

Performances of Hybrid Renewable Energy Based Electrical Charging Station

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Abstract- Electric vehicles (EVS) represent one of the most promising technologies to green the transportation systems. An important issue is that high penetration of evs brings heavy electricity demand to the power grid systems became an important solution to reach the remote area and maximizing the economic, technological, and environmental benefits. In this thesis, A combination of solar energy, diesel generator, and electric vehicle gave an excellent result to ensure an uninterruptible power supply in case of low irradiance of PV solar energy. The main element is a photovoltaic system that is designed to satisfy the daily load energy requirement. A three-phase active filter is used to improve the power quality, manage the power, and corrected the unbalance. Backup energy storage systems including plug-in hybrid electric vehicles and the diesel generator are used to ensure an uninterruptible power supply in case of low solar irradiation. An effective way to reduce the impact is to integrate local power generation such as renewable energy (RES) into the charging infrastructure. Due to the intermittent and indivisible nature of RES, it has become very challenging to coordinate the charging of electric cars with other grid loads and renewable energy. This studies the charging of electric vehicles with smart grid technology and reviews its interaction with renewable energy. First introduces electric cars and renewable energy, which mainly introduces the main types of electric vehicles and the estimation method for renewable energy. In line with the objectives, the existing research work is divided into three categories: cost awareness, efficiency awareness and emission awareness of the interaction between electric cars and renewable energy. Each discussion category contains a description of the core idea, an overview of the solution and a comparison between different works. Finally, some important open-ended questions related to the interaction between electric cars and RES are given, and some possible solutions are discussed. To take care of the battery life, the PHEV supplies power to the load only during emergencies. This motivates the development of this work to the used robust algorithm, sizing, and energy management to balance the load consumption and electricity production this simulation has performed on MATLAB Simulink.

Keywords- HEV, Solar Energy, Wind Energy, Electrical Energy.

I. INTRODUCTION

Electric vehicles are widely used because of their greater benefits such as easy maintenance, lower running cost, and environmental pleasant. The storage of electrical energy in rechargeable batteries is the main source to propel electric motors present in an electric automobile. The 1880s was the year of the invention but popularized in the 20th century as an advance of internal combustion engines.

In 1987, electric cars found their commercial use in the USA and it does not require gear exchange when compared with conventional vehicles. Characteristics of an electric vehicle depend on the battery size and electric range of utilization [1]. There is no tailpipe emission when compared with IC engines which in turn reduces the greenhouse gas emission-related issues.

Significant reduction of air pollution in city areas is the result of EV usage because they do not emit pollutants including soot, hydrocarbons, carbon monoxide, volatile organic compounds, ozone, lead, and oxides of nitrogen. The pollutant emission is based on the emission intensity of charging sources as well as there is energy wastage during the charging state. High power to weight ratios is the output of electric motors which require a heavy current supply. Fixed ratio gearboxes and clutch absence are the reason for the reliability and simplicity of the EV's.

Acceleration capability is based on the size of motors and has constant torque [2]. Especially at low speeds, acceleration performance will be more relative to that of the same motor power internal combustion engine. The power rate increment relies on motor-to-wheel configuration because wheels directly have the connection

with motors for propulsion & breaking. Therefore, there is an improvement in traction mechanism with less drivetrain rotational inertia. A fraction of energy used for propulsion has a greater effect on thermodynamics units generated through fuel burning. Regenerative braking can recover as much as one-fifth of the energy normally lost during braking. There is a chance of combustion due to the cell rupture in the thermal runaway of lithium-ion batteries.

The range & endurance of electric vehicles is possible to keep the mass of energy flow but it makes the vehicle heavier based on the battery size and weight. A lithium-ion battery is widely used in electric vehicles due to its special characteristics such as long life and greater energy density. At the same time, Lithium-iron-phosphate and titanate are used to overcome the difficulties present in the 2 conventional types.

But lead-acid batteries are also currently in use because they consume less cost for the design purpose than other types. But the zinc-air battery is very light and requires refilling rather than recharging in the battery development field. Battery type decides the range and performance of the vehicle but it is very low in cold weather than other times of the year [3-8]. Several considerations on the impact of environmental factors should be provided in the design of the electric vehicle. These kinds of electric vehicles are pollution-free and charged from the power grid stations using the dirtiest areas of the United States. The engines of the EV can automatically be turned off in the idle situation. They can save more than \$1000 financially when compared with traditional engines.

Microgrids including renewable energy sources have been used in remote areas around the world. However, intermittent energy can cause large fluctuations in the Microgrid frequency. To suppress the frequency deviation, many different frequency control strategies have been investigated.

The optimized maximum power point tracking (MPPT) control method is used in photovoltaic systems to smooth out fluctuations in output power that cannot consider the supplementary energy production of hybrid energy sources. The battery energy storage system (BESS) has been used to limit the output power fluctuations of the microgrid, but the cost of energy storage equipment is high and wasted batteries can cause environmental pollution. [20-21] LFC is used in uncertain electrical systems to reduce frequency deviation, but renewable resources are not taken into account.

The corresponding author redesigned the frequency regulator to a hybrid Microgrid based on PI control or minimum observer, which can effectively suppress the frequency deviation by reducing the PV power fluctuation based on the estimated load value. However, this only applies to electrical systems without parameter uncertainty

and load interference. Sliding Mode Control (SMC) algorithm is used to design frequency control due to its strong robustness. The frequency control with sliding condition aims to optimize the power quality in the insulated wind system. SM Loci can adjust the system frequency according to load changes and power fluctuations, thereby reducing the overall frequency deviation and improving the stability of the system.

However, many research findings do not take into account persistent resources, inconsistent uncertainty, and resource changes, and it is inaccurate to use uncertainty limits for design controllers. Based on the analysis, a new dual SM frequency control strategy is designed for the insulated Microgrid, which can realize frequency deviation control and improve the system's response speed and robustness.

A perturbation observer is designed to improve the accuracy of the controller. Based on the estimated load value, the reconstructed SM LFC can significantly reduce the frequency deviation and maintain power balance. [4-15]

II. RELATED WORK

Itie Goswami et al. (2020) This work presents an energy management strategy for multi-power mixed (VV) vehicles, of which the fuel cell (FC) is the main source of energy, and the batteries and super capacitors (SC) are the second most powerful. Electric cars draw the energy they need from fuel cells, while auxiliary energy is used to compensate for power shortages during high-speed or over-power during braking.

The use of secondary energy efficiency has proven to be effective in improving vehicle performance, significantly reducing hydrogen consumption, and bringing reliability and reliability to the operation of the entire system. The proposed strategy regulates the distribution of power to various energy sources in the best possible way to meet power needs. Matlab / Simulink is used as a simulation platform.

T.Porselvi et al. (2019) introduced the amount of power supply, which is highly reliable for electric vehicle steering systems. Batteries, solar photovoltaic power supplies, and supercapacitors play an important role in this long-lasting power supply. The main power source is the battery, which connects to the supercapacitor during transient processes such as overload and start-up.

To purchase mixed electric vehicles, hybrid energy storage systems (HESS) with supercapacitors and batteries are widely used to improve the charging and discharging characteristics of the batteries, thereby increasing the power of immediate discharge. To reduce energy loss in a hybrid battery storage system, a bidirectional DC / DC converter should be used with a flexible conversion

technology. Initially, the power received from the PV sequence was used to charge the super capacitors and batteries. When PV cannot provide enough power to charge the EV, it can use battery power and super capacitors. With the help of MATLAB software, you can also compare the performance of existing and non-super capacitors systems.

III. PROPOSED WORK

The immense introduction of fluctuating renewable energy means that the key to successful integration lies not only in the electricity system but also in the entire energy system and energy system integration. The successful integration of most fluctuating renewable energy sources requires complex interactions between energy production, storage, distribution, and consumption. At the same time, successful integration requires a paradigm shift.

It is expected to transform the paradigm from a unique, radial and mainly centralized system of electricity, natural gas, biomass, and district heating into a single integrated interconnected, distributed, and partially autonomous system and Energy system. A battery-electric vehicle (BEV) runs exclusively on power storage. Its main components include a high voltage battery, one or more electric motors (AC to DC) or DC to DC and a controller for controlling the battery.

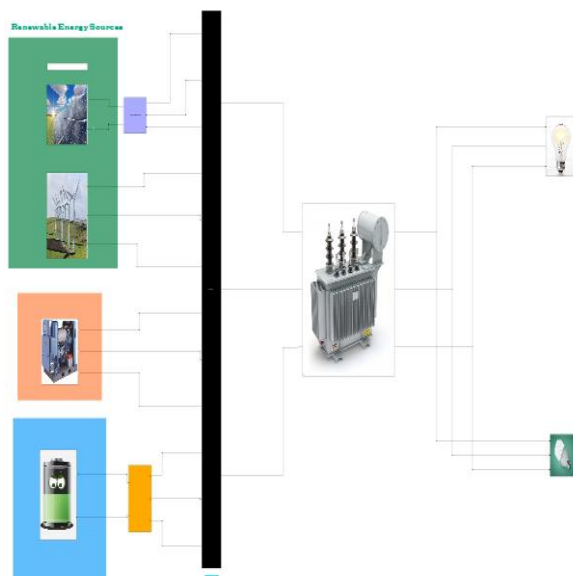


Fig 1. Simulink Model of Proposed System.

The hybrid system under study relies on Diesel, solar and wind energies as the primary power resources, and it is backed up by the batteries (Figure 1). Batteries are used because of the stochastic characteristics of the system inputs. Namely, it is used to meet the electricity demand while the solar and wind energies are not adequate. The basic input variables of the hybrid model are: solar radiation, wind speed, and the electricity consumption.

IV. SIMULATION PARAMETERS

1. Simulation of the Solar Panel:

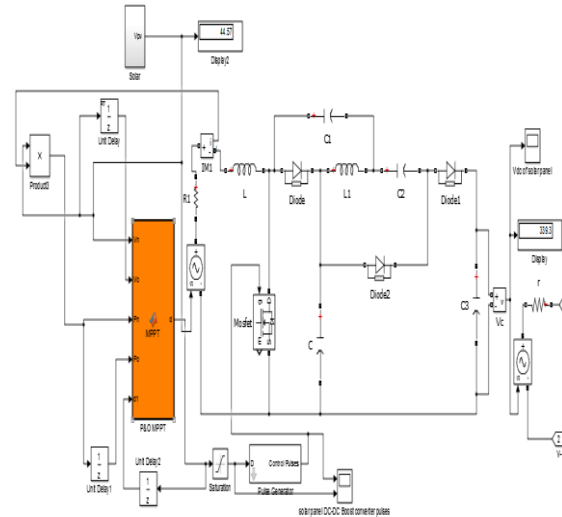


Fig 2. MPPT Model.

2. Simulation Output of the Solar Panel:

The power used by PV cells reaches the maximum at these points. The short-wavelength is measured by short-circuiting the output channels and measuring the terminal end. PV cells are made of semiconductor material, with crystals and thin film as the main material. In terms of cost and efficiency, most future thin materials may exceed PV silicon cells, which can be divided into the following categories: crystalline, thin-film, amorphous, multi-junction, organic or photochemical.

The PV properties are shown in Figure 3, and the current Vs volts are based on the XY configuration. The solar cell produces a maximum power of 230 power at its current point, of which the products V and I are the largest, The voltage on the X Axis Showing 44v and current on x Axis Showing 7.9I

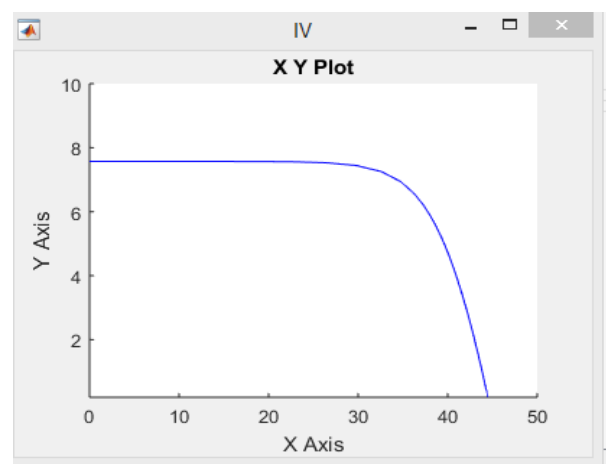


Fig 3. PV Characteristics Waveform.

PV individuality or there is X-Y coordinates Voltage and current plotted. The point of the current-voltage quality where the product of V and I is greatest shown in fig 4 Y-Axis plotted 7.9I and x-axis point maximum 44V.

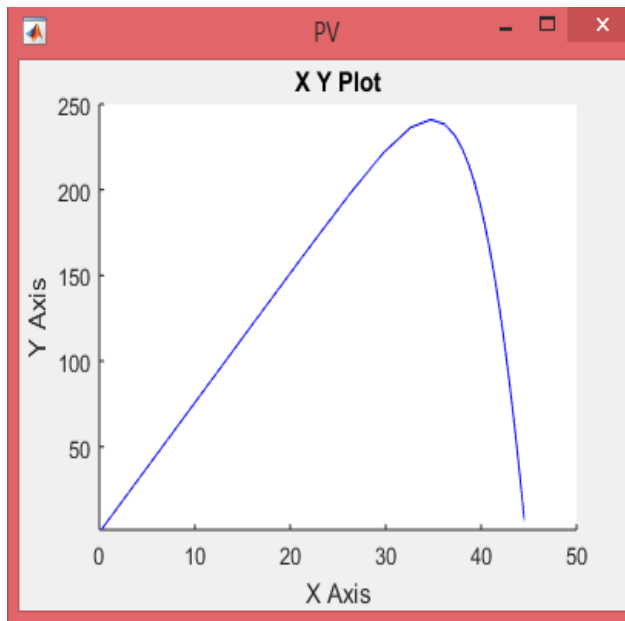


Fig 4. PV Characteristics Waveform.

The greatest power generates 230 Power by solar cell at the point of the current-voltage quality where the product of V and I is greatest shown in fig 5 ,where X axis showing the voltage from the PV and Y axis showing the power from the panel.

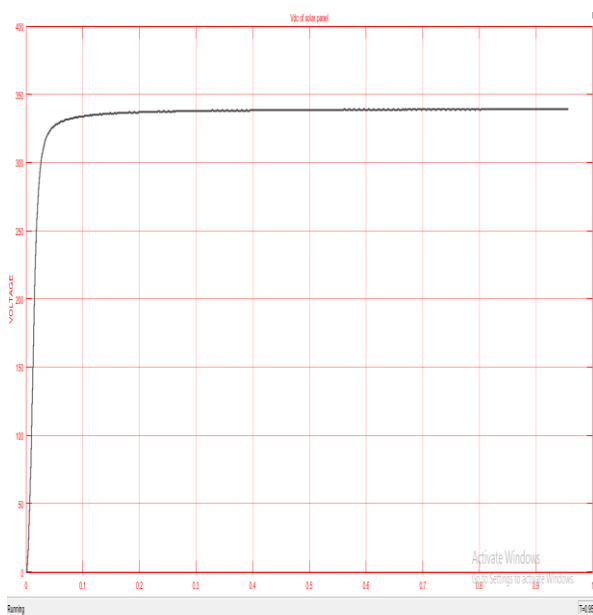


Fig 5. VDC from Solar Panel.

VDC output from the boost converter showing in fig where y axis showing the voltage from the boost converter with respect to time, where x- axis showing time.

V. DIESEL GENERATOR

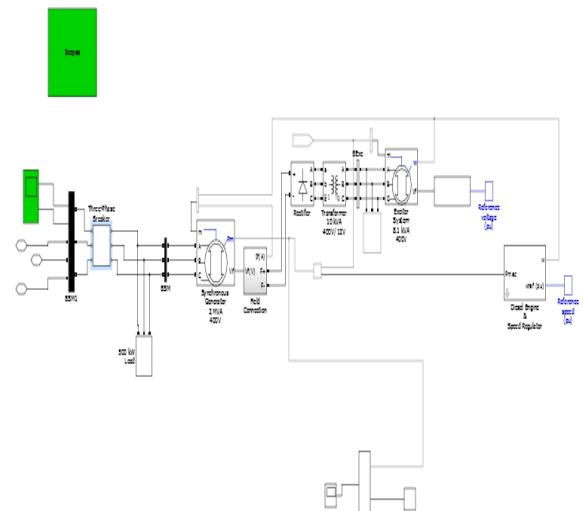


Fig 6. Diesel Generator.

The DG set (a component of a diesel engine and the governor) is a device that converts diesel energy into mechanical energy from a diesel engine and then converts it into electrical energy in the governor's mechanical energy. A governor can be defined as a mechanical or electromechanical device that is used to automatically control the speed of an engine by mixing fuel consumption.

Identify the synchronous engine that regulates three or five steps. The stator winding is connected to the inner neutral point of the star. A three-stage motor may have a sinusoidal or trapezoidal back-EMF wave shape. For sinusoidal engines, the rotor may be round or bulging, when the motor is trapezoidal, the rotor may be round.

1. Simulation of the Diesel Generator:

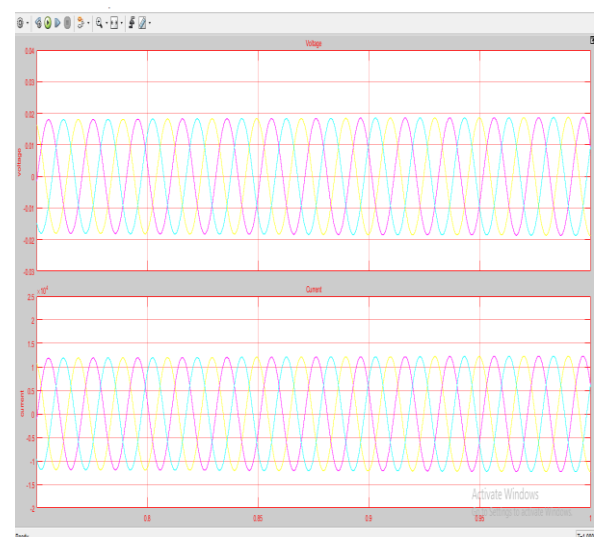


Fig 7. Diesel Generator voltage and current.

Fig 7 showing the current and voltage of the Synchronous Generator where three phase positive and negative voltage and current of the Synchronous Generator Controller transfer function.

VI. BATTERY ELECTRIC VEHICLES

Battery electric vehicles (BEVs) operate only on stored electricity, and their main components consist of a high-voltage battery, One or more electric motors (alternating current [AC] or direct current [DC]), and an electronic power management controller. Compared to the ICE, which provides the highest torque in the engine speed range, the electric motor can provide constant and high-speed steering at speeds above zero mph. Therefore, most BEVs do not need a discount box or complicated engine management system added to the ICE and processing box to comply with emissions regulations while maintaining vehicle efficiency.

So, compared to a traditional ICE car, a full EV drive train is not that difficult. The battery contains a large number of batteries, which form modules, and these modules are divided into battery packs. This can be done in a variety of ways through a series of parallel and parallel connections between the packet bag and/or model group. BEV motors usually operate at a few volts, which means that at least 100 batteries are needed (for example, 100 lithium-ion batteries are installed in the unit, the battery power is 3.6 V, which can generate 360 V).

However, some cars have smaller but smaller components (up to tens of thousands), customized in complex patterns related to lines and series. Besides, in addition to the basic equipment, a “company balance” of heat management and power control systems is needed to prevent overcharging and detect battery damage or failure.

1. Simulation Parameter of the Battery:

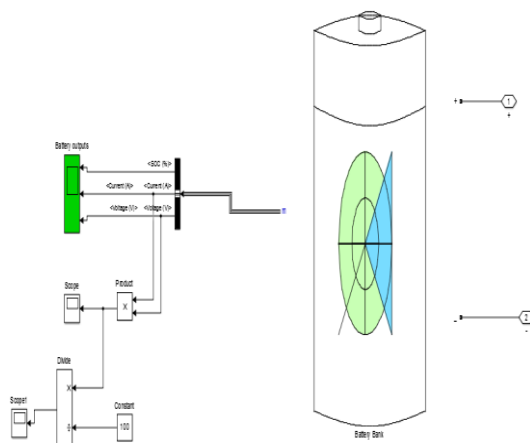


Fig 8. Battery Model.

Fig 9 showing Charging Voltage and Current of Battery where Maximum capacity (Ah) of the battery is 172.3077 and Fully charged voltage (V) of the battery is -237.9492 and Nominal discharge current (A) of the battery is -32, internal resistance (Ohms) of the battery is 0.012625, Capacity (Ah) at nominal voltage- of the battery is 53.8462.

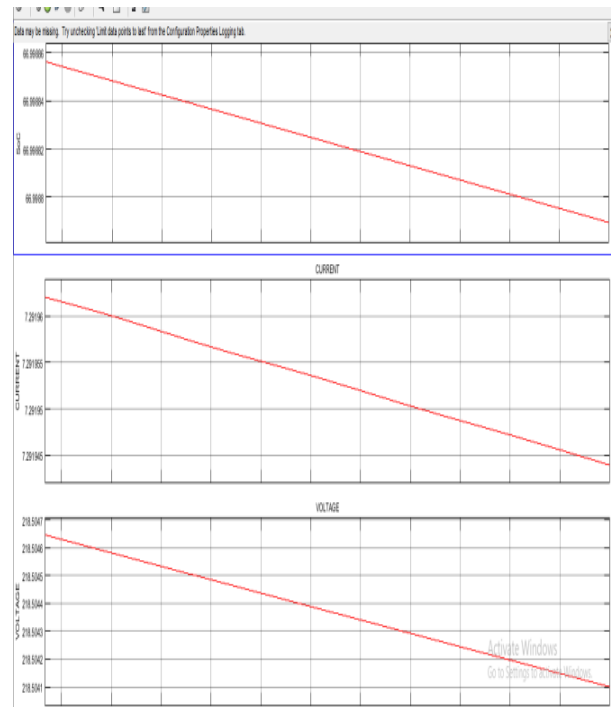


Fig 9. Charging Voltage and Current of Battery.

VII. WIND TURBINE

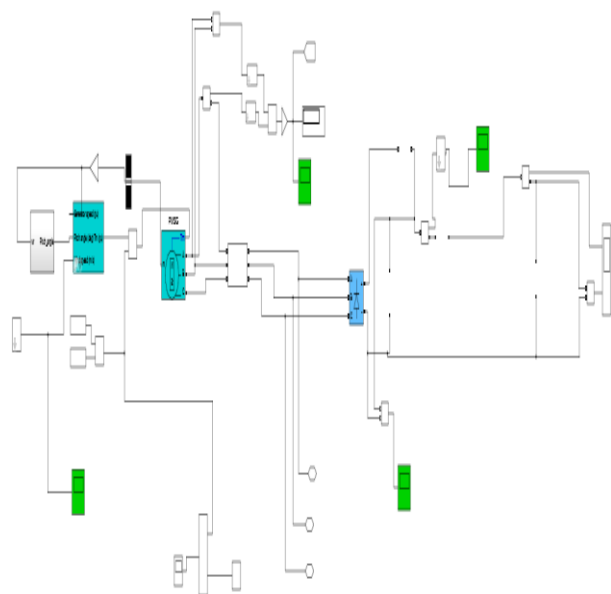


Fig 10. Wind Turbine Model.

This block implements a variable pitch wind turbine model. The performance coefficient C_p of the turbine is the mechanical output power of the turbine divided by wind power and a function of wind speed, rotational speed, and pitch angle (β). C_p reaches its maximum value at zero betas. Select the wind-turbine power characteristics display to plot the turbine characteristics at the specified pitch angle.

The first input is the generator speed in per unit of the generator base speed. For a synchronous or asynchronous generator, the base speed is the synchronous speed. For a permanent-magnet generator, the base speed is defined as the speed producing nominal voltage at no load. The second input is the blade pitch angle (β) in degrees. The third input is the wind speed in m/s. The output is the torque applied to the generator shaft in per unit of the generator rating

1. Simulation Parameters Of The Wind Turbine:

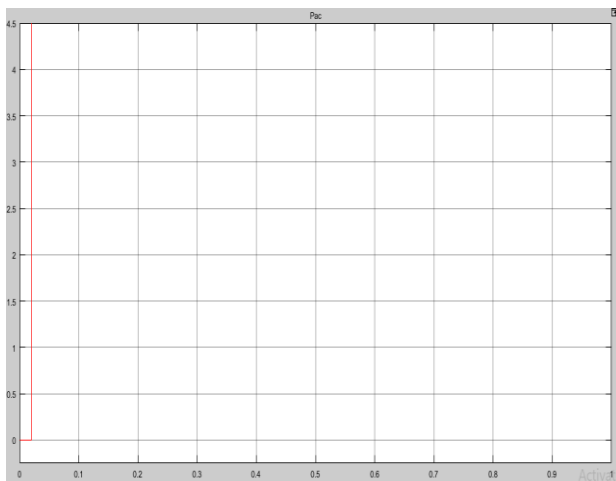


Fig 11. Wind Power.

Fig 11 showing the Wind power 4.5 P (W) from the wind turbine of the Mechanical power output (W): Generator base voltage (VA): 8.5e3: wind speed (m / s): Mechanical output power (W): increase or decrease input. Choose a wise product or matrix,

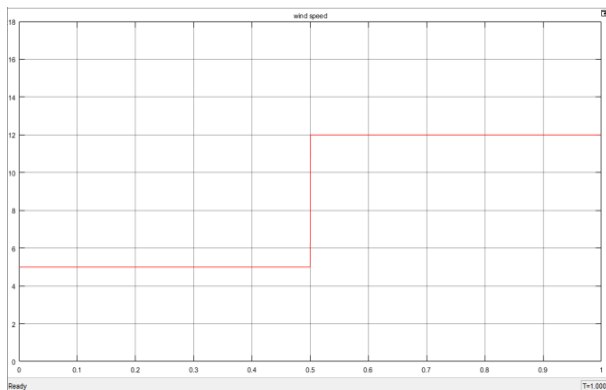


Fig 12. Wind speed.

Motor: Time delay $TdInertia$ and viscous friction are modeled in the Synchronous generator. The base power used to specify the initial mechanical power ($Pm0$ in pu) is the nominal power of the driven generator.

VIII. SIMULATION OUTPUT OF THE NONLINER AND LINER LOAD

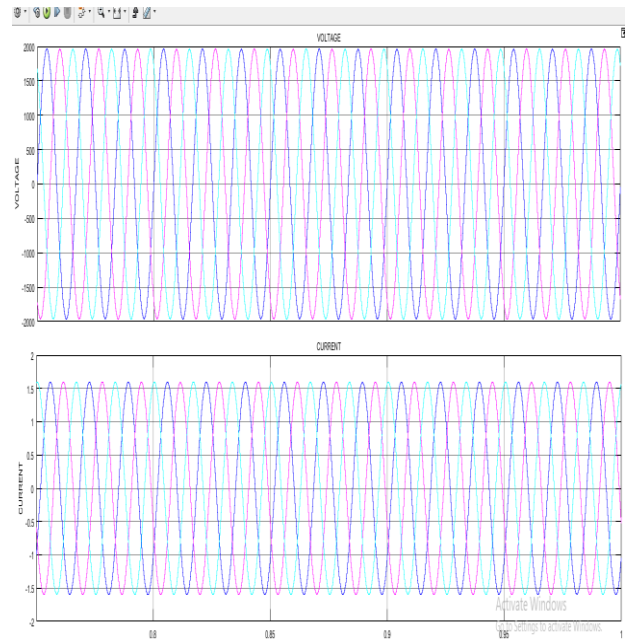


Fig 13. Nonlinear Voltage and Current.

Implements a three-phase parallel RLC load. The block can output the voltages and currents in per-unit values or volts and amperes. Inductive reactive Power QL (positive var): Active power P (W):100 Inductive reactive Power QL (positive var):

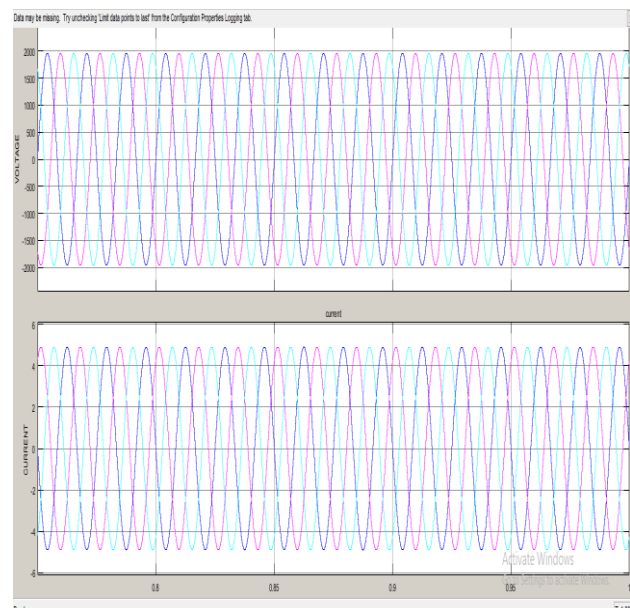


Fig 14. Linear Voltage and Current.

Implements a three-phase parallel RLC load. Nominal phase-to-phase voltage 400Vn (Vrms Nominal frequency fn (Hz):50 Inductive reactive Power QL (positive var): Implements a three-phase circuit breaker.

When the external switching time mode is selected, a Simulink logical signal is used to control the breaker operation. Switching times (s): [4/60 10/60] Breaker resistance Ron (Ohm) 0.001. A direct voltage control is adapted to regulate the ac load voltage.

This complete energy system design is analyzed and simulated under different hybrid energy sources performed table 4.7 showing the comparison of the simulation output for PV and Electrical Vehicle Battery

IX. CONCLUSIONS

The development of the vehicle for the last few years has become an emerging and moving towards eco-friendly technologies and the usage of the energy and storage sources has been improving over the years. The research has focused on the storage system and controlling system of the vehicle. For this research study, a specifically rated ultra capacitor and battery have been selected as sources, and different converters like a buck, boost, and full-bridge buck-boost converters have been simulated.

It also involves the design of three-level inverter using MATLAB Simulink Concerning EV batteries being distributed in smart environments, there are technical issues that need to be addressed: energy management strategies and control of the integration of EVs into tablets is the key to using EVs as shared storage, which needs to be carefully examined. People putting electric cars on plates, we need to understand the problem of control and management.

Before starting charging, the EV battery needs to be connected to the device needed to determine if there is any residue in the system to start charging the battery, so we need a competent inverter. Research and development is a continual and relentless process.

For any research work already carried out, there is always room for improvement, which opens up many avenues for further research. As a result of the research in this paper, the following aspects are determined to further the research work. Current work can be extended through various energy storage, such as battery storage systems (BESS) and power-saving systems (SMES) for AGCs.

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