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SURVEY ON FEASIBILITY AND ANALYSIS OF HYBRID ENERGY BASED ELECTRIC VEHICLE CHARGING STATION

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Abstract: Electrical vehicle is the biggest invention of today's time which works to reduce air pollution and saves the accumulated fuel like petroleum. In view of the increasing demand of electrical vehicle and to keep doing it in the market, we need charging stations in many places, how they can become charging stations has been told by many research authors, in this research those authors Analyzing the work and future work so that the charging station can be made according to the user's requirement. To provide incessant charging during islanded, grid connected and DG connected modes, a solar PV array, a battery energy storage, a diesel generator set and a grid based EV charging station are used.

Keywords: EV Charging Station, Solar PV Generation, Power Quality, DG Set

I. INTRODUCTION

The widespread use of fossil fuels from rapidly depleting conventional energy sources has resulted in an increase in carbon dioxide emissions, which eventually cause the glasshouse gas effect. Today power demand increase also increase pollution due to used of vehicle, so need the rapid expansion of pollution-free electric vehicles for public used and electricity or power generation from renewal energy sources to reduce power demand of electrical vehicle. Current automobile vehicle is generate different type of gases that harm our environment and generate pollution in environment. In 1828 Anyos Jedlik make first an electric motor that is used today electrical vehicle, in 1835, University of Groningen in the Netherlands is show model of electrical vehicle that is invent by Professor Sibrandus Stratingh. The car was powered by non-rechargeable batteries. General Motors President Rick Wagoner unveiled the "Impact," a two-seat electric vehicle, later that year at the Los Angeles Auto Show. The Mitsubishi MiEV was released in Japan in 2009, and this marked the beginning of the modern era of highway electric vehicles. In 2008, Tesla Motors released the Tesla Roadster in California. With the introduction of competitive EVs by Nissan, BMW, Renault, Ford, Volkswagen, and Chevrolet, there are now eight available EVs.

Since traction batteries can handle high power and energy demands while occupying little space and weight, they are frequently used in electric vehicles. In order to advance EV battery technology, a lot of research is being done [Young et al., 2013]. Only lead acid batteries were utilised in electric vehicles up until recently. Due to lead acid batteries' low specific energy and short cycle life, nickel batteries, which have a high power density and dependability, have largely taken their place in electric vehicles (EVs). On the other hand, nickel batteries generate a lot of heat at high temperatures and have a high rate of self-discharge. Because of this high power density , light weight and small size Lithium batteries are used. Low specific energy, subpar thermal capabilities, and chemical leakage are all overcome. Korth Pereira Ferraz et al. (2018); Chen et al. (2012). Additionally, the wide operating temperature range, low self-discharge rate, long life cycle, and fast charging capability all contribute to its increased use in the EV industry. Lithium titanate and lithium ferrophosphate batteries are the most popular types of lithium batteries. The lithium ferrophosphate battery has superior thermal stability when fully charged and is unlikely to be inadvertently overcharged. The lithium titanate battery can be quickly recharged and has a wide operating temperature range..

II. POWER SCENARIO IN INDIA

India is a developing country where there is a never-ending chasing game between the amount of electricity generated and the amount of electricity consumed. There are conventional sources of generation that account for the majority of generation. However, this has resulted in a number of environmental issues, and there is a growing need to generate electricity in alternative ways. When considering remote locations, as well as places where expanding the main grid is a practical constraint, the concept of micro grid is an excellent option. Not only that, but proper coordinated control of a micro grid made up of various distributed energy resources and distributed energy storage systems makes it more efficient and optimal. The proposed micro grid could be a futuristic approach that improves the country's overall socioeconomic status. Two micro grid configurations using PI controllers are extensively studied in this work to support the idea of self-sustaining micro grid. Then, to improve performance, an intelligent controller is proposed.

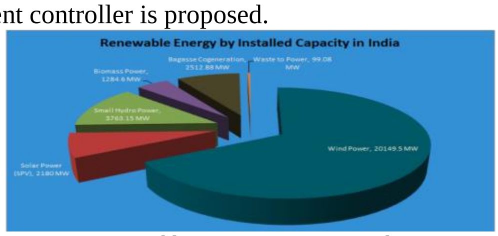

Fig.1 Renewable Energy Scenario in India Courtesy

The Figure 1 depicts the renewable energy scenario in India. Throughout history, India has made steady progress in renewable energy generation. It also depicts the installation of various energy resources in 2009 and the projected installed capacity in 2032. This steady growth is the result of the combined efforts of government organisations such as regional renewable energy development agencies, the Ministry of New and Renewable Energy (MNRE), and private players. (Murthy Balijepalli et al. 2010).

Almost 250 million people in developing countries such as India who live in remote areas are unable to benefit from the rural electrification scheme. A significant investment is required to connect these remote locations to the central or state electricity grid. As a result, electrifying rural areas with DGs may be considered a viable option. Furthermore, semi-urban areas face load shedding issues as well as serious power quality issues. As a result, there is enormous potential for the deployment of self-sustaining micro grids in India.

Small businesses and startups in India are helping micro grid technology take off. However, the viability of a combined Micro grid that connects and coordinates wind and PV resources to achieve power quality while accounting for their sporadic nature with the aid of an electric vehicle has not been fully examined.

The proposed work offers a coordinated control of the DER master controllers, which is a desirable and practical approach to supplying dependable power to remote locations.

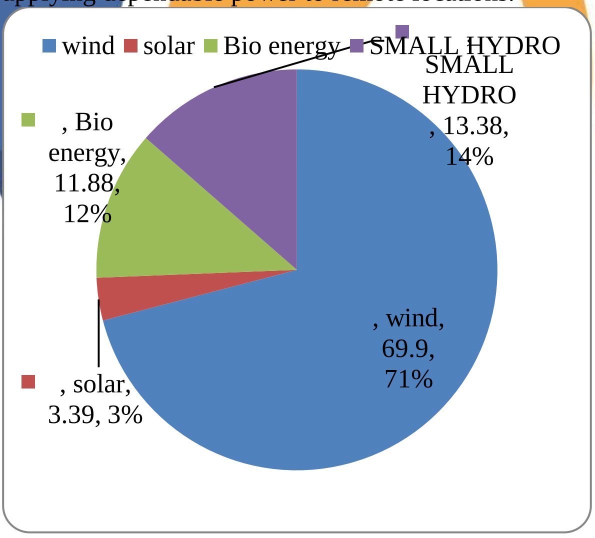

Fig.2 Renewable Power in India

Wind, solar, biomass, small hydro, and co-generation bio gases all have a significant potential for producing renewable energy. The potential for all forms of renewable energy generation in the nation was estimated at 147615 MW as of March 31, 2014. Included in this are the potentials for 102772 MW (69.9%) wind, 19749 MW (13.38%) SHP (small hydro power), 17538 MW (11.88%) biomass power, and 5000 MW (3.39%) biogases-based cogeneration in sugar mills.

III. LITERATURE SURVEY

Bhim Singh et al. in [1] has discussed For EV charging, a DG set-based charging station with a grid, storage battery, and PV array was constructed. The outcomes confirmed the CS's ability to operate in multiple modes—including islanded operation, grid connectivity, and DG set connectivity—with just one VSC. A variety of steady-state and dynamic conditions brought on by variations in solar irradiance, EV charging current, and loading were also successfully handled by the charging station. The results of the proposed work the charging station's operations are a standalone generator with good voltage quality. The ANC control algorithm has been proven to be capable of manage the exchange of power with using grid at UPF and set of optimal DG load through the results of test in set of DG or mode of grid connected. The likelihood of operation of MPP PV array and loading OF optimal DG set , as well as charging reliability, have also increased with island operation, grid connected and operations of DG set connected , as well as automatic mode switching. According to the IEEE standards voltage, current and total harmonic distortion are always being less than 5% with the charging station operation, which confirms the efficacy of the control On the basis of the aforementioned, it is possible to draw the conclusion that this charging station, with the suggested control, is capable of using various energy sources very effectively while providing EVs with constant and affordable charging.[1]

Anjeet Verma et al. in [2] has centered on the use of a photovoltaic (PV) array, a battery, the grid, and a diesel generator (DG) set-based charging station (CS) to supply uninterrupted power to household loads. There are many tasks just like power manage between various sources of energy and charging electric vehicles (EVs), maximising the power from the PV array, regulate the voltage of generators and frequency, compensating for harmonic currents in nonlinear loads, and compensating for intentional reactive power. In the charging station a single voltage source converter runs the CS in islanded mode, grid connected mode, and DG set connected mode (DGM), carrying out. The PV array and a storage battery are intended to provide the bulk of the power for the charging station (CS) control. The charging station depends on grid power and, finally, a squirrel cage induction generator-based direct current (DC) set if these two sources are unavailable. The DG set is smaller because it is designed to generate up to 33% more power than it is rated for while maintaining the rated current in the windings. Additionally, without the use of a mechanical speed governor, the generator's voltage and frequency are maintained at the recommended levels. In all modes of operation, the CS complies with IEEE 1547, and the total harmonic distortion of voltage and current is less than 5%.

Anjeet Verma et al. in [3] has concluded There are electric vehicle loads of household and grids all functioned by a solar PV grid connected power electric vehicle charger of residential. Using of PV array , the charger can run on its own for supplied loads of household with uninterrupted power and charging. if there is insufficient generation of pv array , the grid connected mode of operation is offered. The charger also has seamless mode switching control and synchronisation, which enable it to connect and disconnect from the grid without affecting EV charging or household supply. When islanded, the charger also transfers power from a vehicle to a home to support local loads and offers active/reactive power support to the grid. The charger is also programmed to function as an active power filter in order to operate with a unity power factor and keep the total harmonic distortion of grid current to under 5%. Additionally, a sliding mode control is used to control the dc-link voltage as part of an energy management strategy based on dc-link voltage regulation. The sinusoidal reference grid current is produced by a second-order generalised integrator frequency-locked loop with dc offset rejection when the voltage is distorted. A single-phase, 230-volt, 50-Hz grid has been used to test the charger.

Samir M. Shariff et al. in [4] has suggested The design and implementation of a contemporary Type-1 vehicle connector-controlled level-2 electric vehicle charging station. A methodological model is derived to study the parametric design features after the designed model is created in the MATLAB/Simulink environment and the circuit operation is examined. To produce a 48 V buck converter dc output and test the power factor correction performance under steady-state conditions with respect to load variation, a 3 kW, 230 Vrms input rated at 1-phase, 50 Hz, has also been developed. As an illustration, a 6.4 kW solar photovoltaic (PV) charging station was set up on the campus of Aligarh Muslim University in the parking area of the Centre of Advanced Research in Electrified Transportation building. Additionally, a lab prototype model was tested, and PROTEUS software was used to simulate the controller circuit. The experiment is conducted on a 10 kWh lithium-ion battery pack under typical solar panel test conditions on a bright sunny day.

Vinit Kumar et al. in [5] has reported It is suggested that the EV battery be charged at an off-grid charging station (OGCS). PV usage lessens the load on the grid, while EV usage rises in remote areas. In this paper, an ESS is connected to the OGCS, enabling the system to operate in any environment. The OGCS with ESS exchanges power to charge the EV battery when there is no or little sunlight. Furthermore, a constant current technique is used to charge the EV battery at various C-rates. Overall, this paper promotes cleaner transportation as well as an OGCS that is more sustainable, effective, and pollution-free.

T. S. Biya et al. in [6] has suggested Electric vehicles (EVs) have gained popularity as a result of global warming, and they seem to be the best alternative to internal combustion engines. Due to the increasing number of electric vehicles (EVs) on the road, it is no longer economical or efficient to charge them using the conventional grid powered by fossil fuels. The potential and control of a renewable energy charging station for electric vehicle charging is therefore enormous. For the current situation, a Battery Energy Storage System (BESS) and solar-powered electric vehicle charging station are planned. For uninterrupted power in the charging station without increasing the grid's load, more grid support is under consideration. For the best power management between solar, BESS, the grid, and the EVs in the charging station, an effective charging station design with MPPT, PID, and current control strategies is developed. MATLAB/Simulink is used to formulate and validate the charging station design while taking into account the demands of EVs' dynamic charging.

Ankit Kumar Singhet al. in [7] focused on the development of a multipurpose power electronic converter (PEC) that can use both grid and solar photovoltaic (PV) power to charge plug-in electric vehicles (PEVs). The developed configuration supported all vehicle modes (charging, propulsion, and regenerative braking). When the car is stopped, the grid, or both the grid and the solar PV system, charges the battery. While the car is moving, the kinetic energy of the wheels can be used to recharge the battery. In plug-in charging (PIC) mode, the proposed converter functions as an isolated SEPIC, and in solar PV charging mode, it functions as a non-isolated SEPIC. The proposed PEC also performs as a conventional boost converter and buck converter in the PP and RB modes. The modes of the proposed converter have all received simulation and experimental validation, which has been presented.

Anjeet Verma et al. in [8] has discussed It is recommended that a solar photovoltaic (PV) array, a battery energy storage system (BES), the grid, and a diesel generator (DG) be used to provide electric vehicle uninterruptible charging. The CS's operating costs are reduced by the efficient use of these energy sources. As a result, the price of charging an electric vehicle is reduced. The priority of an uninterruptible method of charging that the use of energy sources is provided , which is to achieve uninterruptible charging while lowering charging costs. Therefore, the highest priority is given on solar PV and BES energy. When all other sources of energy have run out, then a DG set is used. In this methodology the cost per kWh of electricity is used. The grid charges INR 10 per kWh, whereas DG sets charge INR 17–20 per kWh. In order to further lower charging costs, the single phase two winding self-excited induction generator (SEIG) based DG set is operated at a single point of saturation, producing significantly more power than its rated power. In addition to lowering the initial cost of the CS, a single two-leg voltage source converter (VSC) can also generate sinusoidal voltage in standalone mode, regulate generator voltage and frequency, manage power flow, compensate for reactive power, and eliminate harmonic current. To achieve continuous charging while connecting the grid/DG set to the CS, the point of common coupling (PCC) voltage is synchronised with the grid/DG set voltage. The CS has output ports with both AC and DC power for charging EVs. The CS creates a sinusoidal voltage of 220V and 50Hz using power from a solar PV array and BES in order to charge the EVs through the AC port. In order to charge the EVs via the AC port, the CS produces a sinusoidal voltage of 220V and 50Hz using energy from a solar PV array and BES. In accordance with an IEEE 519 standard, the CS draws power at unity power factor (PF) with less than 5% current total harmonic distortion (THD).

Ugirumurera et al. in [9] have discussed the significance of renewable energy for the long-term viability of EV charging stations These advantages would be lost if the associated EV charging systems solely relied on conventional power grids, the majority of which are powered by fossil-fueled power plants, even though the proliferation of electric vehicles (EVs) has been linked to significant environmental benefits. On the other hand, the use of dispersed renewable energy sources will protect and strengthen these environmental advantages. On the other hand, the technical literature has not sufficiently examined the planning of green EV charging systems. The goal of this study is to determine the ideal size of a solar-powered, entirely renewable energy-based charging system. This paper, in particular, describes a methodology for determining the optimal resource size that minimizes the investment costs of the charging system while meeting the charging system performance metrics (for instance, the number of solar panels and energy storage capacity). A search-based algorithm is created to effectively explore the problem's solution space in order to resolve the non-linear integer programming problem that has been formulated. The intermittent nature of solar power generation is taken into account using a three-dimensional Markov chain model. Finally, a demonstration of an entirely green charging system demonstrate the use of the proposed methodology.

Mouli et al. in [10] have used EVs are charged by solar energy using a ihigh-power ibidirectional iEVs charger. The charger, however, is not intended to support iAC charging. A sustainable transportation future is ensured by using photovoltaic (PV) panels to charge electric vehicles (EVs). This paper describes the design of a i10kW EV charger that can be ipowered by both a PV array and the three-phase AC grid. The objective is to create a three-port power converter that integrates grid charging standards, Chademo and CCS/Combo EV charging standards, and has a high power density and efficiency. Due to the isolation and bidirectional nature of the EV port, it supports both vehicle-to-grid (V2G) integration and charging. The converter uses a central DC-link to exchange power between PV and EV because they are both direct current systems, boosting efficiency. High EV, switching frequency, and power density are achieved by silicon carbide devices and inductors with powdered alloy cores. Four power flows are supported by the closed-loop control: wind, solar, and PV grid. As a result, the converter functions as a grid EV, PV grid, and bidirectional EV charger. The experimental 10kW prototype has undergone successful testing..

IV. ACTIVE AND REACTIVE POWER CONTROL

The term "Smart Parks" is used in the context of the smart grid and is closely related to the management of active and reactive power in a microgrid. It is possible to conduct vehicle to grid transactions when an electric vehicle fleet is parked in a parking space. Because it provides grid support, it is called a "Smart Park." The advantage of this method is that reactive power can be added to the grid without affecting the state of charge of the battery. Only a small amount of real power will be lost during the process, and the vehicle will compensate for it. (Ganesh Kumar Venayagamoorthy 2012). The main benefit of using electric vehicles is, it is a cost effective solution for smoothing variations due to intermittent sources and offers grid support as mentioned earlier (Ahmad Zahedi 2012). In the present research work, a simple logic for the PI controller is introduced which helps in power sharing between multiple EVs and flattens the fluctuations caused by varying renewable DGs. Hence the usage of FACTs devices can be eliminated for reactive power compensation.

V. POWER QUALITY

The Institute of Electrical and Electronics Engineers (IEEE), a standard-setting organisation, defines power quality as "the idea of recharging and grounding electrical devices in a sort of way that is ideal for that vehicle's operation and compatible with the premise wiring system and other connected equipment." Power quality may be defined by utilities as dependability. This is a common definition for power quality, which is a significant issue for electricity users at all usage levels, especially businesses and the service sector. Because of the widespread use of sensitive power electronic equipment and the use of non-linear loads in industries for commercial and domestic purposes, power quality is becoming a problem. Poor voltage and frequency regulation, harmonics, switching transients, and electrical noise are all examples of power surges and sags, and the electro-magnetic interference effect are just a few of the issues that can occur in such a setting. This results in costly appliances being damaged, safety issues, a loss of dependability, and most importantly, a significant financial loss.

Control systems based on converters are used to enhance power quality (Jeffrey Bloemink and Reza Iravani 2012). Decoupled control, or a virtual -E frame droop method, excels at power control and organising the flow of real and reactive powers (Yan Li and Yun Wei 2009; Yan Li and Yun Wei 2011). It is becoming increasingly important to maintain the power quality of the system to which DGs are connected without the use of auxiliary equipment. A higher standard of power is ensured when coordinated control and energy storage are used (Phatiphat Thounthong et al. 2012). This study focuses on achieving this goal by integrating a decoupled d-q control strategy for converters in order to provide stiff power at a competitive price..

VI. CONCLUSION

By combining the aforementioned individual EV battery charging systems, an efficient grid-tied hybrid RES-based EV battery charger with a reduced number of converters with improved performance and a simple control circuit is proposed to charge the batteries of electric vehicles effectively using renewable energies installed in parking/charging stations, office buildings, and residential buildings. The development of the hybrid renewable energy system is done in proposed system here is renewal energy PV and Wind is primary input source and diesel generator is alternative power generation source.

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