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A paper on barriers and challenges of electric vehicles to grid optimization

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Abstract - *A significant possibility for lowering greenhouse gas emissions is the usage of electric automobiles. Electric cars not only lessen reliance on fossil fuels but also lessen the effects of ozone-depleting compounds and encourage the widespread use of renewable energy sources. Electric vehicle production and network modelling continue to change and are limited despite extensive study on the qualities and traits of electric vehicles as well as the makeup of their charging infrastructure. The study addresses the various modelling approaches and optimization strategies used in studies of the market penetration rates of battery electric vehicles, hybrid electric vehicles, plug-in hybrid electric vehicles, and electric vehicles. For a developing nation like India, the study is unique in that it addresses crucial hurdles including insufficient charging infrastructure.*

Key Words: electric vehicles Technique for vehicle to grid optimization CO2reduction

1. INTRODUCTION

Electric Vehicles (EVs) are evolving as a promising avenue for enhancing air quality, energy security, and economic opportunity as a result of the rapidly expanding Indian automobile market. The Indian government is aware of the pressing need to investigate sustainable mobility options to lessen reliance on imported energy sources, cut greenhouse gas emissions, and lessen the negative effects of transportation, such as global warming. By taking preventative efforts to lessen the catastrophic climate change that threatens the life on this planet, the carbon dioxide output can be decreased. Significant efforts have been made to reduce the use of fossil fuels for energy production, transportation propulsion, energy consumption reduction, and carbon sequestration protection. Electric vehicles (EVs) might be a solution to reduce carbon dioxide gas emissions [1].

Although the use of electric vehicles has begun, people still rely on fossil fuel-powered vehicles. However, EVs face challenges in life cycle analysis (LCA), charging, and range compared to traditional fossil fuel vehicles. The CO2 emissions of electric vehicle production are (59%) higher than the CO2 emissions of ICEV. ICEVs generate 120 g / km of CO2 emissions on a tank-to-wheelbase basis, which increases from 170 to 180 g / km from an LCA perspective. Tank-to-wheel EVs have no CO2 emissions, but average CO2 emissions are estimated to be measured throughout the vehicle's life cycle, not the entire vehicle. Lifetime CO2 emissions vary widely depending on the energy source from which the vehicle is manufactured and operated [2].

Harmful emissions from the transportation sector and investment from various OEMs raise concerns about producing more and cheaper electric vehicles in the coming years. Several factors, such as technological advances, vehicle cost reductions, government support, vehicle purchasing incentives, parking benefits, and good public charging infrastructure, can lead to the adoption of EVs in India. EV production is so low that the overall share of EVs in the Indian market is negligible. EVs include i) electric motorcycles such as electric bicycles and scooters (E2W), ii) three-wheeled vehicles such as electric bicycles, and iii) four-wheeled vehicles consisting of electric vehicles. Reva Electric Car, India's first electric vehicle company to launch cars in the early 2000s, focuses on making affordable cars with advanced technology. As the only BEV manufacturer, Mahindra Electric Mobility Ltd is a leader in the Indian market. Another major HEV manufacturer operating in the Indian market is Toyota Kirloskar MotorPvt. Limited, BMW AG, Volvo Car Corporation, Honda Motors Co. Ltd. Other models include Mahindra e2oPlus, Mahindra e-Verito, Mahindra e-KUV 100, Eddy Current Controls Love Bird, Atom Motors Stellar, and Tata Tiago Electric [3].

In 2014, India's total greenhouse gas emissions reached 322 million tons in terms of carbon dioxide, accounting for 6.55% of the world's greenhouse gas emissions. In India, 68% of GHG emissions come from the energy sector, followed by agriculture, manufacturing processes, land use improvement, forestry and waste, 19.6%, 6.0% and 3.8% of GHG emissions. It accounts for% and 1.9%. Four]. The electric vehicle can be used as a flexible load to integrate the grid in a significant portion of fluctuating renewable energy production [5]. Electric vehicle owners do not trade in the electricity market due to the poor performance of a single transaction [6]. Some authors [7], [8], [9], [10], [11], [12] estimate current smart policies that are pre-established and extrinsic for changing scenarios. We are considering a general way to do this. To take full advantage of the potential of electric vehicles, flexible charging and intelligent charging strategies need to be implemented. Another study by [13] showed that EV users are organized to communicate their time and energy needs to aggregators. Timing requirements define the amount of time that charging must be completed while the battery level supports energy requirements. Similar studies conducted by [14] suggest that decentralized frameworks and central institutions should signal EV owners who expect centralized and decentralized frameworks to overlap.

Brady and Mahony, 2016 [15] investigated electric vehicle stochastic simulation techniques to generate dynamic schedules and charging profiles for powering electric vehicles in this real world. They conclude that increasing the parking time distribution condition improves not only the overall accuracy of the model, but also the accuracy of the parking time distribution. Morrissey et al. , 2016 [16] surveyed some EV consumers and showed that they prefer to charge their cars at home during peak evening electricity demand. Foley et al. , 2013 [17] investigated the impact of EV charging in peak and off-peak charging scenarios in Ireland's single large electricity market and found that peak charging was at a disadvantage compared to off-peak charging. Doucette and McCulloch, 2011 [1] conducted a study to determine carbon emissions for BEVs and PHEVs and compared the results with Ford Focus's CO2 emissions. Steinhilber et al. , 2013 [18] explored the basic tools and strategies for adopting new technologies and innovations by investigating the major barriers to electric vehicles in the two countries. Yu et al. , 2012 [19] introduced driving pattern recognition technology for assessing the range of electric vehicles based on driving segment sharing algorithms. Hayes et al. , 2011 [20] builds vehicle models for different driving conditions and terrain. Salah et al. , 2015 [21] investigated the impact of EV charging on Swiss substations and found that higher penetrance and dynamic rates increase the risk of congestion in some locations. These parameters are then compared to each other based on the range type. Observers in [22], [23], [24], [25], and [26] non-linearly investigated the effects of different classifications of electric vehicle charging methods on public power grids and storage utilization. .. Estimate the torque of a permanent magnet synchronous motor for a hybrid electric vehicle. The maximum transferable torque method is determined by [27], [28], which enhances the non-slip design of the torque control frame and improves the stability of the electric vehicle. Lu et al. , 2013 [29] outlined the most important aspects of lithium-ion battery management for electric vehicles. Topics such as battery cell voltage, battery state estimation (battery SOC, SOH, DOD, and SOF), battery balance and uniformity, and battery failure analysis can provide motivation for research and design of battery management systems. A review of optimal management strategies, energy management systems, and modeling approaches for electric vehicles has been reviewed by [30], [31], [32], and [33].

2. METHODOLOGY

We have studied diverse forms of electric powered motors exiting at gift throughout the world. Besides this, we've got found out the obstacles of EV withinside the Indian market. Different forms of optimization strategies also are mentioned and are supplied in Table 2. The unique evaluate on Electric Vehicles became studied and is supplied in Fig. 1. This paper is based into some segments such as: Section 2 describes the methodology. Section three explains the evaluate of all forms of electric powered automobile configuration accompanied via way of means of its charging state of affairs in Section four and the barrier of EV in Section 5. The optimization method for EV and V2G is supplied in Section 6, accompanied via way of means of a end in Section 7.

3. ELECTRIC VECHICLE OVERVIEW

The grail at the back of the electrical car is to update an inner combustion engine with an electric powered motor that is powered via way of means of the power saved within side the batteries via strength digital traction inverter. The Electric motor makes use of 90–95% of enter power to strength the car, which makes it a completely green one. The key additives of an Electric vehicle are battery, charging port, charger, DC/DC converter, strength electronics controller, regenerative braking, and pressure system.

The motive of the electrical motor is that it makes use of the electric power saved in batteries for powering the Electric vehicle. The EVs end up environment-pleasant as they're recharged with decrease emission strength sources. The cells are charged from the electrical grid. The number one feature of the battery is to offer strength to the Electric vehicle for making it in strolling condition. Generally, EVs use lithium-ion batteries due to the fact they're greater green than different cells because of their light-weight and negligible protection. The production of those Li-ion batteries is bit high-priced in comparison to the nickel-metallic hydride and lead-acid batteries. Depending upon the climatic region and protection schedule, the Li-ion batteries last as long as eight to twelve years.

The charging port is the factor that lets in the car to hook up with an outside strength deliver machine thru a charger to price the battery. The characteristic of the charger is to take AC deliver from the strength supply the usage of a price port and converts it into DC strength for charging the battery. It additionally video display units the voltage, current, temperature and state-of-price of the battery even as charging it. The DC/DC converter converts excessive voltage DC from the battery to low voltage DC strength to run the car accessories. The strength electronics controller controls the velocity of the traction motor and torque with the aid of using dealing with the waft of electrical electricity from the traction battery. The regenerative braking performs an crucial function in keeping car energy and accomplishing stepped forward electricity. This braking technique makes use of the mechanical electricity from the motor and converts kinetic electricity into electric electricity to provide again to the battery. Regenerative braking additionally complements the variety of the EV, so it's miles broadly followed in all hybrid and BEV models. Here the electrical motor generates ahead momentum while the auto movements ahead, and while the brake is applied, it may be used to price the batteries, that's called regenerative braking. It can get better 15% of used electricity for acceleration. Being an powerful component, it's miles not able to recharge the electrical car fully.

The function of the power gadget is to generate movement with the aid of using moving the mechanical electricity into the traction wheel. Based on the usage of the additives, the electrical automobile has numerous inner configurations and does now no longer require traditional transmission. For example, a few layout makes use of more than one smaller automobiles meant for powering every wheel individually. On the opposite hand, a huge electric powered motor probable is coupled to the rear wheels the usage of differential housing. The electric powered-powered automobile makes use of tons less difficult additives whilst in comparison with the factors of a gas-powered vehicle engine. However, electric powered automobiles might now no longer cross tons quicker as a gas powered vehicle can.

4. OPTIMIZATION TECHNIQUE

4.1. Application of optimization technique for EVs

In this paper, the charging call for of EV is characterized with the aid of using numerous frameworks in one-of-a-kind geographical locations. The framework includes Random software version, Activity-primarily based totally equilibrium scheduling, Driving sample recognition, Stochastic version, Trip prediction version, Probabilistic version, Fuzzy primarily based totally version and Data mining version, Forecasting version, Distributed Optimization, Hybrid particle swarm optimization, Ant colony optimization and Household Activity Pattern, Particle swarm optimization, linear programming, multi-goal and adaptive version that are summarized below. The scope of this observe become to research the ability advantage of charging traits of all EVs. Various research carried out international with the aid of using one-of-a-kind authors for locating the optimization approach of Electric Vehicles.

4.2. Vehicle to grid technology

The V2G idea changed into first added via way of means of [106]. Under this idea, the parked EV can deliver electric electricity to the grid and feature a bi-directional charger, i.e., it is able to both supply electricity to the grid or may be used to price the battery. In V2G and Grid to Vehicle, the effect of bidirectional charging of Li-ion cells has been proposed to locate its mobileular performance [34].Overview of using power garage generation withinside the making plans and operation of a distribution device is provided via way of means of [35], [36]. They studied the battery generation and coverage of V2G generation. They supplied a method to manipulate battery degradation, which may be used for extending the lifestyles of the battery used within side the electric powered vehicle. Kester et al., 2018 [37] made a comparative examine in Nordic international locations on how masses of professionals associated with electric powered mobility mirror coverage hints for V2G and EVs. Dubarry et al., 2017 [38] made an experimental examine on how the Li-ion battery is degraded from the effect of V2G operation. They additionally discovered the effect of bi-directional charging for maximizing the earnings of EV customers via way of means of the usage of industrial Li-ion cells. Another examine made via way of means of [39] used an empirical version to locate the V2G viability taking into account the power fee and battery durability for battery degradation.

Habib et al., 2015 [40] made a comparative review on the charging strategy of an EV in addition to V2G technology to investigate their impact on the power distribution network. They also stated that the charging strategy and vehicle aggression could make V2G technology economically viable. There are numerous advantages of the V2G system, however if we increase the number of PEV, then it may have a direct impact on the dynamics of power distribution system and performance of the system through overloading of transformers, cables, and feeders. This lessens the effectiveness as well as requires extra generator starts and creates voltage deviation and harmonics [41], [42]. The Vehicle to Grid charging system is shown in Fig. 1.

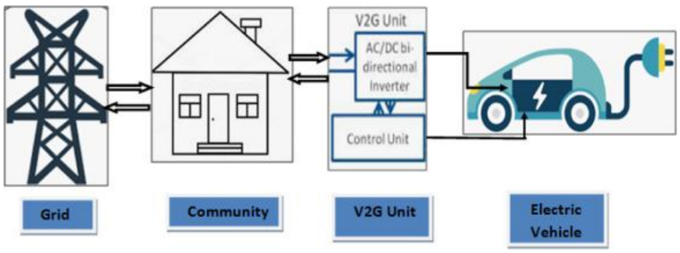

Fig. 1. Vehicle to Grid charging.

4.2.1. Application of optimization technique for V2G

Various control strategies are proposed for optimal performance of V2G. Many authors across the globe have investigated challenges to V2G and different optimization techniques. The strategy published by different authors across the globe is reviewed and presented

Tulpule et al., 2013 [43] showed the feasibility study in a parking lot at a place of work in USA, OH, Columbus, Los

Angeles, and CA and compared it with the home charging system in terms of carbon dioxide emission and its expenditure. A similar study performed by [44] also considered the parking lot in USA, NJ, and New Jersey and employed 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 the EV fleets at a different city or regional level. One such study made by [45] in Kansai Area, Japan, and combined 1 million EVs with 1 million heat pumps for reducing excess of solar power by 3 TWh by using 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 [46].However, V2G faces many socio-technical barriers due to their large scale deployment [47]. For evaluating V2G economics, Kempton and Tomic, 2005 [48] expressed the lifetime of the battery energy as a function of battery capacity, battery cycle lifetime, and it's 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. Ekman, 2011 [49] studied the cooperation between large EV fleets and high wind energy penetration in Denmark.V2G concept for Electric vehicle can either be hybrid, fuel cell, or pure battery vehicle. These hybrid vehicle drive train, fuel cell, and battery EVs have been analyzed for various energy markets peak load, base load, spinning reserve, and regulation services . Several elements must be met to enable V2G; these 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 [50] expressed the role of building-integrated grid-connected PV generation in a commercial building in a warm and sunny climate. Previously vehicles were only able to charge and were not able to discharge, so supporting the grid was not possible at that time [51]. Reviews of technologies, benefits, costs, and challenges of the vehicle to grid technology have been mentioned. The optimal management of V2G system and a residential micro grid and the feasibility of electric vehicle contribution to grid ancillary services have been presented. 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 CO2 emissions are reduced by 25% in the short term and 50% in the long term basis by using a mix of generating power plants.

5. CONCLUSION

Hybrid, Plug in Hybrid and Electric Vehicles are able to growing the gasoline economic system of motors however with an growth within side the value of purchasing as compared to standard motors. In trendy their reduced intake of petroleum and extended productiveness gives monetary gain to buyers, society, automakers and policymakers over the lifetime. This paper affords an in depth review of the literature, review, and suggestions for HEV, PHEV and BEV penetration price research into the Indian Market. The current projects and numerous subsidies via way of means of the Indian Government will assist push the e-mobility pressure in India. The improvement of a brand new idea of Vehicle-to-Grid can both supply electricity to the grid or may be used to fee the battery while non-traditional electricity reasserts aren't available. This generation is an vital thing of electricity security, renewable electricity, and giving a high-quality scope to address international warming issues. This paper affords a précis of an electric powered vehicle's obstacles and issues within side the Indian context and is the primary novelty of the paper.

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