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Analysis of Hybrid Based Grid Integration for Vehicle-To-Grid Based Energy Management

P. Lakshmi Varshini[1*], S. Shashavali[2], P. Siddartha[3], B. Mounesh Achari[4], B. Tharun[5], P. Chandan Kumar[6], P. Nagarjuna[7]

[1,2,3,4,5,6]UG Students,Department of EEE,Chaitanya Bharathi Institute of TechnologyProddatur

[7]Assistant Professor,Department of EEE,Chaitanya Bharathi Institute of TechnologyProddatur

[*]Corresponding Author emailid: palurulakshmivarshini16@gmail.com

Abstract—***This project's primary goal is energy management for hybrid integration between ev and the grid system. Given the depletion of the environment and the scarcity of fossil fuels, the amount of renewable energy globally, particularly wind power, has grown significantly in recent years. But when connected to the power grid, the unpredictability, irregularity, and uncertainty have a significant negative impact on the power system's dependability and lead to numerous issues.. V2G systems are being studied as a means of mitigating the oscillations of large-scale wind power.Electric vehicles (EVs) are gradually being considered as energy storage components to replace battery cells in order to lower the investment costs of energy storage. Therefore, in order to overcome the voltage fluctuations and manage the energy instantly, an energy management and optimization system is designed and modeled in this project. MATLAB/SIMULINK 2018a software can be used to evaluate the performance results of electric vehicles, grid, and load with different characteristics waveforms of voltage, current, and power waveforms.***

IndexTerms—**Electric Vehicle, solar PV, wind turbine, Hybrid energy resource, Grid connected system, Matlab/Simulink.**

I. INTRODUCTION

Over the last few years, the size of worldwide renewable power, particularly that of wind power, has enlarged enormously against the backdrop of the environment's degeneration and fossil energy deficiency [1]. Although the randomness, intermittence and uncertainty have profound influences on the power system reliability and bring vast amounts of difficulties in being powered for grid. Therefore, power connected to grid needs to be within certain limits in order to guarantee the power system's safety and stability [2], [3]. And it is now a severe challenge to enhance the penetration rate of wind power generation in the power system [4].

Current research has indicated that the application of energy storage technology is very helpful to integrate intermittent renewable energies [5]–[7]. And problems, including the obtaining of target grid-power, the selecting of energy storage equipment, the configuring method of energy storage capacity, and the balance of storing energy devices, have been extensively investigated. For the target grid-connected power acquisition, wavelet packet decomposition (WPD) based techniques are widely applied because of their merits on multi scale decomposition and frequency band partition in the signal, and have been validated through good performance [8]–[10]. In regards to energy choice, a live battery super-capacitor (SC) hybrid energy storage system (HESS) [11] – [13] has been implemented for renewable energy grid interfacing due to their complementary behavior: a battery possesses a comparative energy density with a low power density, while an SC contains vice-versa [14].

To lower the cost of energy storage investment, electric vehicles, as energy storage devices, increasingly being proposed to substitute battery cells [15], [16]. And its operationally is increasingly convincing with the increasing EV numbers [17]–[19]. However, when it comes to smoothing variations in renewable energy, EV's dispatch modes and methods differ greatly from those of traditional batteries due to their mobility and unpredictability [20], [21]. [22] discusses an extremely thorough energy storage model for EVs that can accurately predict each EV's output power. In order to equalize the wind power penalty costs resulting from overestimation and underestimating of the available wind power, a new integrated system of EVs and wind farms (WEV) is launched in [23]. This system uses the charging and discharging of EVs. To fulfill both emission and overall cost goals, a novel multi-objective dynamic economic emission dispatching model is built utilizing the WEV system. [24] Discusses a dispatch model that addresses several competing and conflicting requirements, such as coordinating wind power or delivering vehicle-to-grid (V2G) service. In [25], a HESS model with EVs is built, and its overall energy management strategy is examined. Then, a variety of strategies based on smart metering and sophisticated communication infrastructure are developed for EVs to facilitate the integration of renewable energy [26], [27]. This study proposes a cooperative optimum dispatch strategy for wind power integration in vehicle-to-grid (V2G) systems. The best scheduling of EV groups is determined using a suitable DP algorithm, allowing for highly flexible and efficient energy exchange between EVs and the grid.

II. LITERATURE SURVEY

L. Mitridati, P. Pinson, C. Ordoudis, and J. Ostergaard suggest Deploying renewable energy generation capacities and integrating their power production into existing power systems has become a global trend, despite a single set of operational challenges brought on by the unpredictable and variable nature of power generation from sources like solar and wind. Denmark is a country that immediately proposed highly ambitious goals for the future of its energy system and global energy consumption after making an early investment in wind power. While the Danish example is distinct due to its minor scale and

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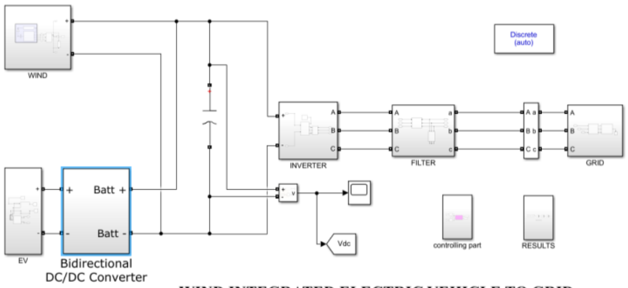
connectivity, there may still be a lot to learn from the evolution of operational practice, which is also heading toward a liberalized electrical market environment and, more generally, keeping up with other societal and technical advancements.

J. Wu and M. Ding suggest this study presents a unique control method based on a two-level power reference signal distribution approach and a self-adaptive wavelet packet decomposition technique for wind power fluctuations to be smoothed with a battery-super capacitor hybrid energy storage system (HESS). Then, using a two-stage rational distribution technique, the HESS power reference signals will be provided depending on the HESS's state of charge and performance characteristics. The findings of the simulation demonstrate that the control approach that was developed is successful in promoting wind power fluctuation smoothing and in putting the HESS in the proper area to allow for long-term steady-state functioning.

III. PROPOSED METHOD

A. WINDINTEGRATED ELECTRIC VEHICLE-TO-GRID



WIND INTEGRATED ELECTRIC VEHICLE TO GRID

The above diagram portrays a simulation diagram showcasing the integration of a wind generation system with a Vehicle-to-Grid (V2G) configuration, through the help of an inverter. In the above figure, wind generation system and the V2G system are connected with each other using the inverter to allow power exchange between grid, wind generation source, and electric vehicles bidirectional. This arrangement supports utilization of additional wind energy in charging electric cars during off-peaks and to release energy to the grid whenever needed. The inverter takes a pivotal function of controlling power flow and providing compatibility between the various elements of the system. The integration holds immense potential for increasing the use of renewable energy and promoting grid stability.

Vehicle to Grid Operation Under WIND Integrated System. Vehicle-to-Grid (V2G) operation under a wind integrated system wind energy sources involves utilizing electric vehicle (EV) batteries to conserving feasible energy and provide grid support services when necessary.

The proposed vehicle-to-grid (V2G) operation is tested within a wind integrated system. The overall system results include battery voltage, current, battery power, and state of charge (%SOC), as well as wind side voltage, wind power, and current.

B. SOLAR INTEGRATED ELECTRIC VEHICLE-TO-GRID

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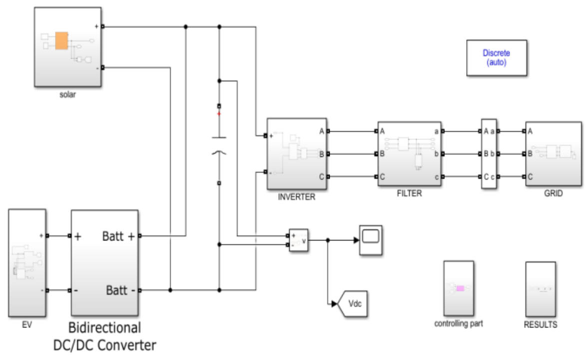


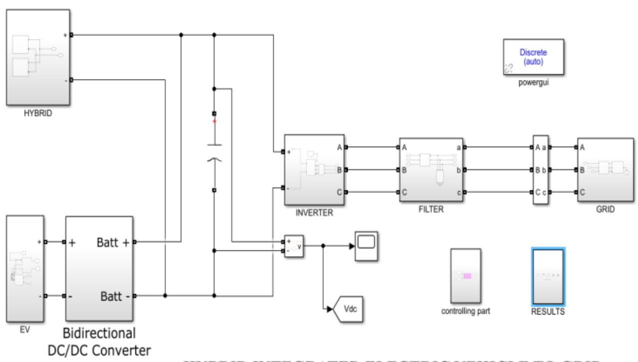
SOLAR INTEGRATED ELECTRIC VEHICLE TO GRID

This diagram illustrates a simulation diagram reflecting the combination of a solar energy system and Vehicle-to-Grid (V2G) configuration, offered through an inverter. Here, Solar generation system and V2G system are connected by the inverter, enabling bidirectional power transfer between the grid, hybrid generation source, and electric vehicles. This configuration offers the potential of utilizing excess solar energy to charge electric vehicles off peak or at night time and releasing energy to the grid at peak hours. The inverter plays a significant part in power flow control and compatibility of system components. They have vast potential for expanded use of renewable energy and grid stability improvement

Vehicle to Grid Operation Under Solar Integrated System Vehicle-to-Grid (V2G) operation under a Solar integrated system sources involves utilizing electric vehicle (EV) batteries are employed to capture surplus renewable energy, storing it for later use, and to provide grid support services when demand increases or renewable generation fluctuates."

The proposed vehicle-to-grid (V2G) operation is tested within a Solar integrated system. The overall system results include battery voltage, current, battery power, and state of charge (%SOC), as well as solar side voltage (Vpv), solar power, and DC link voltage are examined.

C. HYBRID INTEGRATED ELECTRIC VEHICLE-TO-GRID



HYBRID INTEGRATED ELECTRIC VEHICLE TO GRID

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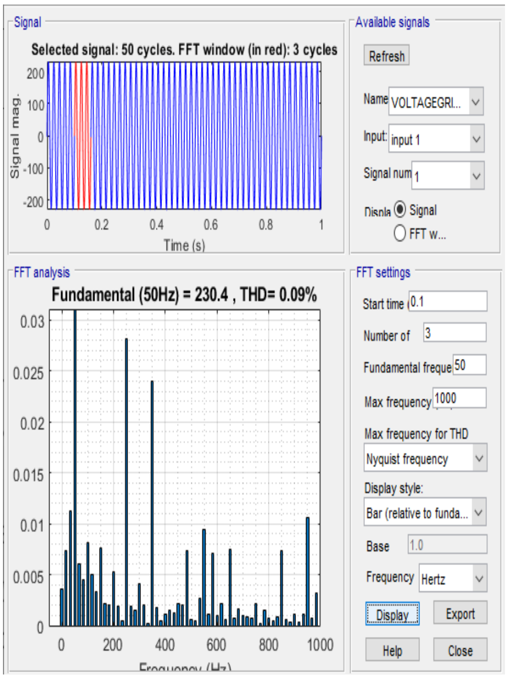
The block diagram portrays a simulation diagram showcasing the integration of a hybrid wind and solar generation system
with Vehicle-to-Grid (V2G) configuration, facilitated by the inverter. Hybrid generation system and V2G system are joined by the inverter in the figure to facilitate power exchange between the grid, hybrid generation source, and electric vehicles in either direction. The configuration facilitates charging of electric vehicles from off-peak surplus hybrid power and supplying electricity to the grid whenever required. Inverter enables the control of power flow and system component compatibility. This integration is full of promise in the efficient utilization of renewable resources and grid stability.

Vehicle to Grid Operation Under Hybrid Integrated System. Vehicle-to-Grid (V2G) operation under a hybrid integrated system combining solar and wind energy sources involves utilizing electric vehicle (EV)Batteries are used to store excess renewable energy and deliver grid support services when required.

The proposed vehicle-to-grid (V2G) operation is tested within a hybrid integrated system. The overall system results include battery voltage, current, battery power, and state of charge (%SOC), as well as wind side voltage, wind power, and current. Additionally, solar side voltage (Vpv), solar power, and DC link voltage are examined. Furthermore, inverter side voltage, inverter active power, and current are evaluated, along with grid side.

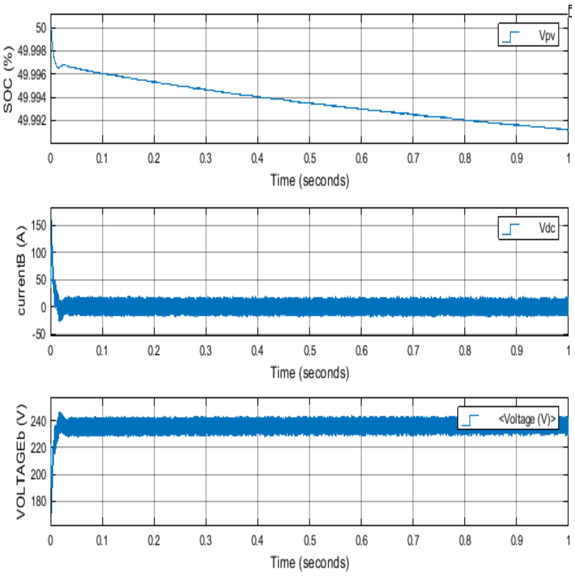
TOTAL HARMAONIC DISTORTION ANALYSIS.

This analysis refers to the calculation of harmonic disturbances of a system. It determines up to what level the harmonics in a wave deviate from its fundamental frequency. THD analysis finds its applicability in power systems, audio engineering, and communications where a high degree of harmonic distortion reduces the system performance and creates interference.

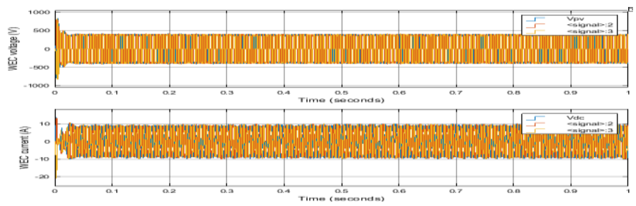


IV.SIMULATION RESULTS

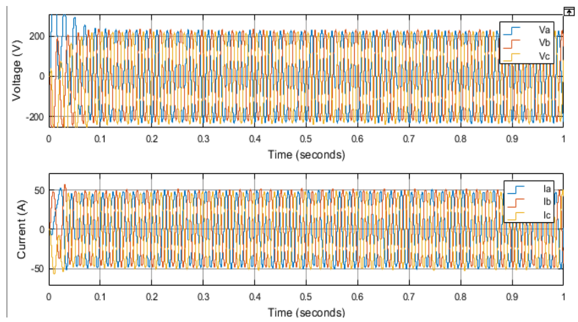
A. WIND INTEGRATED ELECTRIC VEHICLE-TO-GRID

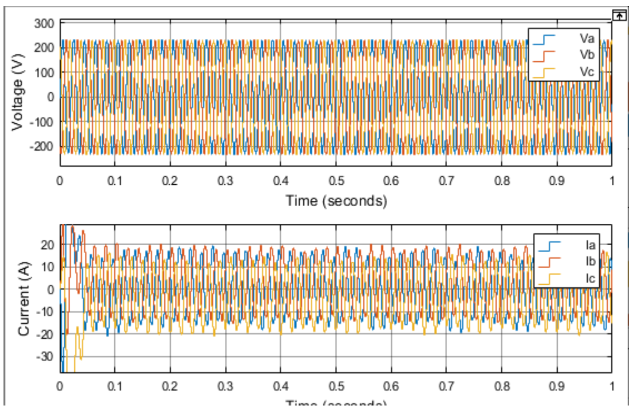


a. Battery Related



a.Wind side voltage and current





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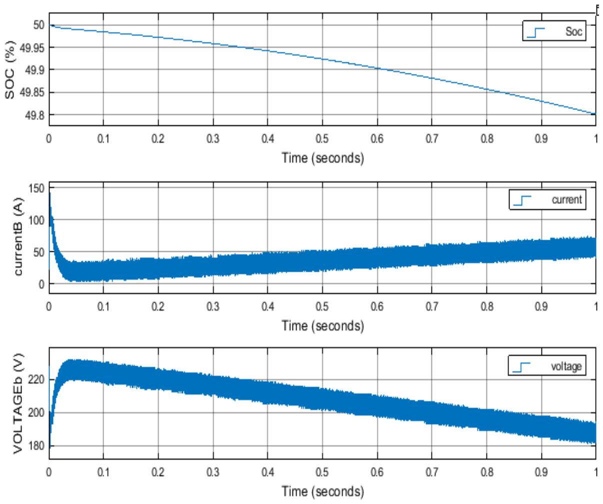
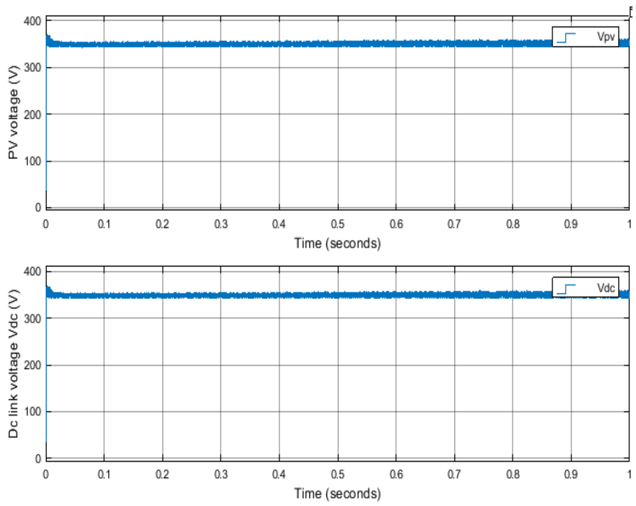
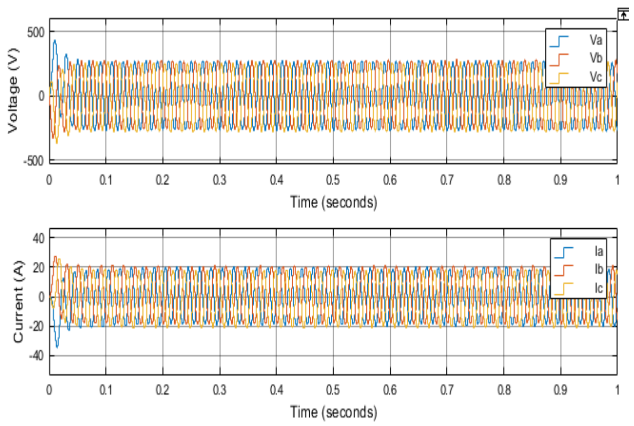
B.SOLAR INTEGRATED ELECTRIC VEHICLE-TO-GRID

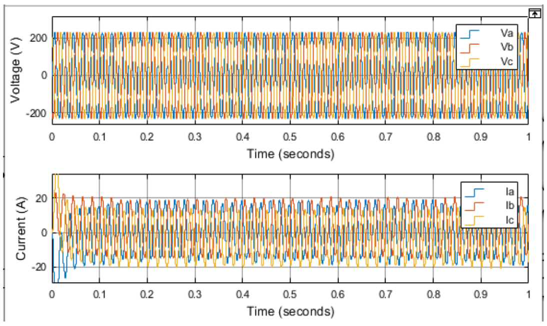


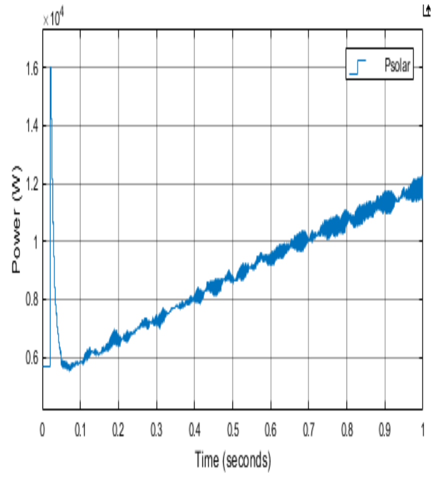
b.Battery Related



Solar Related

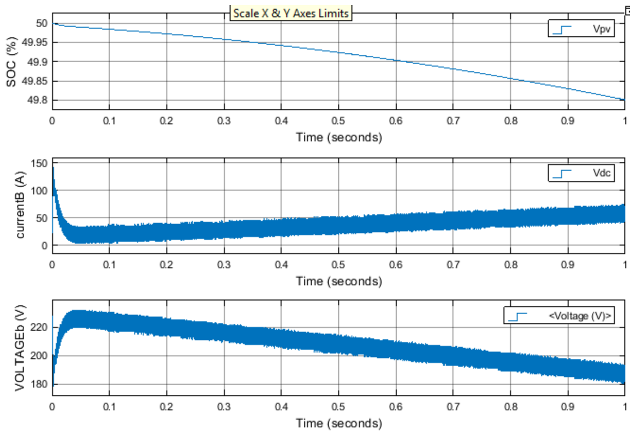




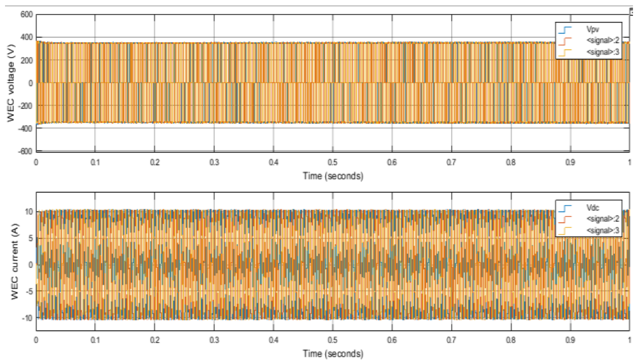


Solar Power

C. HYBRID INTEGRATED ELECTRIC VEHICLE-TO-GRID



c.Battery Related



c.Wind Side Voltage and Current

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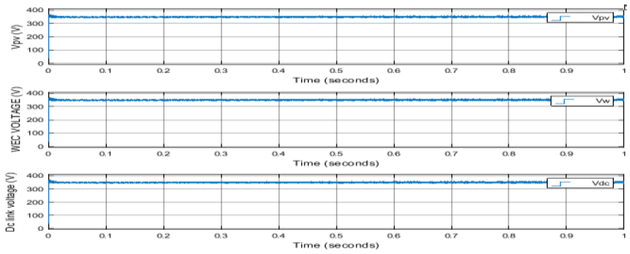
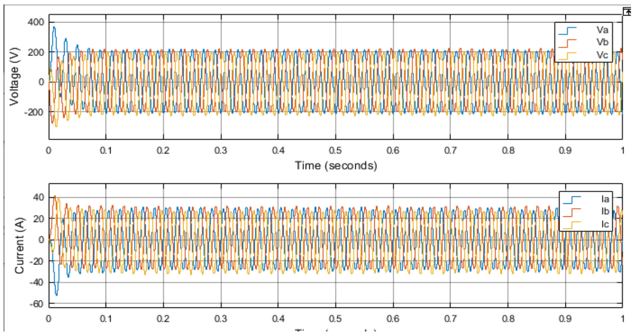
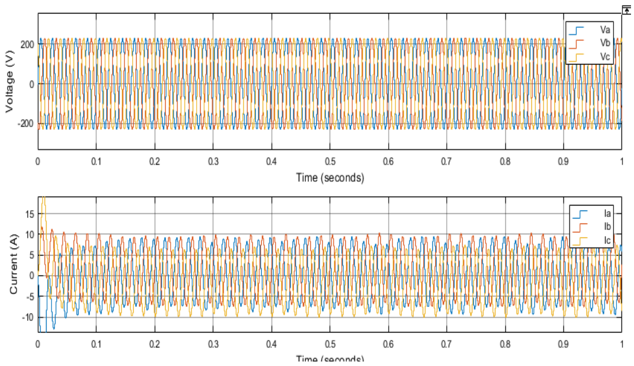
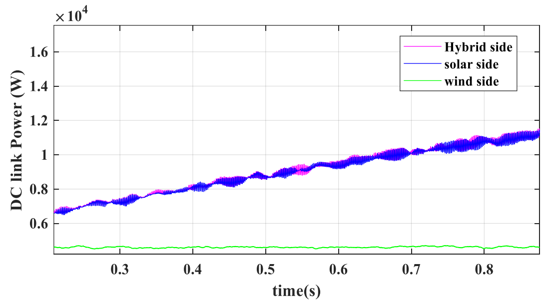


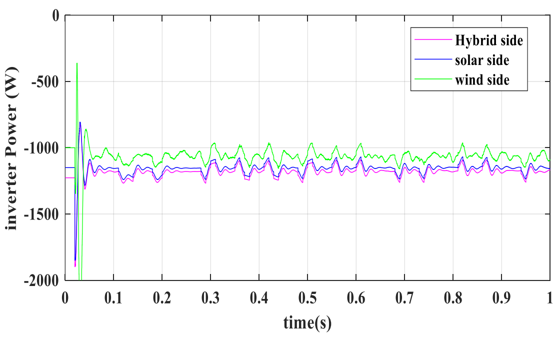
Vwec,Vpv and Vdc



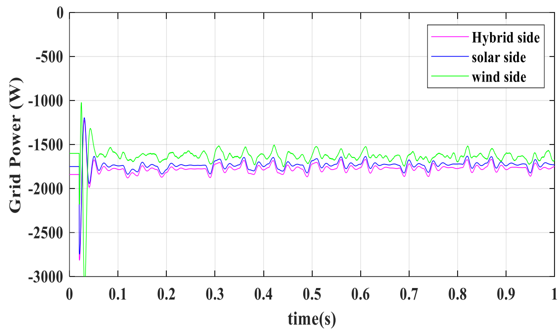




1. DC link power



2. Inverter power



3. Grid power

V.CONCLUSION

The important goal of this effort is to manage energy between electric vehicles and the grid system for hybrid integration. A strategy to mitigate the instability of huge-amount wind generation is summarized through the use of V2G systems. To decrease the investment costs of energy storage, electric vehicles (EVs) are constantly being considered as potential replacements for battery cells as energy storage components. The results of electric cars, the grid, and loads with various voltage, current, and power waveform characteristics may be calculated using the MATLAB/SIMULINK 2018a program.

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