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PERFORMANCE OF HYBRID SYSTEM AND EV BASED GRID CONNECTED SYSTEM

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ABSTRACT

This paper presents the efficiency and effectiveness of integrating hybrid energy systems and electric vehicle (EV) charging stations into the electricity grid. The study will evaluate the performance of the hybrid system and EV-based grid-connected system under different scenarios and identify the factors affecting their performance. The paper will also analyze the economic and environmental benefits of the proposed system, including reduced carbon emissions and energy costs. This research work provides, new findings in renewable power generation for future load demand. The simulation results can be evaluated by using MATLAB/Simulink 2018a Software

Keywords: Wind Power Plant, Grid, Pitch Angle Controller, Wind speed, solar PV, Battery

I. INTRODUCTION

Recent years have seen a significant increase in the size of the worldwide renewable energy sector, particularly for wind power, against a backdrop of environmental degradation and a scarcity of fossil fuels. [1]. However, when connected to the power grid, randomness, intermittent electricity, and uncertainty have a significant negative impact on the power system's dependability and lead to several issues. As a result, grid-connected power must adhere to specific parameters in order to maintain the power system's security and stability [2], [3]. And increasing the amount of wind power generation in the electrical system has become quite difficult. [4].

Studies already conducted have demonstrated that the storage of energy technology greatly facilitates the integration of variable renewable energy sources. [5] – [7]. Also, topics including the selection of energy Storage devices, methods for configuring energy storage capacity, and energy storage equipment control have all been thoroughly researched. Wavelet packets are being used to procure grid-connected power. Due to its benefits for multiscale signal decomposition and frequency band division have been successfully implemented tested, WPD-based algorithms are frequently used. [8] – [10]. The energy system will employ a hybrid energy storage system (HESS) consisting of active batteries and super capacitor (SC) [11] – [13] due to their complementing qualities, SCs have a Battery energy density is high but power density is low, whereas capacitor energy density is low but power density is high. However, the power density is low. They have been used to help renewable energy grid connections. [14]

Electric vehicles (EVs) are progressively being evaluated to replace battery cells as energy storage components to reduce energy storage investment costs. [15], [16]. Moreover, as there are more and more EVs, its operability is improving [17] – [19]. When assisting in reducing the swings of renewable energies, however, EVs' mobility and unpredictability cause their dispatch modes and procedures to differ significantly from the standard battery [20], [21A comprehensive electric vehicle energy storage system model is reviewed in order to determine each EV's output power with great precision. [22The use of electric vehicle charging and discharging to reduce the costs of wind power penalties caused by overestimation and underestimation of available wind power. is suggested in [23]

As a new integrated EV-wind farm framework (WEV). Meanwhile, in order to take both emission and total cost targets into consideration, a new multi-objective dynamic economic dispatching model built on the WEV system is now being developed. The design of dispatch that takes into account many competing factors In, several competing goals are presented. [24], including working with wind power or offering a vehicle-to-grid (V2G) service. [25] Constructs a HESS model with EVs, as well as its overall energy management strategy. Based on sophisticated smart metering and communication technology, numerous techniques for EVs that enable renewable energy integration are then developed. [26], [27] Wealth. However, the problem of dispatching and managing the grid's EV power production remains because selecting the best EV clusters is difficult common the dynamic scheduling of non- Hard problems with deterministic polynomials (NP) [28]. And there are still others. a few bottleneck issues that need to be resolved right away [29] – [31]. To begin, consider the energy storage model. This paper is organized as follows Section-II possesses a system description, Section-III depicts the controller topology, and Section-IV includes the results and Discussion, and Section-V conclusion

II. SYSTEM DESCRIPTION

Fig.1: Wind integrated to grid

The above Fig-1 depicts about the systematically representation of the system in this, supply to the AC loads and AC grid will be supplied by using the DC Sources such as wind and battery and AC source wind which will form the hybrid system. The battery is fed up with DC-DC bidirectional converter and the wind energy system is fed with rectifier system the obtain DC sources id given to the DC loads and as well as to the inverter circuit which performance the conversion operation of DC-ac. Then the obtained power is fed to the AC loads as well as the AC grid. In between this a LC filter is employed to overcome the ripple contents.

A. Wind Power System Generation

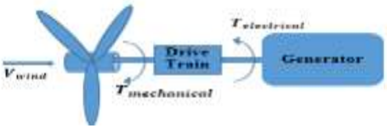

Fig.2: Wind Power System

Using wind power to generate electricity is known as WPSG (wind power system generation). It includes the use of wind turbines, which are substantial buildings with rotating blades that are propelled by wind. The generator, which generates energy that may be utilized to power residences, companies, and other facilities, is driven by the blades' spinning.

A considerable quantity of electricity might be produced by wind power, a renewable energy source. Also, it is a clean energy source that does not release any pollutants or greenhouse gases that contribute to climate change.

i) Wind Turbine (WT)

A wind turbine is an apparatus that transforms wind's kinetic energy into mechanical energy, which may subsequently be utilized to produce electricity. Wind turbines typically consist of a rotor with two or three blades that are mounted on a tall tower. When the wind blows, the blades rotate, turning a shaft that is connected to a generator. Electricity generated by the generator may be utilized to power buildings such as residences and businesses.

ii) Wind Generator (PMSG)

In the production of wind energy, PMSGs (permanent magnet synchronous generator) are a crucial technology. They have the potential to make a substantial contribution to lowering greenhouse gas emissions and battling climate change since they provide a more effective and economical method of generating electricity from wind energy.

PMSGs work by using the rotational motion of the wind turbine blades to rotate a rotor that is equipped with permanent magnets. As the rotor spins, it generates a magnetic field that interacts with the stator (the stationary part of the generator) to produce electricity. The electricity is then sent to a transformer and converted to the appropriate voltage for use in the power grid.

A. Solar power generation:

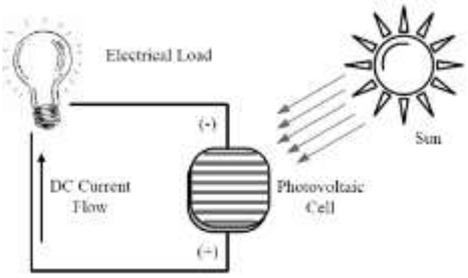

Fig.3: Solar power system

Solar power generation is the process of converting sunlight into electricity using photovoltaic (PV) cells. Solar energy is a sustainable energy source that may provide a sizable quantity of electricity while emitting little greenhouse gases and other pollutants that worsen climate change.

PV cells, which are created from silicon and other components, are what make up solar panels. The PV cells produce energy when sunlight strikes them because it stimulates silicon's electrons. The electricity is then captured by wires and sent to an inverter, which converts it into the appropriate voltage for use in the power grid.

B. Modelling Of EV System

EVs (Electrical vehicles) are becoming increasingly popular around the world. As a part of their initiatives to lower greenhouse gas emissions and battle climate change, several nations have set goals for boosting the usage of EVs. As technology continues to improve and the cost of batteries decreases, it is likely that EVs will become even more widely adopted in the coming years. The two primary categories of EVs are plug-in hybrids and battery electric cars (BEVs) (battery electric vehicles) (PHEVs). (Plug in electric vehicles) BEVs are powered solely by electricity and have no gasoline engine, while PHEVs have an electric motor and a gasoline engine, which can be used to extend the vehicle's range.

Lithium-ion battery

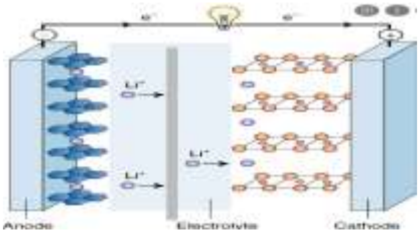

Fig.4: Li-ion Battery

The most prevalent battery type seen in electric cars is the lithium-ion battery (EVs). The high energy density, lengthy cycle life, and relatively low self-discharge rates of these batteries are just a few of their many benefits that make them ideal for use in EVs. The basic structure of a lithium-ion battery for EVs consists of one or more cells, each containing a positive electrode (cathode), a negative electrode (anode), and an electrolyte. When the battery is charged, lithium ions move from the cathode to the anode through the electrolyte. Lithium ions migrate from the anode to the cathode when the battery is depleted, and this action is what causes an electric current to flow. Overall, lithium-ion batteries are a critical component of EVs and have helped to make electric transportation a viable option for many people. It's expected that lithium-ion batteries will be used much more often in the upcoming years as technology advances and prices continue to drop.

CONTROLLER STRUCTURE

a) Controlling topology of Bidirectional DC-DC Converter

The diagram depicts a typical configuration for connecting a system of hybrid storage, which includes a to the microgrid, a battery and a super capacitor are connected. A super capacitor is a common high-power device that has a quick response time, a large output power capacity, and a high energy conversion efficiency battery is a high-energy device that has a long power output duration, a slow response time, and a high energy density. Microgrid power balance control is low-cost. It is recommended that a hybrid storage solution be used. A two-way the power electronics interface is the buck/boost converter provides this information. The battery and the converter's super capacitor serve the low voltage side. Let D1 represent S1, D2 represent S2, D3 represent S3, and D4 represent S4. The converter acts as a buck converter while charging DC voltage transfer function is used to transfer power from the DC bus to the storage units...

$$m_{vdc} = D2 = and\ m_{vdc=}D4 \qquad (1)$$

Specifically for the battery. The converter operates as a boost converter with a conversion ratio of during the discharging mode.

$$M_{VDC} = \frac{1}{1-D_1} \text{ And } M_{VDC}=\frac{1}{1-D3} \quad (2)$$

The power is then transferred from the battery or super capacitor to the DC bus. Because the storage units differ, the converters must be able to meet these requirements. Charging and discharging characteristics, as well as various balancing capabilities, are all available... Control schemes must be used to determine the best storage unit based on the type of disturbance or unbalance that needs to be corrected Mitigated.

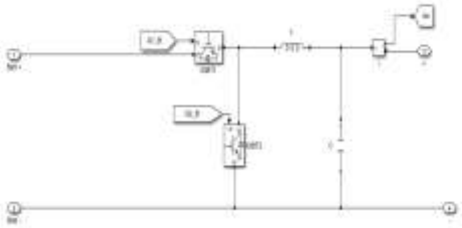

Fig.5: Simulink Model of BDC

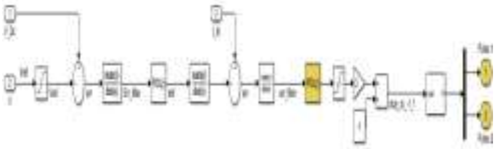

Fig 5.1: Schematic Representation of controlling topology implemented in BDC

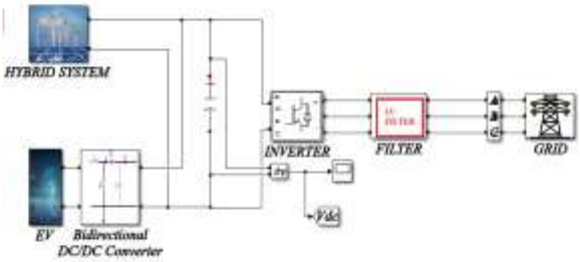

Fig 5.2: Schematic diagram of hybrid integrated to grid.

The proposed method of "Analysis of hybrid-based EV to grid integration for grid supply -based energy management paper" suggests a strategy to integrate hybrid system into the electrical grid to manage energy supply and demand.

The paper focus in continuous power supply to grid: A hybrid system generates electricity by combining two or more sources of energy. In this case, we can combine renewable energy sources like solar wind with traditional power sources like diesel generators. This hybrid system can be used to supply power to a remote location where the grid connection is not available or is unreliable.

To analyze this hybrid-based grid integration system, the paper would need to consider several factors. If in case renewable energy sources are not available due to some conditions, we have stored energy by batteries to supply through grid.

Overall, the proposed method of hybrid-based grid integration for a concept that could provide significant benefits for both electric supply loads, and the electrical grid. However, the analysis and implementation of such a system would require careful consideration of various technical and economic factors.

III. SIMULATION RESULTS

1. Wind integration with grid configuration:

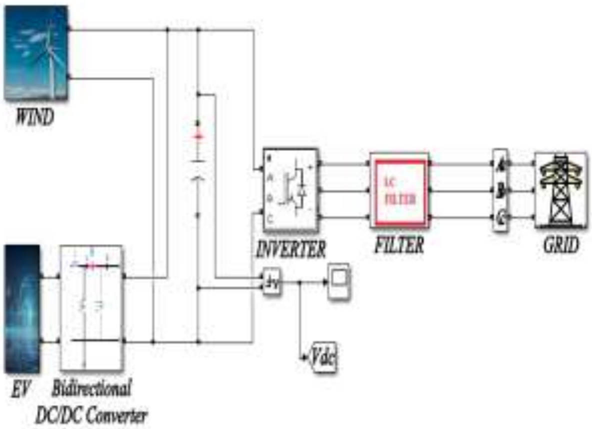

Fig.6: Schematic diagram of wind integration with grid configuration

Schematic diagram

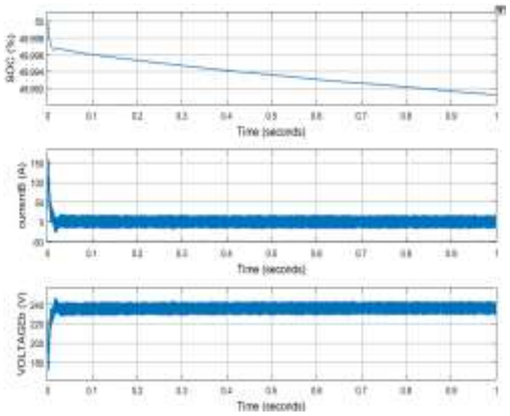

Fig 6.1: Battery related

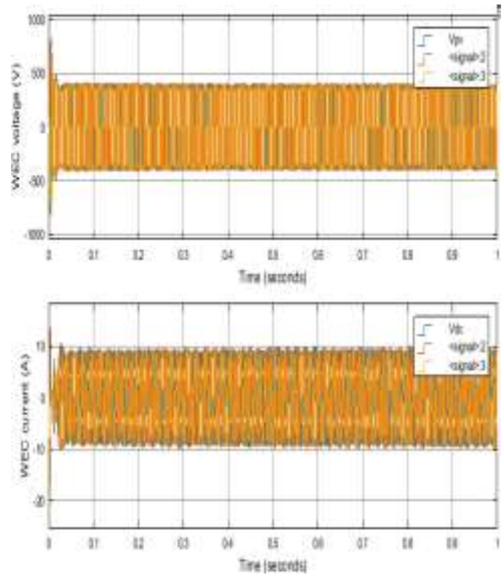

Fig 6.2: Wind voltage and current

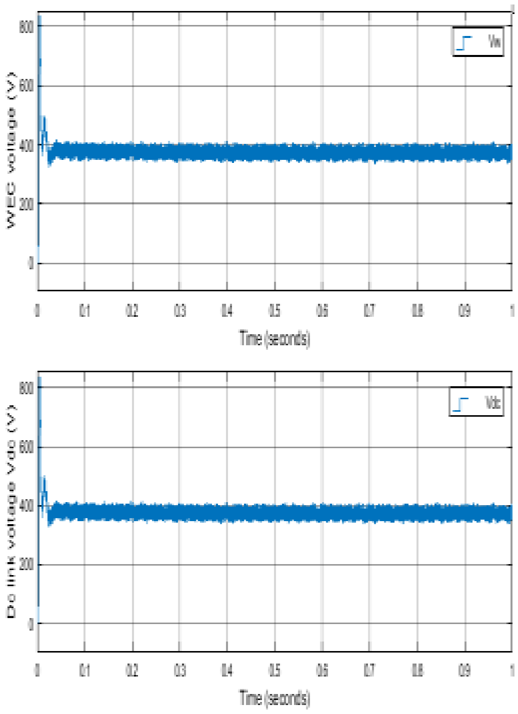

Fig 6.3: Wind energy conversation voltage and DC link voltage

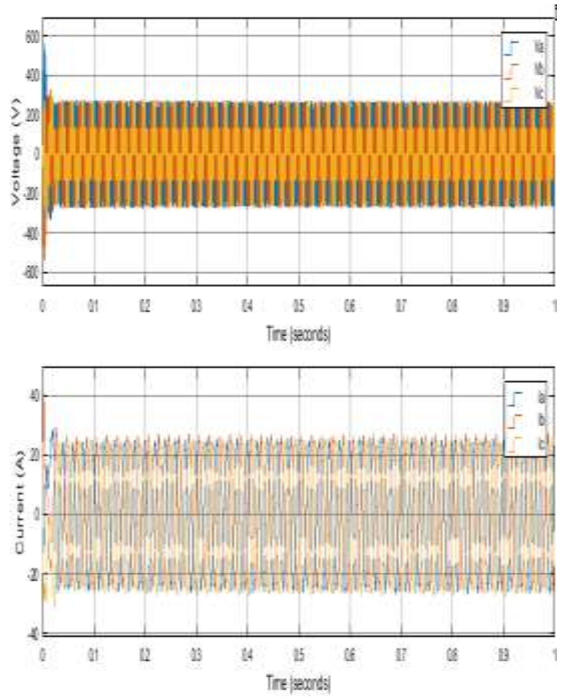

Fig 6.4: Inverter voltage and current

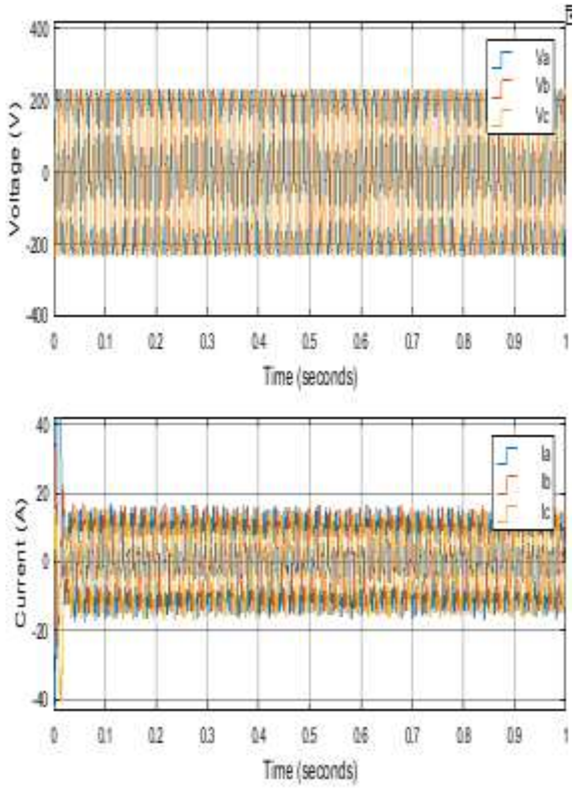

Fig 6.5: Grid voltage and current

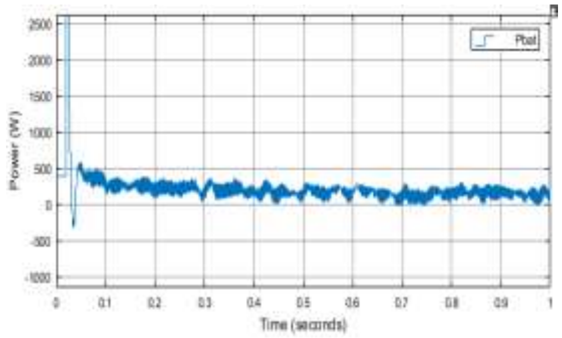

Fig 6.6: Battery power

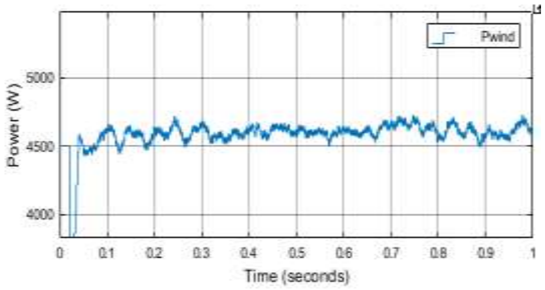

Fig 6.7: Wind active power

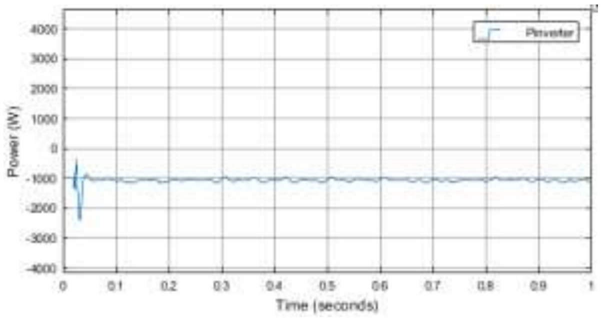

Fig 6.8: Inverter active power

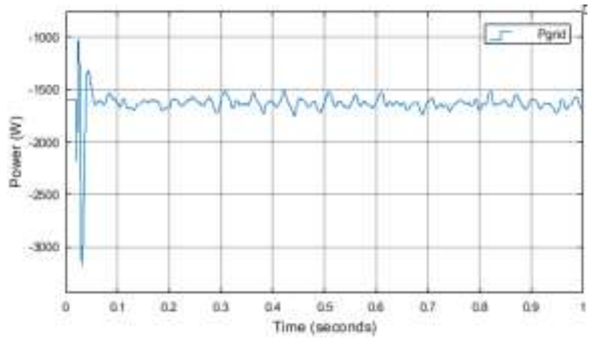

Fig 6.9: Grid active power

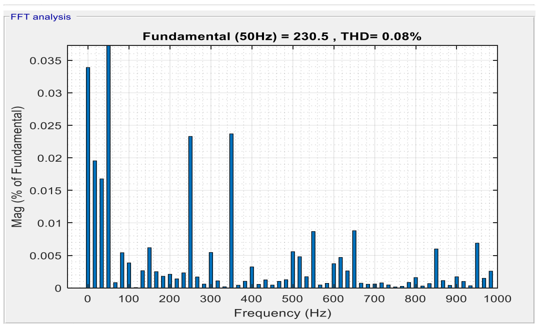

Fig 6.10: Grid voltage

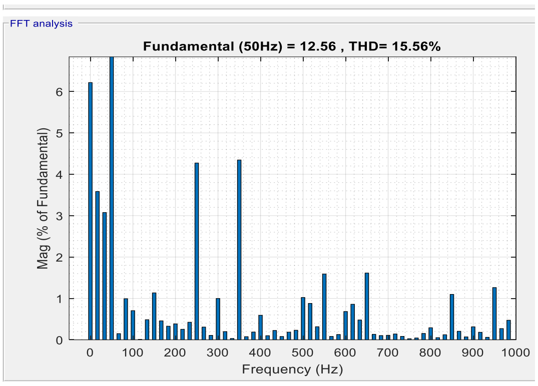

Fig 6.11: Grid current

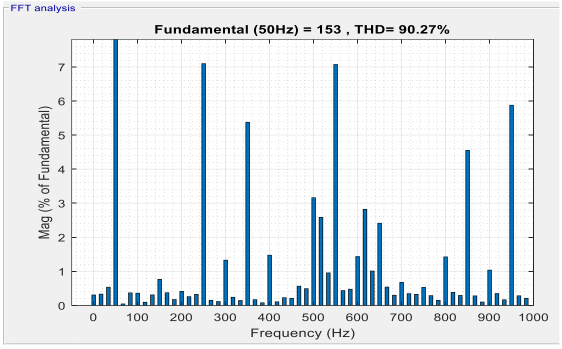

Fig 6.12: Inverter voltage

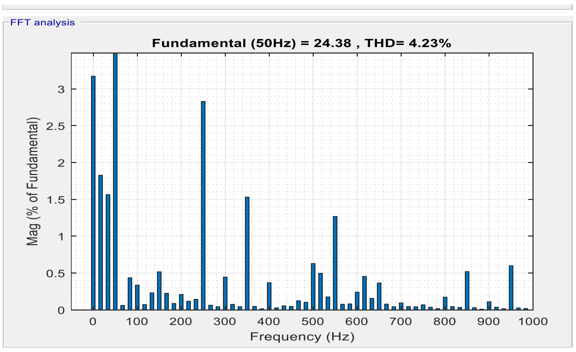

Fig 6.13: Inverter current

(a) simulation of wind integrated with grid configuration of battery related voltage current state of charge and DC link voltage inverter side voltage & current both grid side voltage and current are obtained battery power wind active power inverter active power both grid active power, grid side voltage inverter side voltages and current values results are obtained.

2. Solar integrated with grid configuration

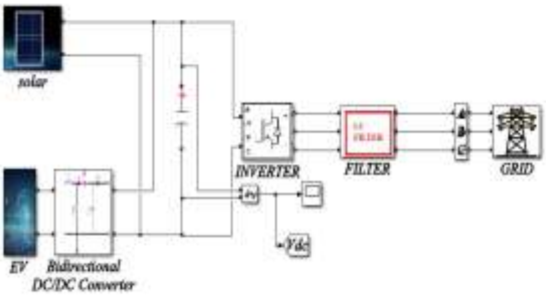

Fig.7: Solar integrated with gird configuration

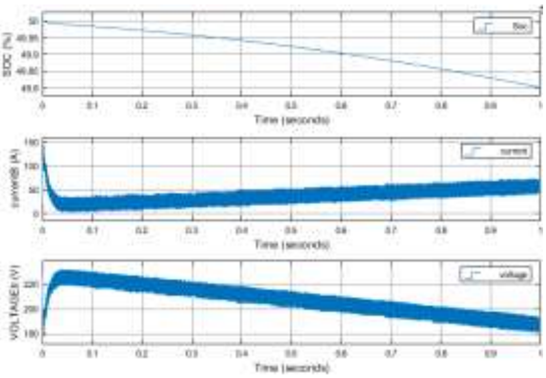

Fig 7.1: Battery related

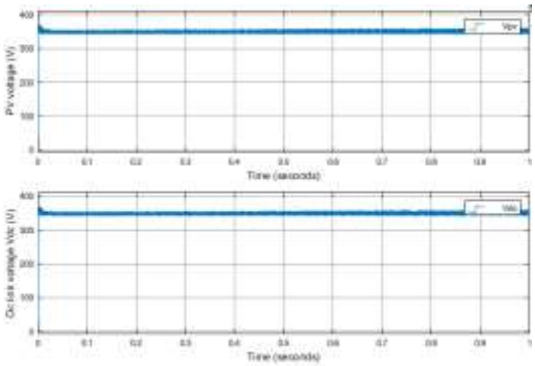

Fig 7.2: PV voltage and DClink voltage

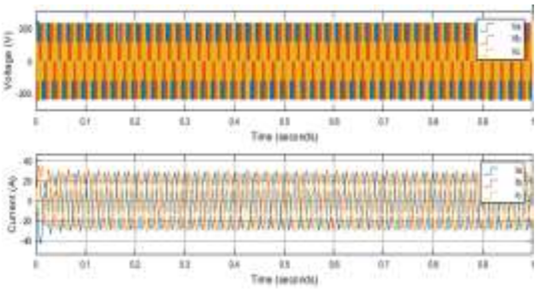

Fig 7.3: Inverter voltage and current

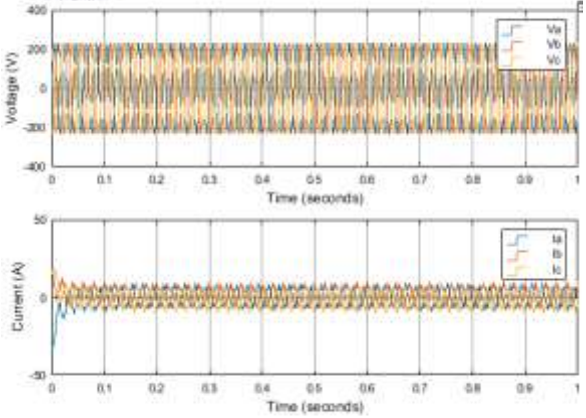

Fig 7.4: Grid voltage and current

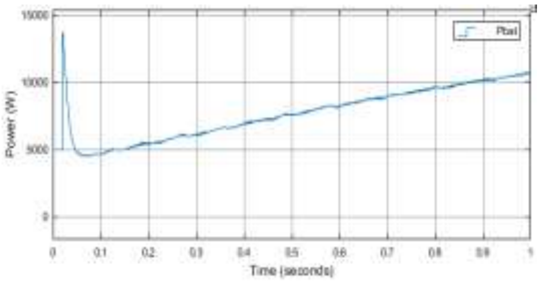

Fig 7.5: Battery power

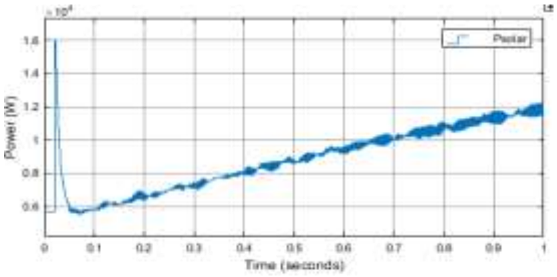

Fig 7.6: Solar power

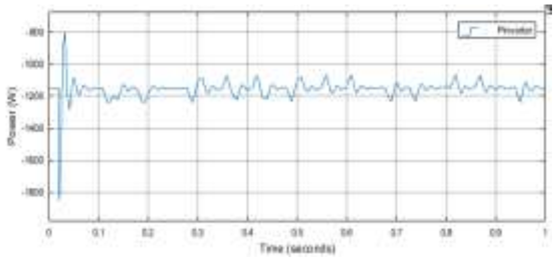

Fig 7.7: Inverter active power

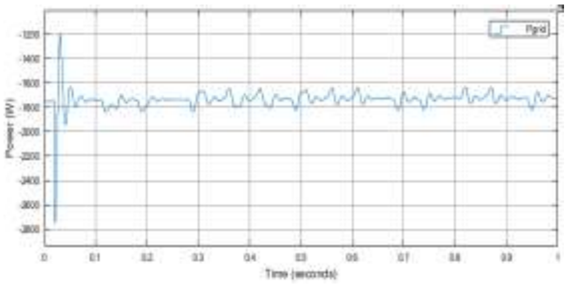

Fig 7.8: Grid active power

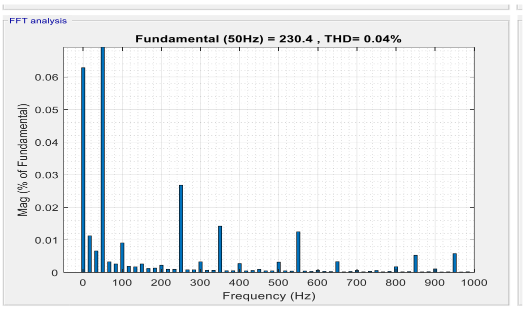

Fig 7.9: Grid voltage

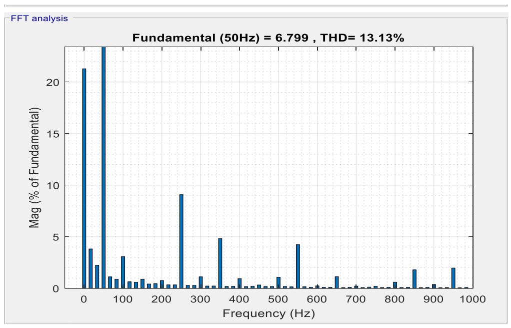

Fig 7.10: Grid current

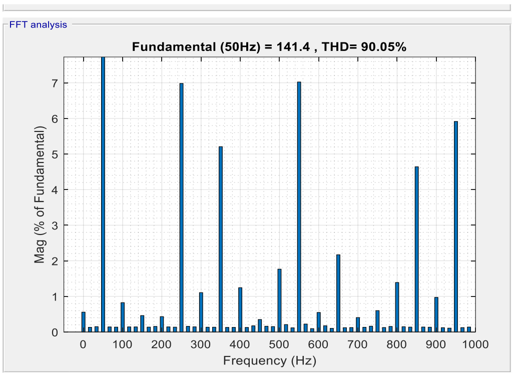

Fig 7.11: Inverter voltage

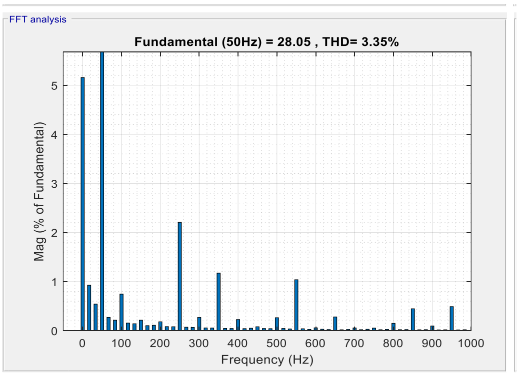

Fig. 7.12: Inverter current

(b) Simulation results of obtained for solar integration with vehicle to grid configuration for battery related state of charge voltage and current are obtained for voltage side of solar and DC link of voltage are both inverter and grid side voltage and current are appear thoroughly battery power solar power, inverter active power and grid. In

THD values of grid side voltage and grid side current and inverter side voltage and current results are obtained.

3. Hybrid integration with vehicle to grid configuration:

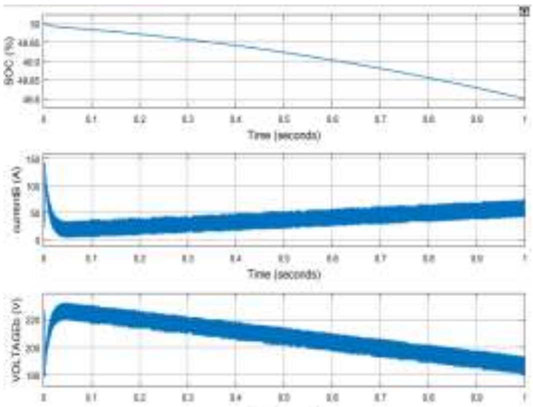

Fig.8: Battery related

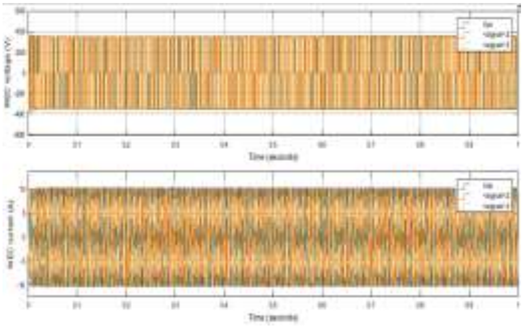

Fig 8.1: Wind voltage and current

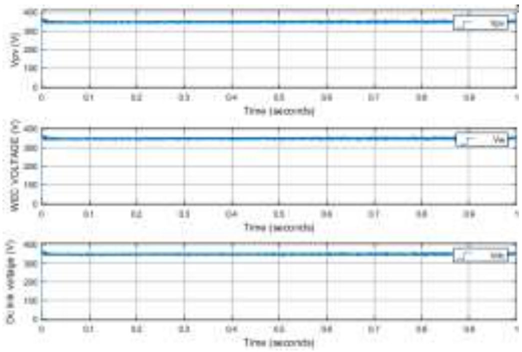

Fig 8.2: PV voltage, Wind energy conversion voltage and DC link voltage

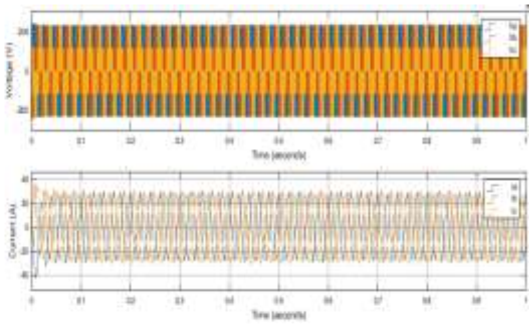

Fig 8.3: Inverter voltage and current

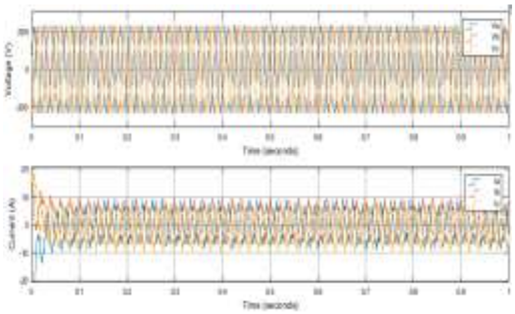

Fig 8.4: Grid voltage and current

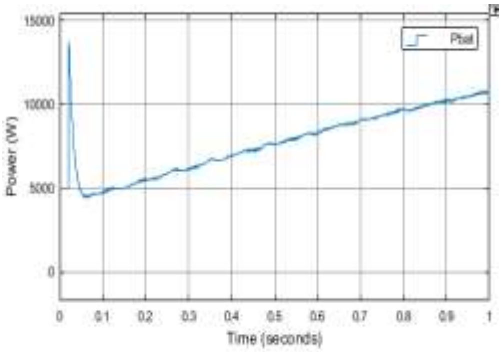

Fig 8.5: Battery power

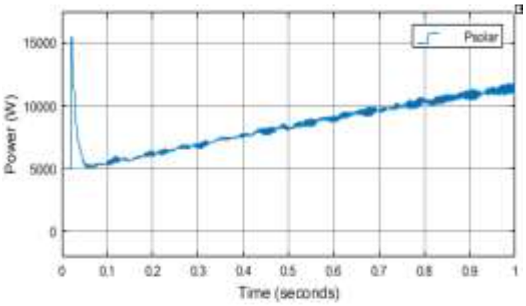

Fig 8.6: Solar power

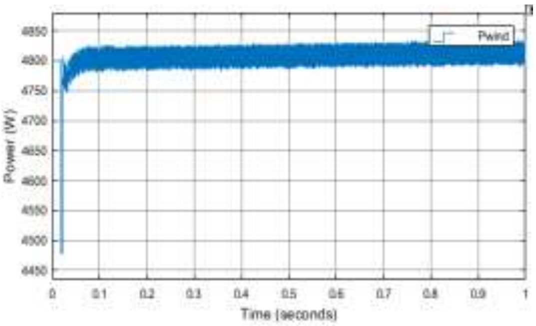

Fig 8.7: Wind power

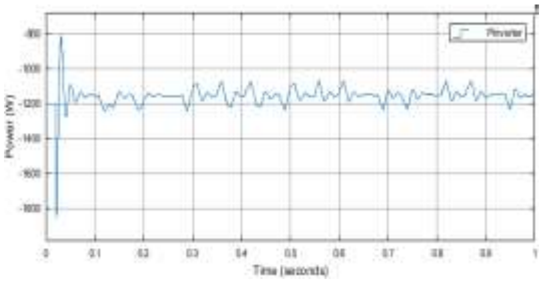

Fig 8.8: Inverter active power

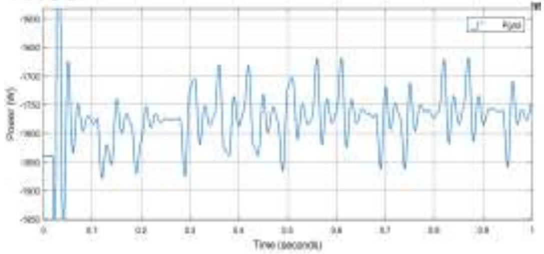

Fig 8.9: Grid active power

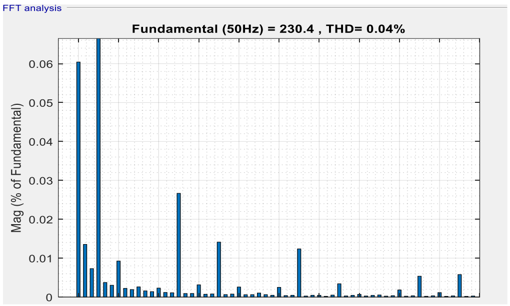

Fig 8.10: Grid voltage

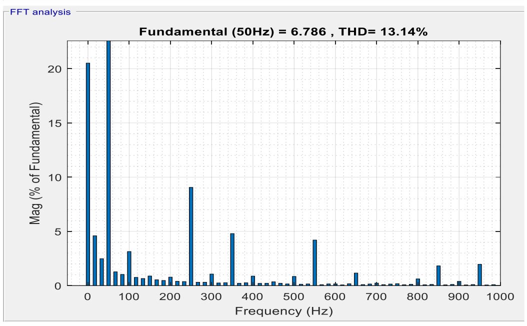

Fig 8.11: Grid current

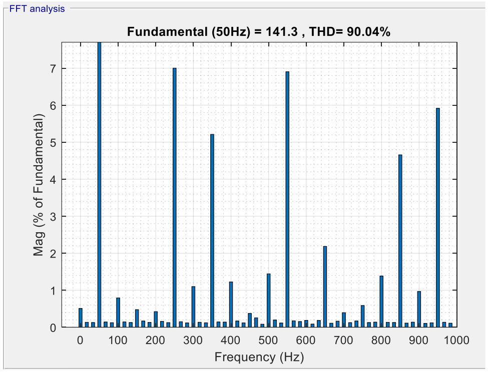

Fig 8.12: Inverter voltage

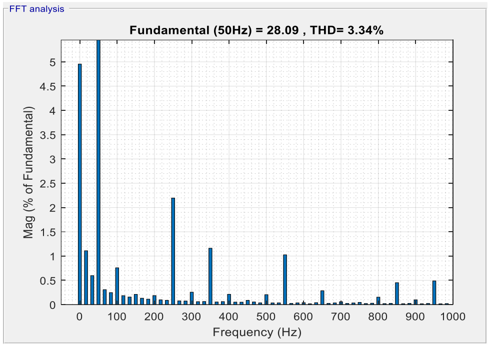

Fig 8.13: Inverter current

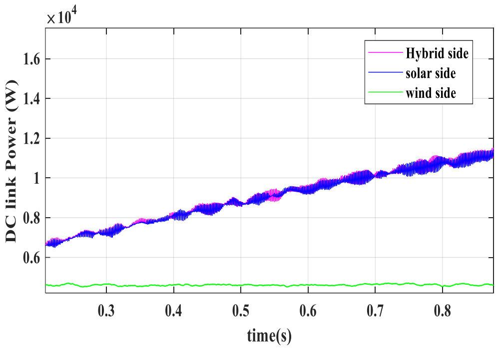

Fig 8.14: DC link power

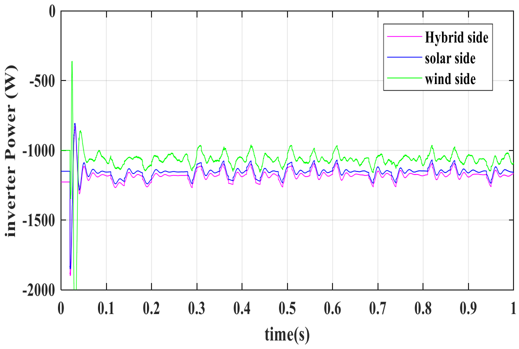

Fig 8.15: Inverter power (hybrid)

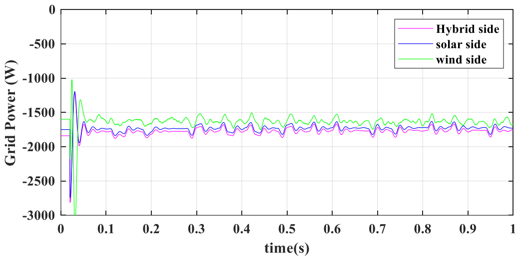

Fig 8.16: Grid power hybrid

(c) simulation results of hybrid integration of the vehicle to grid configuration are obtained for battery related state of charge voltage and current wind energy voltage and DC link voltage obtained hybrid inverter side voltage and current grid side voltage and current battery power and solar power wind power inverter and grid active power grid. These THD values of grid side voltage and current and inverters side voltage and current results are obtained. Both grid, DC link inverter power are obtained.

The analysis of a hybrid-based grid integration of energy management paper can provide valuable insights into its performance and effectiveness. In this section, we will discuss the results and implications of the paper.

The integration of hybrid technology and hybrid -to-grid energy management has led to significant improvements in energy efficiency. The hybrid connected to the grid can draw power from the Off-peak hours on the grid can be used to charge demand batteries. this saved energy can be used to power the delivered during peak hours. reducing the need for energy from the grid.

In conclusion, the analysis shows that the hybrid-based grid integration for -to-grid-based energy management paper can achieve significant improvements in energy efficiency, cost-effectiveness, environmental impact, and user satisfaction. The paper's success can be enhanced by implementing a smart grid system, providing training and support to the users, and optimizing the system's design and operation

Table 1 THD Comparison

configuration/parameter	Wind integrated	Hybrid integrated	Solar integrated
Inverter side voltage	90.27	90.04	90.5
Inverter side current	4.23	3.34	3.35
Grid side voltage	0.08	0.04	0.04
Grid side current	15.56	13.14	13.13

Table 2 Power Comparison

configuration/parameter	Wind integrated	Hybrid integrated	Solar integrated
DC link power	4500	5750	5700
Inverter power	1050	1165	1120
Grid power	1625	1750	1720

The comparison between proposed method and existing method results evaluated in terms of total harmonic distortions and power comparison shown in table 1 and table 2.

CONCLUSION

Hybrid systems based on grid-connected renewable energy sources have shown promising performance in meeting rising energy demand while lowering greenhouse gas emissions. Wind, solar, and biomass combined with other sustainable energy sources, as well as energy storage systems, can provide significant benefits. a stable and reliable power supply.

One of the significant advantages of a hybrid system is that it can provide power even when the grid is down, ensuring uninterrupted electricity supply. The use of energy storage systems can also help to mitigate the intermittent nature RES and ensure a steady power supply.

Moreover, hybrid systems can offer significant economic benefits by reducing the reliance on fossil fuels and lowering energy bills. They can also help in achieving energy independence and increase the resilience of the energy system against potential disruptions.

In conclusion, hybrid systems based on grid-connected renewable energy sources can offer a sustainable, reliable, and cost-effective solution for meeting future energy demands. Their performance is dependent on careful planning, proper design, and effective operation and maintenance to ensure optimal efficiency and longevity.

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