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Some New Aspects for PEV Using In Solar Power Generation

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ABSTRACT: It allows us to evaluate a wide range of Plug-in Hybrid Electric Vehicles (PHEVs) and Plug-in Electric Vehicles (PEVs) charging scenarios and the corresponding control strategies. In addition, this allows us to explore a variety of communication technologies for a PHEV/PEV charging facility. The charging scheme used here is monitored by Arduino board. Some vehicles are parked during the day at workplace parking garages and can be charged from the solar energy using Photo-Voltaic (PV) cell based charging facilities. The charging with solar energy helps to reduce the emissions from the power grid but increases the cost of charging. Moreover, it offers more flexibility to prepare for the emergence of new technologies (e.g., Vehicle-to-Grid, Vehicle-to-Building, and Smart Charging), which will become a reality in the near future. The simulation results provide a general overview of the impact of the proposed charging scenarios in terms of voltage profiles, peak demand, and charging cost. An electric charging method for automobiles using photovoltaic cells is a project that aims to design and implement a reliable system to charge the vehicle using solar energy power sources. Data from the Dutch Meteorological Institute is used to determine the optimal orientation of PV panels for maximum energy yield in the Netherlands. The seasonal and diurnal variation in solar insolation is analyzed to determine the energy availability for EV charging and the necessity for grid connection. Due to relatively low solar insolation in Netherlands, it has been determined that the power rating of the PV array can be oversized by 30% with respect to power rating of the converter. Various dynamic EV charging profiles are compared with an aim to minimize the grid dependency and to maximize the usage of solar power to directly charge the EV. Two scenarios are considered – one where the EVs have to be charged only on weekdays and the second case where EV have to be charged all 7 days/week. A priority mechanism is proposed to facilitate the charging of multiple EV from a single EV–PV charger. The feasibility of integrating a local storage to the EV–PV charger to make it grid independent is evaluated. The optimal storage size that reduces the grid dependency by 25% is evaluated.

KEYWORDS: Charging station, Electric vehicle, Photovoltaic system, Solar, PEV

I. INTRODUCTION

Today, the nonrenewable energy resources such as petroleum, coal, natural gas are depleting at very high rate. Even though nuclear energy has been a consistent source of energy for a very long period, doubts have been raised about its continuation after the last year's Japan disaster. Due to this decrease in the traditional energy sources, the demand for the alternatives energy resources has started to rise. To meet this increasing demand with keeping environmental concerns in mind, people are thinking about increasing use of renewable energy sources such as wind and solar energy. Since the sun is an energy source, which will never get exhausted, it can be used without thinking about shortage of supply of sunlight. The amount of sunlight that falls on the surface of the earth and can be effectively used ranges in amounts of 89,000 terawatts per year. Thus, solar energy can be seen as an emerging source of energy.

During the last quarter of the century, solar generation of electricity has been proven technically feasible and reliable. Despite these advantages, the observation of the following diagram suggests that even after many years of invention of photovoltaic effect, its use to produce electricity has been very limited. A study by International Energy Agency (IEA) shown that from 1973 to 2008, the use of all renewable energy resources including solar, wind and heat have shown a dramatic increase [1]. However, the use of all of these renewable resources still only accounts for less than 1% of overall energy use. Even today, oil, coal and natural gas, which still counts for over 60% along with nuclear energy, have been the most used energy resources.

Conventional Internal Combustion (IC) engine vehicles use petroleum products (i.e. petrol, diesel, or LPG) as the source of energy for driving purpose. The shortage of fossil fuel is the most critical issue over worldwide and the immediate solution is to minimize the use of fossil fuel as much as possible. Moreover, conventional IC engine vehicles emit carbon dioxide and various greenhouse gasses by making it harder to satisfy environmental regulations. The

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solution leads to adopting alternate fuel vehicles such as Electric Vehicles (EV) and Hybrid Electric Vehicle (HEV). EV does not emit tailpipe pollutant like particulates, volatile organic compounds, carbon monoxide, hydrocarbons, lead and oxides of nitrogen which plays a vital role in air pollution and greenhouse gas Moreover the fossil fuel issue can be minimized. As of September 2015 around 30 models of commercial electric cars and utility vans are launched mainly in China, United States, Western European countries and Japan. Over 620,000 light-duty electric vehicles have been sold by mid of September 2015 [2].

1.1Charger Infrastructure and Power Levels

The total amount of power that can be transferred, charging time, cost, location and effect on the grid are some important features of the charger. Some important issues like charging time, standardization of charging stations, distribution, and demand policies can be addressed by the deployment of charging infrastructure and electric vehicle supply equipment (EVSE) [3].

The electric vehicle can be charged through conduction or induction. Charging through Conductive systems can be direct contact between the electric vehicle and charging inlet. Power can be transferred magnetically through inductive charger to electric vehicle at resonance since maximum power can be transferred at resonance. An off-board battery charger has limited restriction to weight and size. The on-road plugin hybrid vehicle (PHEV) includes Toyota Prius and Chevrolet Volt. The on-road Electrical vehicles include Tesla Roadster Nissan Leaf i-MiEV, Mitsubishi. These are commercial ready for road vehicles with electrical different configurations, charging level, charging infrastructure and type of hybridization. These vehicles are costlier than the conventional IC engine systems, instead, it has got higher efficiency and they are go green vehicles. These Electric vehicles are fast picking up its pace with the advent of technology. This update in automobile technology creates a revolution in the transportation system and automobile industries. This topic reviews the implementation and the current status of electric vehicles, battery chargers, battery charger infrastructure, charging level, issues and opportunities.[4]

Based on power levels the chargers are classified into three categories and are described below.

a) Level 1 charging

It is the slowest method and according to U.S. standard 120 V/15A single phase outlet can be used for the charging purpose. A standard J1772 connector can be used to connect the EV ac port with the charging outlet. No extra infrastructure is necessary and the vehicle can be charged in home or office overnight. The charger is an on-board charger (OBC) i.e. the charger can be mounted inside the vehicle.

b) Level 2 charging

It is the semi-fast charging method. According to U.S. standards, a 240 V outlet is necessary for level 2 charging. Dedicated equipment may be required at home or office for this charging method.

c) Level 3 charging

Generally, level 3 charging offers DC fast charging or AC fast charging as the time taken is less than 1 hour. Dedicated charging stations are required and an off-board charger is employed to convert the AC power into DC in order to charge the battery.[3]

1.2 Types of PEV Chargers

There are various types of electric vehicle supply equipment (EVSE), which differ based on charging period of a vehicle, and EVSE can be accessed at home or in public. EVSE for PEVs is classified into several categories by the maximum amount of power provided to the battery. Level 1 provides Alternating Current (AC) electricity to the vehicle. The vehicle's onboard equipment converts AC into Direct Current (DC) that charges the batteries. The level 2 is named as DC fast charging which provides DC electricity directly to the vehicle. Charging times varies from less than 30 minutes to 20 hours or more based on the type of EVSE, the type of battery and its energy capacity. EVs have more battery capacity than plug-in hybrid electric vehicle (PHEVs), so charging a fully depleted EV takes longer than charging a fully depleted PHEV.[5]

A- **DC Fast Charging**: DC fast-charging EVSE (480-V AC input to the EVSE) enables rapid charging at sites such as heavy traffic corridors and public fueling stations. A DC fast charger can add 60 to 80 miles of range to a PEV in 20 minutes.

B- **Inductive Charging**: Inductive-charging EVSE, which uses an electromagnetic field to transfer electricity to a PEV, is still being used in some areas where it was installed for EVs in the 1990s. Currently available PEVs cannot use inductive charging, although SAE International is working on a standard that may apply to PEVs in the future.

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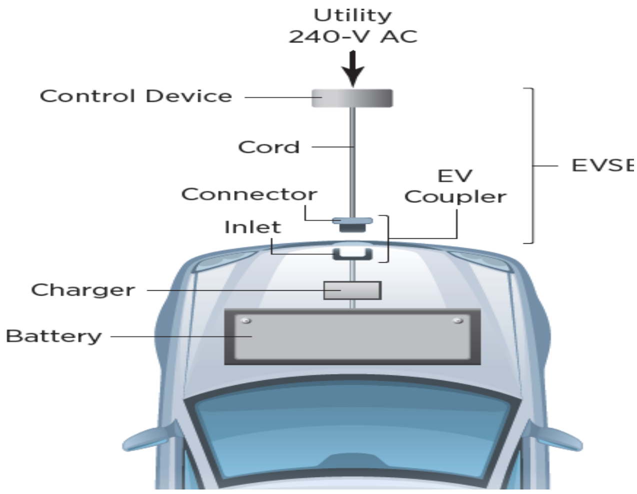

Fig.1: Level 2 Charging Scheme

1.3 Advantages of Using Electric Vehicles

a) Cheaper to operate

EVs are cheaper to operate since they have high efficiencies and fuel economies thereby reduce cost for the owner. The electricity to charge an EV is about one third as much per kilometer to purchase fuel for vehicle.[6]

b) Cheaper to maintain

BEVs have less moving parts than those had by conventional combustion engine vehicles. There is less servicing and no expensive systems such as fuel injection and exhaust systems, which are not needed in an EV. PHEVs have petrol engine and need servicing hence costing more than BEVs but they also have an electric propulsion system, which requires less moving parts leading to less depletion of petrol engine parts.

c) Environment Friendly

EVs are less polluting, as they have zero exhaust emissions. If you opt to use renewable energy to charge your EV, you can reduce greenhouse gas emissions even more. Some EVs are made of eco-friendly materials such as the Ford Focus Electric, which is made of recycled and bio based materials and the Nissan Leaf, which is partly made of recycled plastic bottles, old car parts and second hand appliances. [6]

d) Health Benefits

The reduced harmful emissions will lead to better air quality, which is good for our health. EVs are also produce much less noise compared to petrol/diesel-based vehicles.

e) Safer

EVs have a low center of gravity thereby making them less likely to cap size. They also have low risk of fires and explosions. Their body construction gives them more durability hence making them safer during collisions.[6]

1.4 Challenges in Electric Vehicle

a) Cost of EVs

The cost of EVs should be reasonable and the EVs produced should hold proper value for money.

b) Efficiency of EVs in India

The EVs in India on an average provide around 120 km on a full charge in turn making them unsuitable for long drives.EVs in India lack speed, which may turn off buyers. The top two India made EVs have speed of 85 km/hr.[6]

c)Demand for EVs

Increase in demand will help in achieving vision 2030.Increase in demand of EVs will lead to increase in requirement for energy and raw materials to for the battery.

d) Vehicle Quality

Good vehicle quality will lure more customers.

Better quality vehicles ensure trust among customers.

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e) Batteries

The batteries used by electrical cars are made up of nickel, aluminum, cobalt, graphite and lithium, which are all rare earth materials.The availability of these materials is scarce and the amount of these materials available may not be able to produce enough batteries to power the expected amount of electric vehicles to be produced.

The increasing demand for lithium around the globe given its scarcity on the Earth's surface will make it challenging to meet India's EV requirement.[6]

f) Electricity Generation

There must be enough electricity generation capacity to meet the increasing demands for charging infrastructure and local consumer utilization.There is presently shortage of electricity in many parts of India and a major part of energy generation of the country is still dependent on fossil fuels.

II. RELATED WORK

G.R. Chandra Mouli et al. , System design for a solar powered electric vehicle charging station for workplaces. They investigated the possibility of charging battery electric vehicles at workplace in Netherland using solar energy. Data from the Dutch Meteorological Institute is used to determine the optimal orientation of PV panels for maximum energy yield in the Netherlands. The seasonal and diurnal variation I solar insolation is analyzed to determine the energy availability for EV charging and the necessity for grid connection. Due to relatively low solar insolation in Netherlands, it has been determined that the power rating of the PV array can be oversized by 30% with respect to power rating of the converter. Various dynamic EV charging profiles are compared with an aim to minimize the grid dependency and to maximize the usage of solar power to directly charge the EV. Two scenarios are considered – one where the EVs have to be charged only on weekdays and the second case where EV have to be charged all 7 days/week. A priority mechanism is proposed to facilitate the charging of multiple EV from a single EV–PV charger. The feasibility of integrating a local storage to the EV–PV charger to make it grid independent is evaluated. The optimal storage size that reduces the grid dependency by 25% is evaluated.[7]***Thomas Huld***, PVMAPS: Software tools and data for the estimation of solar radiation and photovoltaic module performance over large geographical areas. A set of computational tools and climatic data, tentatively named PVMAPS, is presented which makes it possible to calculate solar radiation and photovoltaic system power on inclined and/or sun-tracking surfaces over large geographical areas at arbitrarily high spatial resolution. Calculations of solar radiation and photovoltaic performance are done using validated models published in the scientific literature. The software has been implemented as modules in the open-source GRASS Geographical Information System and is delivered together with scripts to perform the calculations for any geographical region in the area covered by the data. The accompanying data set includes information about elevation, horizon height, average temperatures, solar radiation (direct and diffuse components) as well as data to calculate the effects of wind and spectral variations on PV performance. The geographical extent of the data at present includes Europe, Africa and most of Asia.[8]***Christoph Maurer et al***., Progress in building-integrated solar thermal systems. Solar building envelopes are attracting increasing interest. Building-integrated solar thermal (BIST) systems are one of the subgroups of solar building envelopes. This paper summarizes the most important contributions of recent years and extends them. First, BIST elements are defined and available BIST elements are presented. Then, the general functions which BIST systems can provide are presented and the conflict between the constant U and g values of simple planning software and the variable g and U values of BIST elements is discussed. Measurements to characterize BIST elements are presented as well as a design parameter space in which the current BIST elements are located and which can be used when developing innovative new components. Methods to evaluate and compare BIST technologies are presented. The substantial cost savings which were achieved in three building projects between 2002 and 2009 are discussed. Roles within the building process are presented, as well as the general methods and challenges for economic BIST calculations and one economic calculation as an example. Based on existing building processes, a vision for future BIST building process integration is presented. Simple BIST models, which need no programming, are provided with easy-to-use equations. The challenges of standards and regulations are outlined and future research topics are presented. This paper summarizes important recent contributions to BIST research as a basis for future progress in building-integrated solar thermal systems. Instead of aiming to cover all recent BIST developments, the focus is on BIST research findings which are relevant for cost reduction of BIST components and therefore necessary for the economic success of BIST technology. These are discussed, together with proposals for future research.[9]***M.B. Keogh et al.,*** Evaluation of the natural coagulant Moringaoleifera as a pretreatment for SODIS in contaminated turbid water. Solar Disinfection of water (SODIS) is a treatment method that traditionally exposes low turbidity water filled in clear bottles to direct sunlight up to 6 h. Typically, water should have turbidity lower than 30 NTU *before solar exposure; however turbidities of water sources in communities vary and can reach higher than 200* NTU. In order to reduce turbidity, flocculating agents like Moringaoleifera (Moringa) may be used. In this study, Theyeassess the efficacy of Moringa to clear turbid water as a pretreatment for SODIS. We initially evaluate two preparations− powdered seeds and an aqueous

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filtrate of the seeds, to determine if these can benefit SODIS in turbid, E. coli contaminated water (Experiment 1). We show that powdered Moringa seeds reduce turbidity best and that SODIS treatment of highly turbid water was effective regardless of reduced turbidity. Overnight, however; a bio-active sludge layer formed. We then determined if 24 h Moringapretreatment and decanting can maintain water quality over an extended period (Experiment 2). After 24 h Moringa treatment showed a 2.1 log reduction in E. coli, increasing following SODIS (6-log) E. coli without nightly recovery or sludge formation. Untreated turbid controls showed SODIS disinfection after 6 h direct sunlight; however, nightly regrowth and sludge layer formation occurred by 48 h. These results suggest that SODIS is capable of inactivating bacteria inhighly turbid water at 6 h; however, active biofilm sludge layers formed by 48 h. We conclude that, for longer term water storage, we find a combination of Moringa seed powder pretreatmentprior to SODIS to be optimal.[10]***Shruti Sharma et el.,*** Solar Cells: In Research and Applications—A Review. The light from the Sun is a non-vanishing renewable source of energy which is free from environmental pollution and noise. It can easily compensate the energy drawn from the non-renewable sources of energy such as fossil fuels and petroleum deposits inside the earth. The fabrication of solar cells has passed through a large number of improvement steps from one generation to another. Silicon based solar cells were the first generation solar cells grown on Si wafers, mainly single crystals. Further development to thin films, dye sensitized solar cells and organic solar cells enhanced the cell efficiency. The development is basically hindered by the cost and efficiency. In order to choose the right solar cell for a specific geographic location, we are required to understand fundamental mechanisms and functions of several solar technologies that are widely studied. In this article, they have reviewed a progressive development in the solar cell research from one generation to other, and discussed about their future trends and aspects. The article also tries to emphasize the various practices and methods to promote the benefits of solar energy.[11]

III. PROPOSED WORK

The proposed off-grid EV charging station consists of three subsections they are PV generation, EV charger and ESS. The first section is PV generation system which includes a PV array, maximum power point (MPPT) and a boost converter. The PV array converts solar energy into clean electrical energy and provides voltage VPV and current IPV. The VPV and IPV are given to the boost converter which fluctuates due to change in irradiance. Therefore, an MPPT technique is proposed to manage the fluctuations in VPV and IPV . The MPPT extracts maximum power PPV from the PV array and provides corresponding operating voltage and current to the boost converter. The boost converter regulates the output voltage according to the desired DC-link voltage by generating the PWM signals from the MPPT. This DC-link voltage at the DC bus is connected to the EV charger and ESS as shown in Fig. 4.1. The EV charger consists of a DC-DC bi-directional converter (BDC) and EVs. The operation of BDC depends on the charging and discharging of the EV battery. During charging mode, BDC acts as a buck converter. On other hand, it works as a boost converter during discharging mode. Similarly, the ESS also consists of a BDC and a battery bank. This battery bank is used as the energy saver during excess energy generation and is utilized at the maximum extent. The power that is stored in the ESS is fed back to the DC-link through BDC which is operated in boost mode. The mode of conversion is carried out with the help of constant current (CC) control strategy. This control strategy generates PWM signals to switch on the BDS. The mode (boost or buck) of converter changes according to the control signal generated by the control strategy. In this way, the operation of an off-grid EV charging is carried out. Further, the brief modeling and control of PV array, boost converter, bi-directional converter.

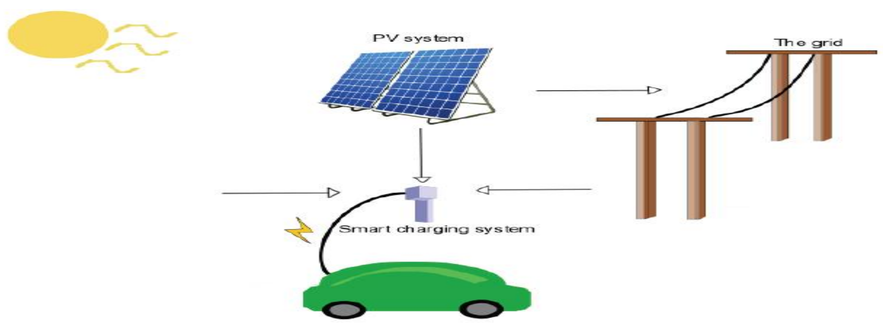

Fig. 2: A smart charging system

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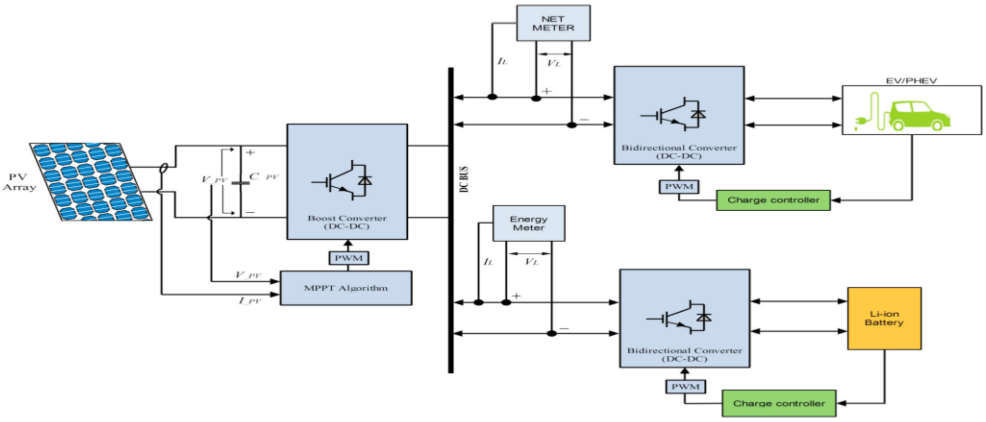

Fig. 3: Proposed block diagram of the PV based Off-grid charging station with energy storage system

3.1 Charging Speed

One of the greatest concerns with EV adoption is the lengthy amount of time required for charging car batteries. The Solar Edge Inverter-Integrated EV Charger allows for a speedier charge time than ever, due to its ability to combine instantaneous solar production with AC power from the grid at the same time. Using a "solar boost mode," EV owners can expect a full charge at a rate 6x faster than the standard Level 1 EV charger during optimal solar conditions. For example, where a standard Level 1 EV charger would add 5 miles per hour of charging, Solar Edge's solar boost yields between 25-30 miles in the same amount of time. Solar Edge's EV Charging solution also offers monitoring capabilities for its users, giving them the ability to exercise meaningful control over their EV charging. More specifically, the system owner can tailor charging behavior around Time of Use (TOU) rates determined by the utility. This ensures the freedom and convenience to charge during rates yielding the best value charge, making EV charging as cost-effective as possible. Monitoring capabilities also give the user the appropriate online metrics, making sure the system works accordingly. This is synced with the Solar Edge online portal where the user can view the state of charge, grid usage, and other metrics through a smartphone, tablet, or computer.

3.2 Reduced Installation Time & Costs

Installers benefit from reduced installation costs with the Solar Edge HD wave with EV-integrated charger. First, the integrated nature of the product eliminates the need to install an individual EV charger and PV inverter. In addition, there is no need for a designated circuit breaker for the EV charger as it is embedded within the same unit. This results in reduced wiring, conduit, and the convenience of avoiding a potential main distribution panel.

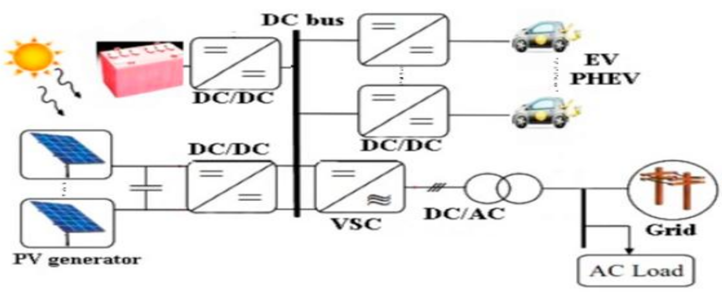

Fig. 4:Solar Edge HD wave with EV-integrated charger

The main components of the system were as follows:

1. Photovoltaic panels (PV) were in accordance with the data presented in Table 1. The loss factor was defined as the increase in power required for the PV generator to compensate for any loss from shadows, orientation, dirt in panels, etc. Usually, the value ranges between and for this study, the loss factor is selected and the PV slope was 60.
2. The batteries are lead-acid type, and the input data used for the study are presented in Table 1. The data shown in Figure 4.2 were provided for each battery for the number of life cycles to failure (Ciclesi) for each depth of

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discharge (DODi %), which are displayed in red. The simulation software used in this study calculated the cycled energy throughout the battery lifetime for each DOD. This value is displayed in gray.

3. The inverter selected for the solar system operation was a 900 VA inverter. Its main characteristics are shown in Table 4.1 and it is found that the average power was 40.

Table 1: Characteristics of photovoltaic (PV) panels

Item	Value	Unit
Nominal voltage	24	V
Shortcut Current	8.39	A
Nominal Power	280	Wp
Operating Temperature	-40 to 85	0c
Maximum Wind Speed	2400	Pa (km/h)

IV. EXPERIMENTAL RESULTS

The major difference between both the possible MPC's is the capability of isolating PV panels from the grid. The depicts that, both the topologies adapt a central DC-link available within the DC-DC converter. For efficient power flow management, the DC link voltage rating must be higher than the peak voltage of the system. In a non-isolated DC/DC converter is adapted for achieving maximum power from the PV array. A high-frequency DC-DC conversion is adapted for EV charging station by adding a high-frequency transformer between the conversion process as per proposed energy management strategy.

In order to design the proposed system configuration, the flow of the power between the four main elements in this system needs to be explored. The main elements are the connecting electrical grid, the PV sources, the battery storage and the EVs charging load. The decision on the need for a bi-directional power flow power electronic system, along with their sizing requirements, can be decided based on power flow management. Consequently, the research attempts to solve the power flow management problem by introducing their applicability on the studied application. Conventionally, the power flow in a grid-connected PV/battery system is predefined by heuristic rules that consider the load demand, the PV insulation levels and the peak utility hours .However, a dynamic grid tare complicates the solution of the proposed system further. In a dynamic grid tar system, the operation of the PV/battery system using the simplified heuristic rules will provide running cost solutions that largely deviate from the minimal cost operation. Thus, the research in this area has taken on an accelerated path battery charging or discharging current, where the objective is to maximize the contribution of the hybrid system to the grid. The proposed technique in Reference assumes there is no dispatch cost associated with the PV/Battery output power. This leads to the negligence of the battery degradation cost and its advisable operating conditions. Additionally, the formulation of the problem is limited to a thermally based electrical grid system where the battery energy storage is integrated into the renewable energy system in order to enable the PV source to act as a dispatch able unit on an hourly basis. The objective of the battery storage utilization system is sensitive to solar power forecasts. From the above literature, it is observed that, initially, the problem formulation should account for the aging factor of the battery in order to extend the battery lifetime, and thus, increase the system reliability. The desired power flow management topology has to accommodate non-linear functions. This allows the generalization of the developed topology on different operating scenarios. An on line error compensation stage has to be included in the topology to allow the system to operate effectively at mismatching conditions and forecasting deviations. Lastly, the online optimization stage should be designed to operate with low computational time, which makes it easily integrated into real-time controllers. Study regarding intelligent energy management strategy and dynamic power allocation is required in order to overcome these drawbacks and achieve the proposed optimization.

The proposed off-grid charging station (OGCS) consists of a 24 kWp PV generation for the EV battery of 15 kWh capacity. Additionally, an ESS of 15 kWh capacity is added to the proposed system. It has been used as an emergency supply to the EV batteries in case of low PV generation and stores the energy during the time of high PV generation. Further, the system has been designed in MATLAB/Simulink. The performance of the proposed system analysed by considering three modes. These modes are categorized such as EV battery charging (i) with OGCS in absence of ESS, (ii) with OGCS in the presence of ESS and (iii) with ESS in the absence PV generation. Every mode is analysed for 12 s. on the basis of charging rate (C-rate) which replicate the power demand at a time of EV battery. Initially, the EV battery is charged at 0.5 C-rate for 3 s. and a step of 0.5 C-rate is added at every 3 s. up to 12 s. Whenever, the power demand increases or decreases in terms of C-rate, the connected ESS and PV generation are

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participating accordingly in the aforementioned modes. The performance of every mode is discussed in terms of power, SoC, terminal voltage and current of the battery.

Table 2: Comparison with previous and Proposed Work

	Base paper	Proposed
1.	**A Single-phase** Without MPPT(W)	**A Signal-phase** With MPPT(W)
2.	**Fix angle current chopping control**	**PWM current chopping control**
3.	Variable power supply	**Constant power** supply

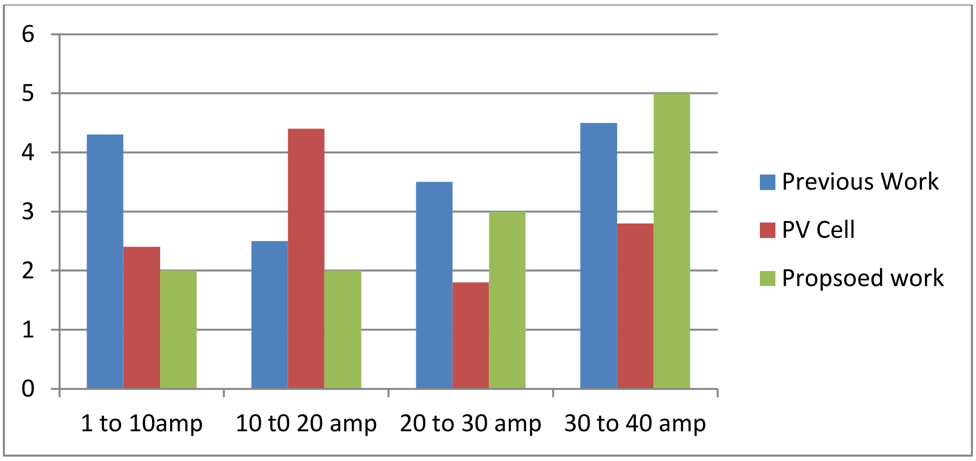

Fig.5: Comparison Chart with previous and Proposed Work

Table 3: Comparison of output power with and without MPPT

Load®	Output Power without MPPT(W)	Output Power With MPPT(W)
4.1	12.4	13.8
6.3	15.18	15.9
7.3	18.2	18.6
11.6	15.41	16.3
17.3	13.125	14.8

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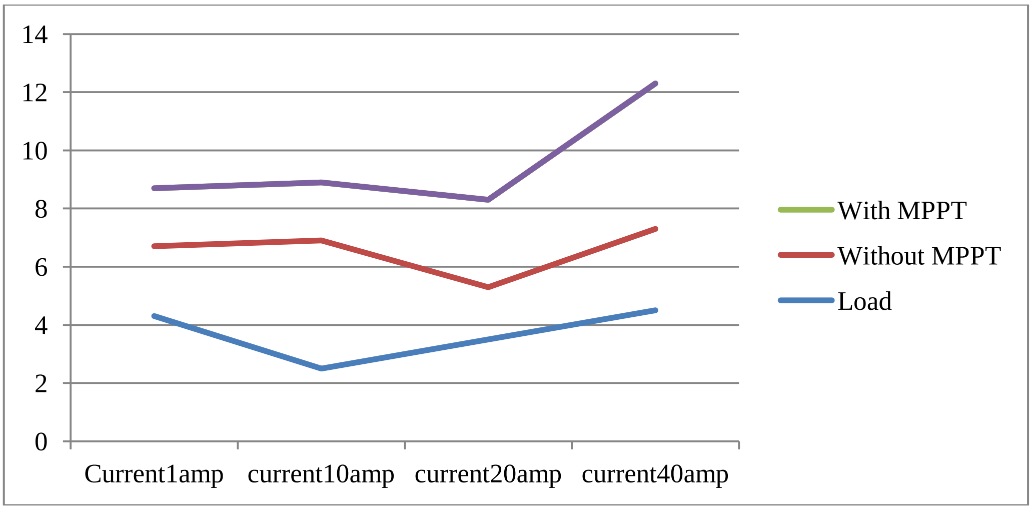

Fig.6: Comparison Chart of output power with and without MPPT

Table 4: Simulation parameters

Modulation scheme	PWM
Rectifier	Bridge Type
Carrier Frequency	Pulse
Converter	Tiger pulse
Supply	Dc Voltage
Clock	60.12
FFT	18 Cycles

V. CONCLUSION

A new recharging mechanism for electric vehicles is proposed using solar and wind energy. The usage of EV is directly affected by the present charging technique. Recharging stations are necessary for longer drive vehicles and it is commonly used in few countries. The traveling distance depends on the capacity of energy storage present in the vehicle. The recharging stations are needed for long distance travel. In this paper, we have introduced a new hybrid renewable charging mechanism for EVs. A simulation model has been developed using MATLAB-Simulink and the performance of solar and wind energy has been studied. Various parameters of the solar module have been verified under different irradiation level. The studied under different loading condition. Finally, the hourly load of EV versus generated electricity has been analyzed. From the output generated by the hybrid system, we strongly say that the proposed provides enough power for recharging the electric vehicle and the time taken for charging can be avoided by battery swapping At last, we are concluding that this approach reduces the pollution and increase the usage of EVs as a result creating pollution free environment. In this thesis, is PEV charging station is proposed to charge the EV battery. This minimizes the grid burden and increases the EVs utilization at remote locations by using the PV. In this thesis, the power to charge the EV battery during the absence or reduced sunlight. Further, a constant current method is used to charge the EV battery as well as pollution-free transportation. The charging process undergone for electric vehicles in parking lot areas. It allows us to evaluate a wide range of Plug-in Hybrid Electric Vehicles (PHEVs) and Plug-in Electric Vehicles (PEVs) charging scenarios and the corresponding control strategies. In addition, this allows us to explore a variety of communication technologies for a PHEV/PEV charging facility. The charging scheme used here is monitored by Arduino board. Some vehicles are parked during the day at workplace parking garages and can be charged from the solar energy using Photo-Voltaic (PV) cell-based charging facilities. The charging with solar energy helps to reduce the emissions from the power grid but increases the cost of charging. Moreover, it offers more flexibility to prepare for the emergence of new technologies (e.g., Vehicle-to-Grid, Vehicle-to-Building, and Smart Charging), which will become a reality in the near future. The simulation results provide a general overview of the

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impact of the proposed charging scenarios in terms of voltage profiles, peak demand, and charging cost.Renewable energy, systems engineering, and electric vehicles. On top of this, we both feel that we have improved time management; organization one thing we would like to emphasize is how unpractical the system is with just one solar panel and battery. We discovered that it could take almost *1 hours* under direct sunlight to fully charge of daylight and those hours of sun aren't efficiently collected by a solar panel, even with a dual-axis tracker built into the system because it will not likely achieve direct sunlight. In this research work reduced energy demand on the grid due to EV charging as the charging power is locally generated in a 'green' manner through solar panels.EV battery doubles up as energy storage for the PV and reduces negative impact of large-scale PV integration in distribution network. Long parking time of EV paves way for implementation of Vehicle-to-grid (V2G) technology where the EV acts as a controllable spinning reserve for the smart grid.

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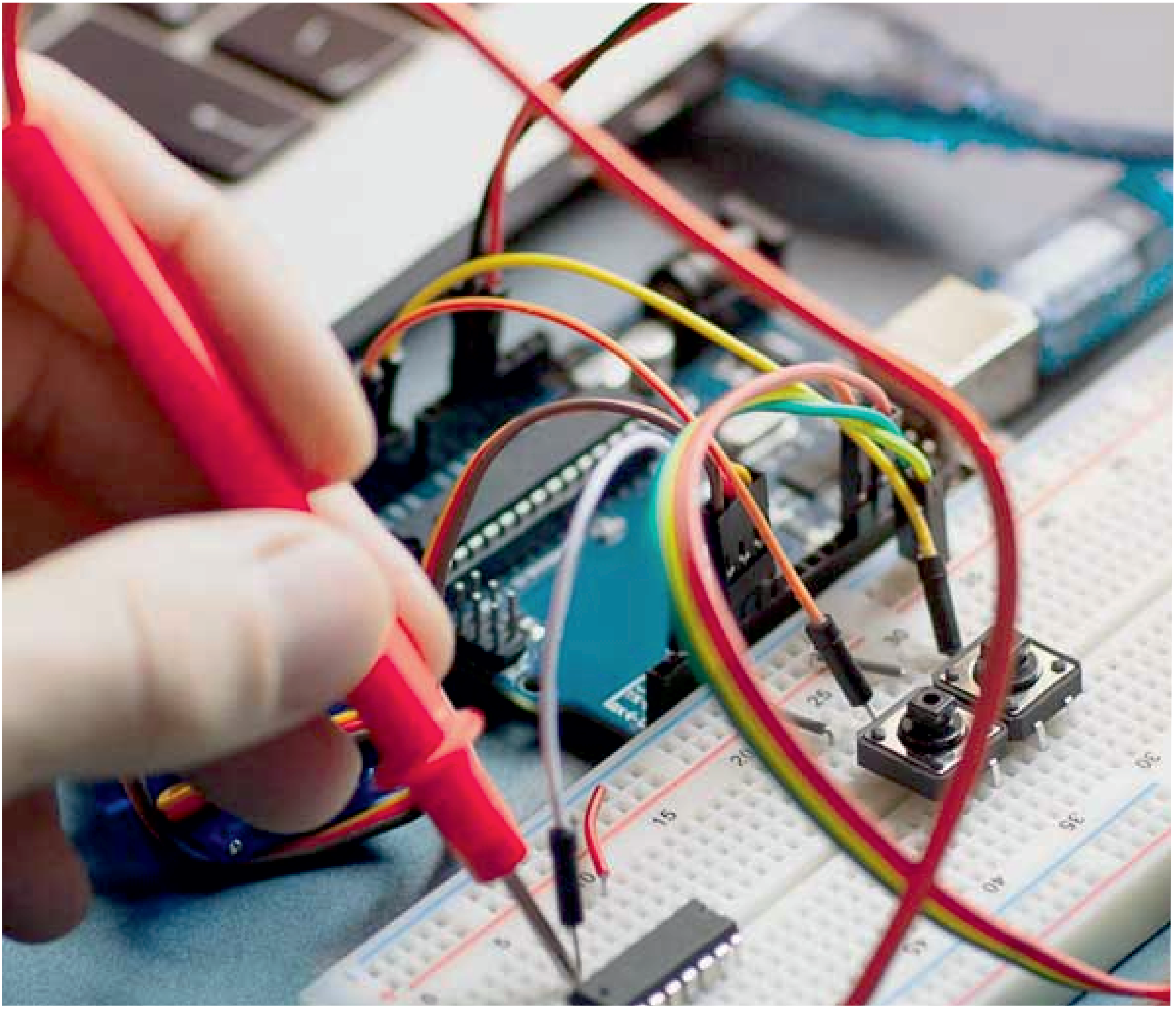

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