHEV, and BEV penetration rate studies into the In- Indian Market. The recent initiatives and various subsidies by the Indian Government will help push the e-mobility drive in India. The development of a new concept of Vehicle-to-Grid can either deliver power to the grid. when non-conventional energy sources are not available. This technology is an important as- pect of energy security, renewable energy, and giving a great scope to deal with global warming issues. In This paper we have provides a summary of an electric vehicle's barriers and problems in the Indian context and is the main novelty of the paper.

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