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Review Paper of EV Battery Exchange Charging System with a Diesel Generator Set and Solar PV Powered Battery

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Abstract- This paper presents the review and analysis of ,an EV charging station powered by the grid (CS), a diesel generating set with an energy storage system, a solar PV (Photovoltaic) array, and battery are utilized. The charging station is primarily used to charge Battery storage using a BES and solar PV system. Smart utilization of the charging station can make use of a DG (Diesel Generator) unit or the grid to supply electricity in the event that the storage battery runs out or the solar array is unable to produce any. To maximize fuel efficiency, the DG sets are built to run at a constant 80–85 percent level of the model.

High CO_2 emission from the transportation sector pollute the environment on a global scale. Adoption of electric vehicles (EV) offers a tremendous opportunity to reduce carbon emissions. Electric vehicles can be powered efficiently and more quickly at battery charging stations by using a battery swapping station (BSS) (BCS). The ideal solution is provided by Switching Technology for finishing a protracted statewide journey.

The analysis of electric vehicle efficiency in many electrical elements is covered in this essay, along with the difficulties and benefits of using them as a logical step toward efficient, environmentally friendly, and sustainable transportation.

Keywords— Electric Vehicles; PV Array; Battery Swapping Charging Station; Charging Modes; DG Set; Grid.

I. INTRODUCTION

Due to their lack of exhaust emissions, electric vehicles (EVs) are today considered to be among the most efficient modes of transportation. Due to their benefits, 3 million EVs have already been put on the road, and by 2030, it's expected that there will be 100 million of them. However, the suggested plan's implementation necessitates a significant quantity of electrical power and infrastructure for charging. In addition, there is no other EVs can be regarded as sustainable if the electrical power required to charge them is produced by using alternative energy sources. However, using coal to produce electricity just shifts emissions from cars to the power plant, not actually reducing emissions. Since emissions can be fully eliminated when power is produced utilizing renewable energy sources, doing so is advantageous for the environment. Out of all the current renewable energy options, PV-based solar energy is the most practical because it is virtually always accessible, whether one lives in a rural or urban region (photovoltaic System, wind, hydro power regarding electricity generated by battery storage are some examples). It's accessible practically all year round in the Indian region. In contrast to a solar photovoltaic system, wind and hydro energy depend on the local environment. Wind energy is most advantageous along its shore, whereas hydroelectric is most advantageous in its highlands.

The most practical battery pack for charging stations is sustainable power, but when it is added to the existing battery charger, a new energy transfer phase is introduced, increasing the complexity of the system and energy loss. Each conversion stage also needs its own special controller, which must incorporate the present control. Because of this, it's essential to design an integrated system that can perform a variety of modes and functions, which calls for unified control over all of the sources and close coordination between them. Much interest has been generated by the construction of a charging station powered by renewable energy.

According to a thorough review of the literature, the work that has been done on charging stations that use renewable energy has a strong emphasis on optimizing an amount of charging variables, including size of the storage facility, the driving force, and the magnitude of the renewable resources habits of the vehicles, the charging time, cost, and planning, among others. However, as of right present, only a small number of publications have actually used the renewable energy charging station. Furthermore, nothing is revealed about how well charging stations perform when they are actually in use.

The literature mostly discusses the effectiveness of CS using the energy method or electrically isolated method. Even when the sun (photovoltaic irradiance) is present, the solar PV panel only has one sort of functioning when it is connected to the network, rendering it useless. Similar to this, PV electricity in island mode has issues due to intermittent sun irradiation. As a result, a capacity battery is required to moderate the impacts of variable sun based illumination. To dodge cheating the capacity battery, the most extreme control point following (MPPT) must be impaired after it has been completely charged.

Large carbon emissions from the transportation sector pollute the environment on a global scale. Electric vehicle (EV) adoption has enormous potential to reduce carbon emissions. Electric vehicles can be powered efficiently and more quickly at battery charging stations by using a battery swapping station (BSS) (BCS). The ideal solution is provided by Swapping Technology for finishing a protracted interstate journey.

As a result of their environmental friendliness, consumers prefer electrical automobiles. They are better for the environment since they don't emit emissions from their exhaust systems. Additionally, because the customer is minimizing their environmental effect by selecting a zero-emission system, they need less maintenance and can be eligible for a tax credit. Several countries, including the United States, China, Japan, and Germany, amended their laws and regulations to help the adoption of EVs.

These automobiles' primary problems, including as range anxiety and prolonged charge periods, can be overcome thanks to the performance of the Design for a Power Storage Stations As the automobile reaches a charging point, the exhausted power supply is changed out for the charged one.

Fast charge saves time but puts strain on the battery, shortening its lives. Similarly, batteries swapping is vital in improving battery life by charging the battery packs under optimal conditions.

There are essentially two methods for replacing the battery:

1. Robotic automation, a term used to describe a process in which the battery pack is replaced without the use of human labor.

2. By hand - In this method, a power that has been drained is altered with the aid of labor, which again takes more time than the first method did. Additionally, this operation will cost more because labor is needed.

This work offers a utility, storage system, and DG set based CS. Under any operational conditions, the PV array must produce the most energy possible. This CS can operate in the islanded, energy, and DG set-connected modes.

II.DIFFRENT TOPOLOGIES OF SYSTEM

When used for road transportation, electric vehicles (EVs) increase energy efficiency, don't require direct fuel burning, and rely on electricity, the most varied energy source, helping to achieve a variety of transport policy objectives. These include increased energy security, improved air quality, less noise, and decreased greenhouse gas emissions when combined with a low-carbon power generation mix. Additionally, as one of the automotive industry's most inventive clusters, EVs have a great deal of potential to boost industrial and economic competitiveness and draw in investment where significant markets may be created. to thoroughly examine the variables that have shaped current trends in electric mobility, the dynamics underlying their rapid development, the effects on potential electrification in the future, and the ramifications for policy changes [1].

Grid integration and the financial standing of distribution corporations, as in the previous year's estimate, impede greater expansion. The outlook for Latin America is more upbeat because to macroeconomic growth in Brazil and successful auctions in Argentina. A more upbeat projection is influenced by further wind and solar auctions held across Sub-Saharan Africa (SSA), although the speed of implementation hinges on the availability of affordable finance and timely grid expansion [2].

Solving this construction conundrum is the best approach to construct a totally solar-powered EV charging infrastructure, such as one in a green neighbourhood. The goal was to create a technique for determining the optimal number of solar panels and the optimal ESS power that reduces charging system development costs with reaching a present target average charging delay of an EV. Photovoltaic cells are powered by solar radiation, which is simulated using a discontinuous model of Markov chains and modified by localized cloudiness. The frequency with which the different cloudiness levels vary over the course of an hour determines the possibility that one solar radiation state will shift into another. Due to this, the methodology is based on a three-dimensional Markov chain model, where each state is determined by the amount of EVs in the system, the quantity of solar radiation present, and the ESS's state of charge [3].

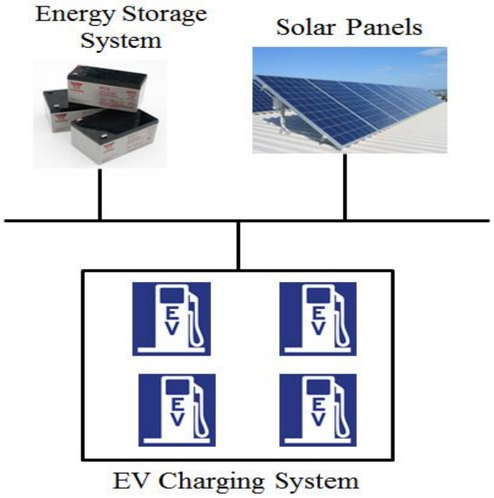

Fig. 1 Green EV charging system in its entirety

A 10kW, three-port, bidirectional converter that enables solar-powered electric vehicle (EV) charging directly to DC. The designed converter is CCS and Chademo EV charging standard compatible and can work with a PV array with a wide range of voltage and power. To improve switching frequency while minimising converter losses, interleaving converters, silicon carbide (SiC) devices, and powdered alloy core inductors are used. This has resulted in a threefold increase in power density and a threefold decrease in voltage ripple at the EV and PV ports when compared to conventional systems.

An interleaved boost converter for solar energy, a three-phase inverter for the AC grid, and an interleaved fly back converter for electric vehicles are coupled on a 750V central DC-link as part of the converter's modular design. This work demonstrates how, despite the fly back being considered to be only appropriate for low powers, employing SiC devices in a QR mode fly back converter can achieve excellent efficiency even at high powers. Three closed loop controls for the three sub-converters that enable the PV-EV, EV-grid, and PV-grid power flows were created and tested [4].

Electric vehicles (EVs) and photovoltaic (PV) panel-based renewable energy sources are connected to the electrical grid using a three-port integrated topology (TPIT). When compared to a typical topology, the proposed topology can reduce the number of conversion stages while also allowing for the construction of innovative operation modes and control algorithms, all while retaining the electrical grid side's power quality. The developed hardware, such as power converters and a digital control system, as well as proposed algorithms for regulating the TPIT based on FBD power theory, predictive current control approaches, and [5]

This gadget has an inbuilt charger for PV-Grid connected charging or energy storage as well as a single stage PV-Grid connection. This topology can be utilised for centralised charging configuration in semi-commercial contexts, such as a mall parking lot. The use of string inverters for residential applications can be expanded upon by connecting the charger side of the string inverter designs in series or parallel to share current [6].

A self-adaptive hybrid optimization technique that combines deterministic and rule-based methodologies is used to achieve energy storage management in a PV integrated EV charging station. The algorithm is flexible enough to adjust for different EV charging models and energy price patterns. The investigation demonstrated that the suggested algorithm is capable of managing energy storage between the ESS and the distribution grid while providing statistical and uncoordinated EV charging demands on a continuous basis.

The study examines the amount of subsidy necessary to economically deploy a PV system close to an EV charging station in conjunction with ESS given the high costs of PV and ESS. The cost of running an EV charging station can be reduced depending on how the load is distributed throughout the day and how volatile the power market is. More savings will be realised in more volatile markets as a result of the use of this strategy in the implementation of ESS [7].

For a system that uses a 6.65 kW PV array in Galway, Ireland to charge four electric vehicles, modelling and analysis have been finished. Over the course of a year, simulations of both the AC and DC system designs revealed that the DC system is 4.67% more effective. By altering power block efficiencies, the models compensate for changing source and load conditions [8].

Both the relationship between the service dropping rate and EV choice and the performance of the dual-mode charging station as a queuing network with numerous servers and varied service rates were looked into. To limit the rate at which the charging station has service disruptions, an appropriate tariff structure must be planned to direct and coordinate EV charging activities. Simulation results [9] demonstrate the usefulness of the proposed charge scheduling technique.

The possibility of using on-site wind energy from several buildings to charge EVs is investigated in light of the information below. Modern technological advancements have allowed mounting and integrating wind turbines on buildings to become easier over time [10].

In order to comprehend the effects on the drivability and lifespan of EVs, it is crucial to analyse the LoL of EV batteries used as SES for solar PV systems. In this study, the effects of different priority criteria on the LoL of EVs used as SES for a typical solar PV system, specifically TCV2G and PCV2G, have been examined. For PCV2G, a step-by-step, priority-based sequential power allocation algorithm that takes power converter resolution into account has been developed. With round robin EV IDs and SOC and energy delivered as priority factors, all EVs receive a fairly even LoL.

Additionally, the results of such study can be utilised to persuade EV owners to put aside their concerns about range and choose V2G services. The research can also be utilised to develop reliable algorithms for V2G dispatch and as a reference for implementing various sorts of characteristics as priority criteria [11].

A WGenCO's competitiveness is increased and risks related to wind and EV energy imbalance are decreased with effective coordination between a WGenCO participating in the short-term electricity market and an EV aggregator engaging in the energy and ancillary service markets.

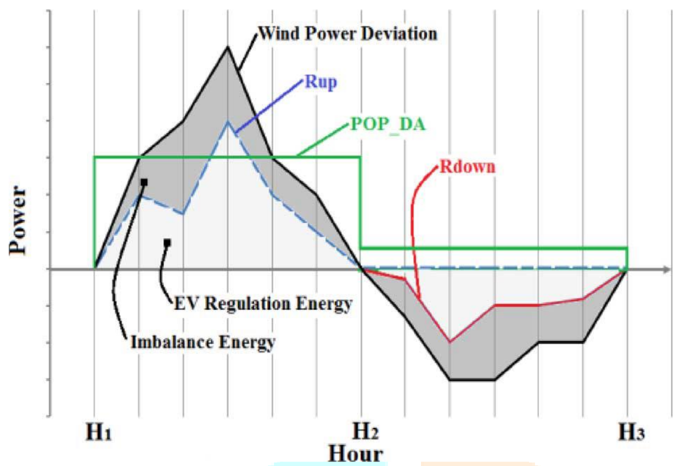

Fig. 2 Wind power and EV demand coordination in the energy and regulation market

It was revealed how to schedule in a stochastic manner. The method has been tried on traditional systems, including WGenCO without storage, WGenCO with energy storage devices, and a power system with a coordinated EV-Wind energy exchange. Model-based, optimal decision-making was used to design the recommended strategy. To adjust for changes in wind output, it allows a WGenCO to choose between balancing, regulations, and/or ESS services [12].

A model predictive voltage and power (MPVP) method is proposed to control the ac/dc interlinking converter in the battery energy storage system, while a model predictive current and power (MPCP) strategy is proposed to manage the bidirectional dc-dc converter (BESS). In order to maintain dc- and ac-bus voltages and smooth out the outputs of renewable energy sources, they are employed to co-ordinately manage the dc/dc converter and the ac/dc converter. A complete energy management plan is designed at the system level to ensure dependable operation in a variety of operating modes. The suggested technique's effectiveness is evaluated using a PV-Wind-Battery system with real-world solar and wind profiles, exhibiting higher control capabilities and enhanced voltage quality as compared to the conventional method [13].

It shows how strict feeder regulatory constraints will lower overall optimality. Communication requirements are addressed. The programme can be implemented using low bandwidth, unidirectional or bidirectional communication infrastructures, lowering investment, operation, and maintenance costs while increasing dependability and scalability. The application is intrinsically privacy-preserving since it deletes PEV's identity information [14].

Consumer adoption of electric vehicles will play a big part in reducing dangerous emissions in the environment. The desire to exchange technology is at an all-time high in many regions of the world today [15].

Fig. 3 Battery swapping station

According to the results, a charging station is capable of producing good voltage quality when used independently. While results in the DG set or grid connected mode have shown the ANC-based control algorithm's ability to sustain power exchange with the grid at UPF or optimal DG set loading, respectively [16].

Controlling a solar PV array and a grid-connected battery storage system. It has a flexible control approach since it tracks the maximum power point, battery charging and discharging, and grid current at a power factor of one. This design and control maintain the system's controlled power dynamics, which also helps to provide a steady amount of electricity to the grid. The control adapts itself based on environmental variables such as no/low solar insolation and a shortage of battery storage, and executes voltage control of the boost converter, grid and DC-link current management, and battery voltage control [17].

The optimum energy managing multi-objective issue was studied utilising RES and DRPs. A novel multi-objective modified Tribe-PSO algorithm has been offered as a solution. The grid-connected and stand-alone modes are explored separately to demonstrate the suggested method more clearly [18].

The investigation of a collaborative evaluation of dynamic pricing and peak power limiting-based DR strategies, a distributed small-scale renewable energy generation system, an EV's V2H and V2G capabilities, two-way energy trading of an EV (using V2G option), and ESS were the main contributions to the literature on smart home operation. These were created with the use of a MILP framework-based HEM structural modelling. Because of net metering, two-way energy exchange is now possible. While energy delivered back to the grid is supposed to be reimbursed at a fixed rate, energy received from the grid has a real-time cost.

Two fundamental premises were used in the study analysis. First off, before the offline optimization window ever starts, the full real-time pricing signal is precisely known. Additionally, it is presumed that user preferences and consumption patterns are correctly known. Real data from a PV plant and a typical four-person Portuguese family's home were used. A number of test cases were investigated. The effects of a second DR technique based on peak power restriction were studied. Consumers were considered to be willing to charge their EVs as soon as they reached home and to not own either a HEM system or an ESS in the base case scenario. When compared to the base scenario, which is likewise linked with the most expensive daily operation, the proposed technique delivered a more efficient operation by cutting power expenditures by around 65%. The operation of a HEM system allows for more cost-effective electricity consumption by utilising more intelligent technology [19].

A unified framework for EV charge-discharge management. The exchange of information between the HEMS and GEMS serves as the foundation for coordination. The suggested system generates a daily EV charge-discharge plan based on the exchanged information and day-ahead estimated power profiles [20] to ensure sufficient free capacity for charging the restricted PV during the day and the charged capacity for the scheduled EV travel.

This study highlights the importance of coordinated control between PV-based storage and PEV storage in lowering the overall cost of receiving energy from the grid for a residential system. To test multiple control strategies, the system takes into account unpredictability in PV generation and load demand. A Cholesky decomposition approach and the correlation between these two uncertain parameters are used to generate future scenarios. In order to guarantee PEV charging levels for the following day in accordance with the owner's wishes and prevent PEV discharge during off-peak hours, penalty costs are added to the target function of the model. The SDDP algorithm is then utilised to solve the optimization problem under uncertainty. By regulating the charge and discharge profiles of both storage components with SDDP, the decision-maker can lower overall costs for the customer [21].

Economic and environmental effects of integrating a photovoltaic (PV) array into diesel-electric power systems for remote villages MATLAB Simulink is used to balance the load and demand, as well as divide the electrical output between the PV and diesel generator. The model's economic component determines how much fuel is consumed, how many kilowatt-hours are generated per gallon of fuel supplied, and how much overall fuel is spent. The environmental module of the model is used to calculate the amount of CO2, particulate matter (PM), and x emitted into the atmosphere [22].

A grid-connected inverter multitasking control strategy for applications using distributed generation (DG) (GCIs). The electricity electrical link between the DG system and the grid is provided by a single-phase H-bridge voltage source inverter. To achieve the desired active power injection to the grid, the proposed control algorithm operates the GCI in current control mode. The suggested control algorithm can improve power quality by reducing current harmonics, compensating for reactive power, and injecting active power. The control algorithm only uses the GCI's remaining capacity to improve power quality. To extract the harmonic and reactive currents of the local loads, the proposed control approach adopts a current decomposition structure based on multiple adaptive noise cancellation (ANC) filters. The extracted harmonics are utilised to calculate the compensatory currents that the GCI will inject. The GCI was synchronised at fundamental frequency with a single-phase phase-locked loop (PLL) and ANC filters, resulting in a control algorithm that is robust to grid voltage distortions and tolerant to grid frequency fluctuations [23].

III. CONCLUSION

Discussion of the Performance of Solar PV-Powered Battery and Predicted EV Battery Swapping Charging Station is done in this study. With the help of photovoltaic systems, battery banks, grids, and DG set-based CS, it has been made possible to design and implement an EV charging system. The goal of this assessment is to discover a good solution for the current disadvantages. This essay provides examples of earlier research, techniques, and inventions.

The advantages and disadvantages of using electric vehicles for transportation are covered in this essay, along with how they can be a logical step toward effective, ecologically friendly, and sustainable transportation.

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