Optimization Of Vehicle-To-Grid (V2G) System And Its EnergyManagement For Renewable Power Integration

G. Rishitha[1*], P. Rizwan[2], Y. Manasa[3]

ABSTRACT:

Due to environmental degradation and a scarcity of fossil fuels, the size of the world's renewable energy sector has significantly increased in recent years. When power is connected to the grid, the unpredictability, intermittent nature, and uncertainty have a significant negative impact on the system's dependability. The Vehicle-to-Grid (V2G) is being researched to reduce the volatility of large scale renewable power integration. A system for energy management is modeled by placing battery super capacitors which also reduce the investment costs with satisfactory way of operation. The intended grid connected renewable energy power necessary Electric Vehicle (EV), and battery super capacitor are calculated. An analysis of real world system shows that the energy management and optimization approach of V2G systems produces considerable performance gains over benchmarkmethods.

Index Terms – Vehicle-to-Grid (V2G), electric vehicle, Battery super capacitors, Solar resource, Wind resource, Hybridresource.

DOI Number: 10.48047/NQ.2022.20.16.NQ880426 **NeuroQuantology2022;20(16):4194-4202**

I.INTRODUCTION

Due to environmental degradation and a scarcity of carbon fuels, the size of the world's sustainable energy sector has grown rapidly in the last decade, particularly the wind energy sector [1]. When a power source is connected to the power grid, theunpredictability, intermittent nature, and uncertainty, however, have a significant negative impact on the system's dependability and present several challenges. To maintain the security and stability of the power system, grid- connected electricity must comply with a set of standards [2, 3]. Improving the rate at which wind power generation is incorporated into the electricity grid has become a massive issue[4].

Recent research has demonstrated the use of energy storage techniques greatly facilitates the integration of variable sustainable sources [5–7]. Additionally, a lot of research has been done on topics including the selection of energy storage equipment, the method for configuring energy storage capacity, and the control of energy storage **e**quipment. So the Vehicle-to-Grid technology methods are frequently used for the objective grid-connected power acquisitions. Regarding the choice of energy equipment, an active battery Super- Capacitor (SC) and HESS [11–13] has been used to support renewable energy grid connections due to their complementary characteristics: a battery has a relatively high energy density but a low power density, whereas a Super Capacitors has a comparatively high power density but a low energy density[14].

Electric Vehicles (EVs) are gradually being considered to replace battery cells as energystorage components in order to lower the investment costs of energy storage [15, 16]. And as there are more and more EVs on the

---

***Corresponding Author**: -G.Rishitha
Address:[1*]PGScholar,DepartmentofEEE,JNTUACollegeofEngineering(Autonomous)Anantapuramu,India.**,**
rishitharao964@gmail.com

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest road,its operability is improving [17–19]. When assisting in reducing the variations of renewable energies, EVs' mobility and unpredictability, therefore, causetheir dispatch modes and ways to differ significantly from the standard battery [20, 21]. In [22], a very thorough energy storage model for EVs is investigated. This model is capable of calculating each EV's energy output with a great deal of accuracy. The charging and discharging of EVs is suggestedin [23] as a unique integrated framework of EVs and Wind Farms to exploit the wind power penalty costs brought on by over-estimating and under-estimating available wind power to be moothed out. A new multi-objective dynamic economic emission dispatching model based on the wind integration with EV system is being created in the interim to take into account both emission and overall cost objectives. In the [24] presents a dispatch model that takes into account many competing and incompatible goals, such as offering Vehicle-to-Grid (V2G) service orworking with wind power. A HESS model with EVs is constructed and [25] analyze its whole energy management strategy. The development of different EV integration techniques for renewable energy is then done usingsophisticated smart metering and transmission technology, [26,27].

Furthermore, as choosing the best Electric vehicle clusters dynamically for scheduling is a typical non-deterministic polynomialchallenging task, the issue of how to distribute and manage the energy output of Electric Vehicles throughout the grid exists [28]. Additionally, therecontinue to be a variety of constraint challenges that need to be resolved right now [29–31]. Initially, due to inherent complexities, each EV's power storage model differs. Second, it is challenging to assess the real-time status of each EV and the changes that occur within Electric vehicle clusters with in grid. Third, because Electric vehicle power dispatch merely follows the waiting principle without assigning power according to each EV's best condition, EV clusters fall short of maximizing the suppression of powerfluctuations.

In order to integrate wind power, this research work suggests a cooperative optimum dispatch strategy for V2G systems. The best scheduling of Electric vehicle clusters is determined using a suitable Bidirectional converter resulting in high flexibility and efficiency in the energy exchange between EVs and the grid. Thus the Power optimization and energy management of the Renewable energy resources aregeneralized by the Vehicle-to-Grid connected suggested strategy. The followingisasuccinctsummaryoftheapproaches discussedinthisresearchwork:

1) Here, a very precise hybrid energy storage system is constructed, particularly for a single EV. By including the time constraints for charging and discharging as well as the parking status in the scheduling procedure, the EV model is made more complete. The target grid- connected power is determined, and the overall demand for EVs is calculated by eliminating the highestfrequency layer from thedecompositionoutput.

2) Due to the special properties of Vehicle-to-Grid(V2G) which allows a Battery Super Capacitors to store the energy including renewable and then safely discharge apart of energy back tothegridsothattoprovidegridservicesduringpeaktimesandstabilize,preventgridfrom blackout. We discovered via verification that the pre mentioned technique can produce wind, solar, hybrid power output that is as close as feasible to the desired grid-connected power.

II. STRUCTURAL MODEL OF HESS

In this article, HESS includes EV clusters and SC. In the event that EVs are unable toentirely squelch renewable source power variations, a SC is be used for replenishing. Additionally, this technique permits a little level of wind, solar, wind curtailment. Fig. 1 displays the HESS's general framework for integrating renewable source power.

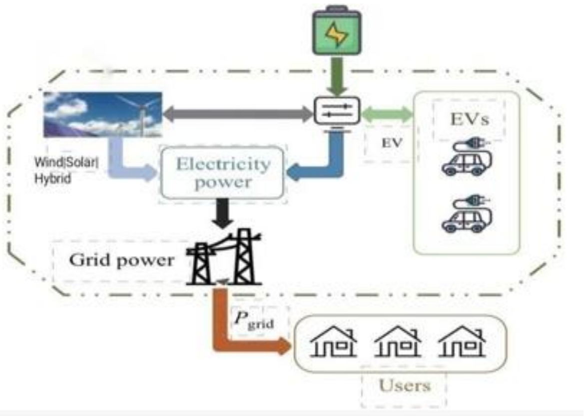

Fig. 1 Hybrid Energy Storage System Architecture

$$P_w(t)+P_{cur}(t)=P_{wind}(t)\quad(1)$$

$$P_W(t)+P_{KESS}(t)=P_{grid}(t)\quad(2)$$

$$P_{KESS}(t)=P_{EV}(t)+P_{SC}(t)\quad(3)$$

$$\Delta(t)=P_{wind}(t)-P_{wind}(t)\quad(4)$$

Where inP_{wind} is the wind's initial output, P_W is its output without wind curtailment, andP_{cur} is its output after wind curtailment, The hybrid energy storage system power output is P_{KESS};

P_{grid} stands for the desired grid-connected power, P_{EV} and P_{SC} for the desired EV cluster and super capacitor output powers,respectively, and P for the desired smoothing power deviations.

The grid-connected wind power fluctuation rate standard must be met by wind power in order to ensure the stability of the power system [35]. The following active power fluctuation specifications are given for a wind farm with an installed capacity of 30–150 MW for the time scales of 1 min and 10min:

$$\{\begin{array}{l}\Delta P_{grid,1Nin} \leq \frac{P_{wind,inc}}{10}\\ \Delta P_{grid,10Nin} \leq \frac{P_{wind,inc}}{3}\end{array}\quad(5)$$

where$P_{grid,1Nin}$and$P_{grid,10Nin}$are,respectively,thedisparitiesbetweenthehighestand minimumpowerlevelsinthosetimeperiods;The installedcapacityofthewindform is$P_{wind,inc}$

III. Operating Mode ofHESS

EVs and SC will work together in the HESS to stabilize the variations in wind, solar, hybridid energy.

The following are their models and operational mechanism:

1. EVmodel

In order to take part in power dispatch for renewable power smoothing, an EV is used as an energy storage component. The necessary State of Charge (SOC), which includes the requestedSOC value of users, and charging and discharging time limitations, can be applied when EVs are connected to thegrid.

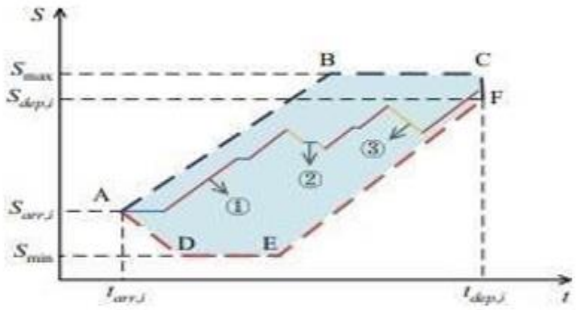

Fig. 2 Single Electric Vehicle energy storagemodel

In Fig. 2, which illustrates the SOC fluctuations throughout the charge or discharge process, the working mechanism and model for an EV are presented. The SOC value of an EV is shown on the Y axis (S). S_{min} and S_{max} are the lowest and maximum SOC restrictions that may apply while an EVistakingpartinpowerdispatch,respectively.ThetimeittakesEVstoenterandleavethegridis measured as $t_{arr}$to t_{dep}. When connected onto a power source, S_{arr}represents the SOC's initial value. $S_{dep}$is the SOC value that consumers want. When an EV participates in dispatching, the maximumboundaryvalueoftheSOCisA-B-C,indicatingthattheEVgetschargedrightawayafter connecting into thegrid.

The SOC checks S_{max}, the EV charging is complete, and the remaining SOC time is unaffected. In fig. 2 D-E-F, which is the minimal boundary value of the SOC, denotes an instantaneous discharge of the EV. When the SOC value reaches S_{max}, the discharge must stop. The EV may continue to be uncharged if it is connected to the grid for an extended period of time. When therequiredchargingperiodhaspassed,thebatteryisrechargedtomeetuserdemandfortravel.EFdenotes the forced charging method in Fig. 2.

$$S_i(t)=S_i(t-1)+h\frac{P_{EV,i}(t)y_{EV,i}}{E_{rated}}\quad(6)$$

$$P_{EV,i}(t)=\{\begin{array}{ll}P_c & P_{EV,i}(t)>0\\ 0 & P_{EV,i}(t)=0\\ P_d & P_{EV,i}(t)<0\end{array}\quad(7)$$

$$\eta_{EV,i}(t)=\{\begin{array}{ll}\eta_c & P_{EV,i}(t)>0\\ 0 & P_{EV,i}(t)=0\\ 1/\eta_d & P_{EV,i}(t)<0\end{array}\quad(8)$$

If the sample time is t and the sample interval is h, then the charge-discharge model of an EVmay be used to characterize the EV state as: where i is the EV number, P_c and P_d stand for the corresponding EV chargingand ischarging powers; EV stands for "Electric Vehicle", "c" and "d" stand for "electric vehicle" charging and discharging efficiency, respectively; The storage capacity of an EV israted.

The following are the restrictions on an EV's ability to participate in energy storage power dispatch:

$$S_{min} \leq S_i(t) \leq S_{max}, (9)$$

$$t_{arr} \leq t \leq t_{dep,i}, (10)$$

$$S_i(t) + P_c\eta_c(t_{dep,i} - t)/E_{rated} - S_{dep,i} \geq 0, (11)$$

$$\sum_t^{t+Tc2d} cou_{:2d}\, i\,(t) = 0 \quad (12)$$

$$\sum_t^{t+Td2c} cou_{12c}\, i\,(t) = 0 \quad (13)$$

where T_{c2d} and T_{d2c} stand for the required minimum time intervals from charging to discharging and from discharging tocharging, respectively; $cou_{c2d}$and $cou_{d2c}$are the counts of the twotypesofstatechanges,i.e.,fromchargingtodischargingandfromdischargingtocharging.Eq. (11) indicates that a schedulable EV is required to maintain its SOC value meeting the demand of users when it isoff-grid.

The maximum power distributing capability of EV's I which is EV number under constraint circumstances may be stated by equations (9) and (11) as follows:

$$E_{c,i}(t) = E_{rated}\,(S_{max,i} - S_i(t))$$

$$\text{s.t. } \begin{cases} S_{max,i} \leq 1 \\ S_{max,i} \leq S_i(t) + P_c\eta_c(t_{dep,i} - t)/E_{rated} \end{cases}$$

$$E_{d,i}(t) = E_{rated}(S_i(t) - S_{min,i}) \quad (14)$$

$$E_{d,i}(t) = E_{rated}(S_i(t) - S_{min,i})$$
$$\begin{cases} S_{min,i} = S_{dep,i} - P_c\eta_c(t_{dep,i} - t_{dis,max})/E_{rated} \\ S_{max,i} = S_i(t) - P_d/\eta_d(t_{dis,max} - t)/E_{rated} \end{cases}$$
$$(15)$$

where $t_{dis,max}$is the time at which an electric vehicle reaches its maximumdischargeleveland E_c and E_d, respectively, represent the maximum charging and discharging potentials. The overall number of EVs in a system is frequently guaranteed, but the quantity of EVs in the grid changes dependingontheirunpredictabilityateachtimepoint.AssumingNEVisthenumberofdispatchable EVs, $P_{EV}$is the total EV cluster power, and N_f is the number of EVs that must be compelledto charge, we will have:

$$P_{EV}(t) = \sum_{i=1}^{NE7} \blacklozenge_{EV,i}(t) \quad (16)$$

In the event that the EVs that are dispatched are discharging,

$$P_{EV}(t) = \sum_{i=1}^{N_{E7}-N_f} \blacklozenge_{EV,i}(t) + \sum_{i=1}^{N_f} P_{c,i}(t) \quad (17)$$

2. SCModel

The EV battery serves as the study's main energy storage mechanism. In this study, the EVcluster and SC are also used to smooth out variations that EVs can't completely eliminate due to their mobility and unpredictability. The SOC of SC may be explained using the EV model by:

$$S_{\text{S€}}(t) = S_{\text{S€}}(t-1) + h\frac{P_{\text{S€},c}(t)y_{\text{S€},c}}{E_{\text{S€},rated}}N_{\text{S€},c} - h\frac{P_{\text{S€},d}(t)y_{\text{S€},d}}{E_{\text{S€},rated}}N_{\text{S€},d}$$
$$(18)$$

Operating constraints of SC are presented as follows

$$S_{\text{S€},min} \leq S_{\text{S€}}(t) \leq S_{\text{S€},max}, (19)$$

$$0 \leq P_{\text{S€},c}(t) \leq P_{\text{S€},c,rated}, (20)$$

$$P_{\text{S€},c,rated} \leq -P_{\text{S€},d}(t) \leq 0 (21)$$

$$0 \leq N_{\text{S€},c}(t) + N_{\text{S€},d}(t) \leq 1 (22)$$

where SSC stands for the SC's SOC value, ESC is the SC's rated energy storage capacity, $S_{\text{S€},min}$and $S_{\text{S€},max}$, are the SC's SOC limitations, and $P_{\text{S€},c}$and $P_{\text{S€},d}$are the SC's respective charging and discharging powers SC, c and SC, d are the SC charging and discharging efficiencies, respectively, $N_{S\text{€},c}$and $N_{S\text{€},d}$reflect the number of SCs in the charging and discharging states, respectively.$P_{S\text{€},c}$and$P_{S\text{€},d}$aretheSCratedcharginganddischargingpowers,respectively.

IV.The Vehicle-to-Grid(V2G) Optimal scheduling for Renewable Power Integration

The optimal scheduling of power system problem are considered into 3 cases:

a) Wind PowerIntegration.
b) Solar PowerIntegration.
c) Hybrid PowerIntegration.

a) Wind PowerIntegration

The power generation from wind energy based on parameters wind speed, generator speed, pitch angle. Such power based on wind parameters directly connected to grid may leads to gridcollapse due to vary in wind parameters. Sometimes we get low wind and gusts which will order to optimize this power fluctuations wind power integration is done with the electric vehicle (EV). So whenever there is a high or low supply the Electric Vehicles stores the energy in the battery super capacity and this happens with the help of bidirectional converters. This bidirectional converter helps to regulate the power supply with two switches upper switch and lower switch or buck converter or boost converter. So when there is high power supply from wind, excess power supply can be stored in the battery super capacitor and sufficient amount of supply can send to grid. Vice versa when there is low supply, then sufficient amount of supply can get from the battery storage capacitor and can sent to grid. Thus the wind power generated based on parameters through the permanent magnet synchronous generator (PMSG) as AC power will get rectified and get Dc supply which is given to load balancing storage device DC link capacitor to minimize the effect of voltage. This DC supply is converted into AC supply with the inverters. This AC supply contains harmonics. The RLC filters are used for filtering and tuning harmonics and removed unwanted oscillations, noise and distortions. This filtered and even AC supply is given to grid thenthe grid supplies to the consumers.

b) Solar PowerIntegration

The power generated from solar is based on the solar radiation, number of cells, number of series string, and number of parallel string, open circuit voltage, short circuit current, maximum power point voltage and maximum power point current. The power supply from PV cell is integrated with the electric vehicle and stores the excess amount of supply or gets the power supplyfrom battery storage capacitor whenever there is no sun. Thus the integrated DC supply from PV cell is given to DC link to minimize the voltage effect. The DC Supply is sent to inverter so that AC supply is given. The RLC filters are used to filter and tune the unwanted oscillations, noise and distortion. This gives the undistorted AC supply to grid without anydisturbances.

c) Hybrid Powerintegration

The hybrid energy is the combination of wind and solar resulting in better power quality and continuity of power supply. In this hybrid power is generated from wind parameters and solar parameters. The huge amount of power supply which is to be integrated with the Electric Vehicles so that to avoid grid collapse when power is supplied directly connected to grid. So the integrated DC power supply from hybrid is given to load balancing storage device DC link capacitor and sent to inverters and receive AC power supply with harmonics. The RLC filters tunes the uneven and harmonics AC supply. This filtered AC power supply is given to Grid for consumption purpose.

V. RESULTS

The results of the optimization of Vehicle-to-Grid (V2G)System and its energy management for renewable power integration can be observed in threecases

A. Wind powerintegration

In the wind power integration, there are two cases one is wind power integration without EV and second is wind power integration with EV. Through the comparison between with and without EVdemonstrateshowthepoweroptimizationdoneandhowfeasible,desiredoutputpowerisshown.

Case 1: Fig. 3 shows the simulation block diagram of wind integrated without EV and Fig 4 Shows the output power analyzed at grid without EV

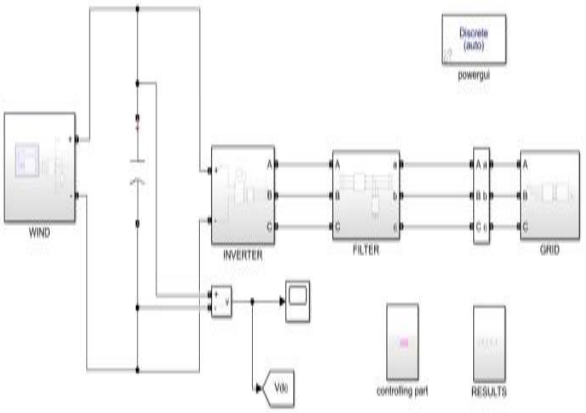

Fig. 3 Block Diagram of wind integrated without EV to grid

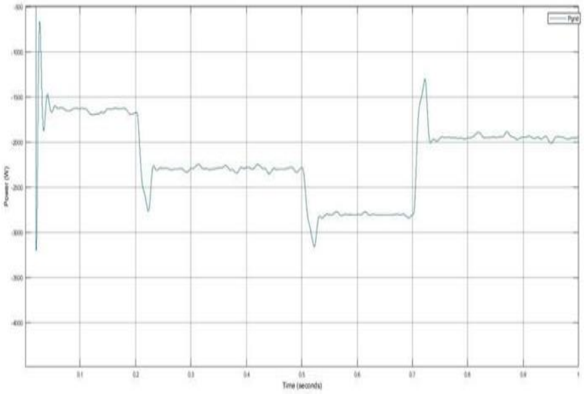

Fig. 4 Grid output power waveform without EV.

The case 1 wind power integration without EV shows the power fluctuations which results in grid collapse. The power is analyzed at Grid is shown which is not a desired output power.

Case 2: Fig. 5 shows the simulation block diagram of wind integrated with electric vehicle to grid and Fig. 6 shows the output power analyzed at grid with EV.

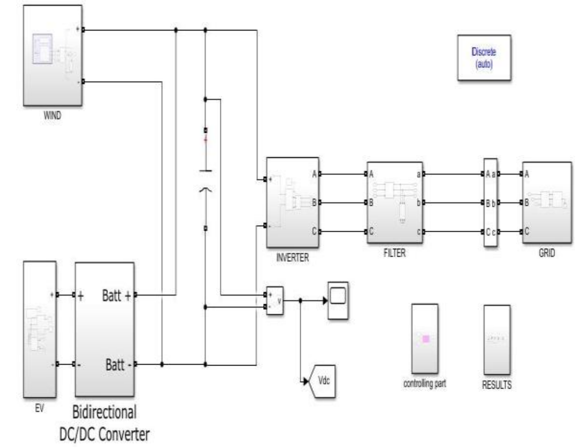

Fig. 5 Block Diagram of wind integrated electric vehicle to grid

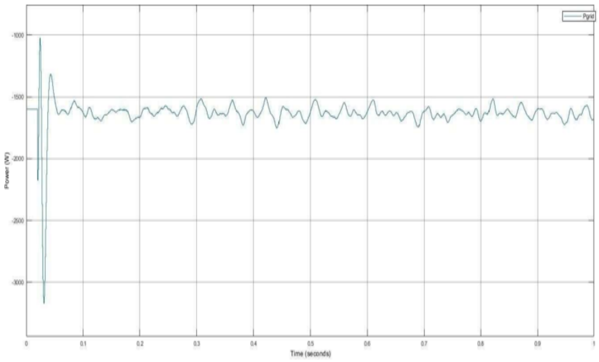

Fig. 6 Grid output power waveform with EV at wind power integration.

In case 2 wind power integrated with Electric vehicle result waveform is shown. The analyzed

B. Solar powerintegration

In the solar power integration, Fig. 7 shows the simulation block diagram of solar integration with EV to grid and Fig. 8 shows the power waveform at grid

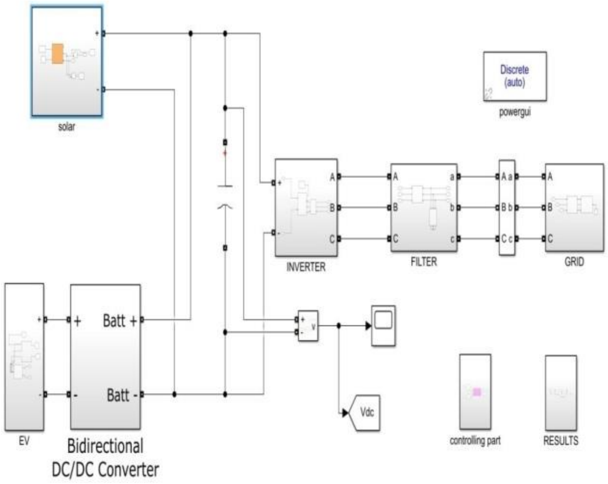

Fig. 7 Block Diagram of solar integrated electric vehicle to grid

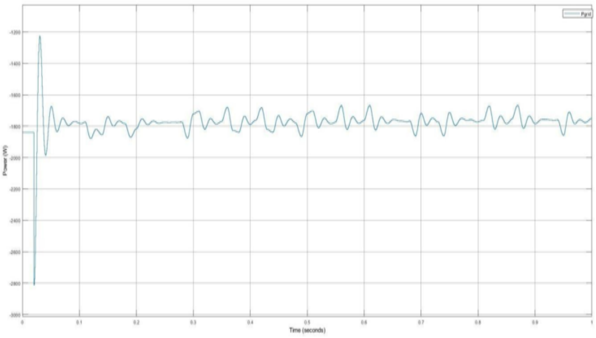

Fig. 8 Grid output power waveform with EV at solar power integration.

The desired output power is shown at grid which is much better when compared to the wind power integration.

C. Hybrid powerintegration

In the hybrid power integration, Fig. 9 shows the simulation block diagram of hybrid power integration with EV to grid and Fig. 10 shows the block power waveform at grid

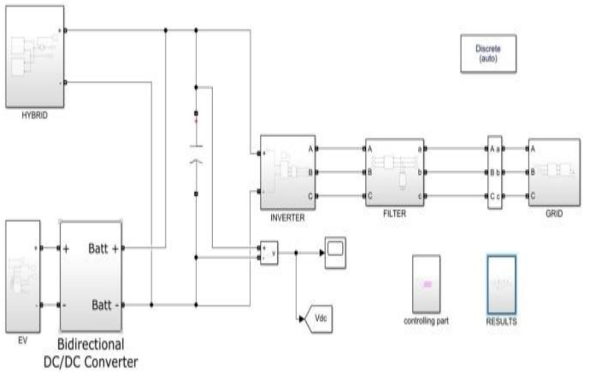

Fig. 9 Block Diagram of Hybrid integrated electric vehicle to grid

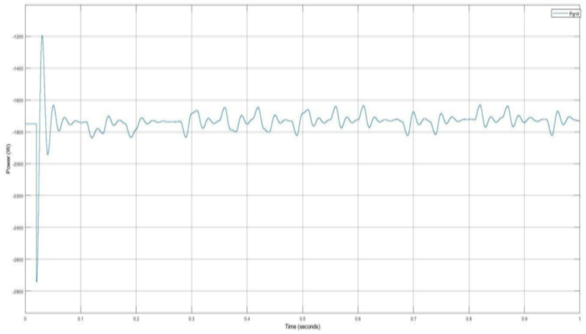

Fig. 10 Grid output power waveform with EV at hybrid power integration.

The results of output power at grid are more compared with solar wind. It is obtains power either from wind or solar or both which supply uninterrupted power as well asreliability.

VI.COMPARISON OF WIND, SOLAR, HYBRID OUTPUT POWER VALUESAT GRID.

Thus, from the results, we discovered that the fore mentioned V2G technique can produce power output that is as close as feasible to the desired grid-connected power. Among all the wind, solar and hybrid output power, hybrid power integration has high and better power behavior and power consumption. The second places take by solar power integration and lastly wind power integration.Thecomparisontabledepictstheoutputpowervaluesofwind,solarandhybridatgrid.

Fig. 11 shows the grid output power waveform with EV at wind, solar, hybrid power integration.

Parameter	Wind power integration	Solar power integration	Hybrid powerintegration
Grid	1625W	1720W	1850W

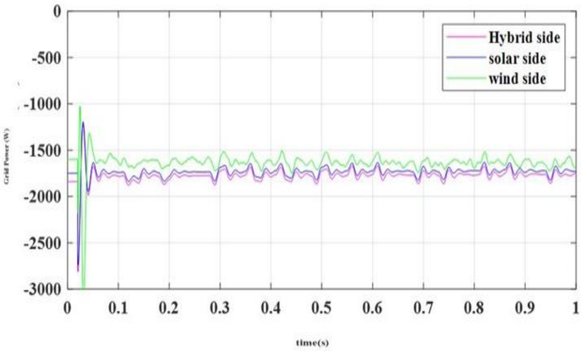

Fig. 11 Grid output power waveform with EV at wind, solar, hybrid power integration.

VII. CONCLUSION

The significant volatility of renewable energy will cause the grid to suffer severely if it is directly linked. The economic advantages will decline if this problem is only addressed by curtailing solar, wind, hybrid power. V2G promotes the electric vehicle benefits both environmentally and commercially. Using Vehicle-to-Grid (V2G) systems, a method of reducing the instability of large- scale wind generation is examined. Energy storage devices, like EVs, feature intelligent power consumption patterns and control the predictable power consumption. Power optimization is done with continuity supply and quality power. EV's promotes cleaner environment with reduced carbon footprint and storing the renewable energy in the batteries resulted in energymanagement.

REFERENCES

P. Pinson, L. Mitridati, C. Ordoudis, and J. Østergaard, "Towards fully renewable energy systems: Experience and trends in Denmark, "CSEE Journal of Power and Energy Systems, vol. 3, no. 1, pp. 26–35, Mar.2017.

Y. B. Chen, Z. Zhang, Z. Y. Liu, P. Zhang, Q. Ding, X. Y. Liu, and W. R.Wang,—

“Robust N k CCUC model considering the fault outage probability of units and transmission lines,”

IET Generation, Transmission & Distribution, vol. 13, no. 17, pp. 3782–3791, Sep. 2019.

Y. B. Chen, Z. Zhang, H. Chen, and H. P. Zheng, “Robust UC model based on multi- band uncertainty set considering the temporal correlation of wind/load prediction errors,” IET Generation,Transmission&Distribution,vol.14,no.2, pp.180–190,Jan.2020.

Y. B. Shu and Y. Tang, “Analysis and recommendations for the adapt- ability of China’s power system security and stability relevant standards,” CSEE Journal of Power and Energy Systems, vol. 3, no. 4, pp. 334–339, Dec.2017.

A. G. Olabi, “Renewable energy and energy storage systems,” Energy, vol. 136, pp. 1–6, Oct.2017.

B. V. Mathiesen, H. Lund, D. Connolly, H. Wenzel, P. A.Østergaard,

B. Mo¨llerd, S. Nielsen, I. Ridjan, P. Karnøe, K. Sperling, and F. K. Hvelplund, “Smart energy systems for coherent 100% renewable energy and transport solutions,” Applied Energy, vol. 145, pp. 139–154, May 2015.

D. Larcher and J. M. Tarascon, “Towards greener and more sustainable batteries for electrical energy storage,” Nature Chemistry, vol. 7, no. 1, pp. 19–29,2015.

M. Ding and J. Wu, “A novel control strategy of hybrid energy storage system for wind power smoothing,” Electric Power Components and Systems, vol. 45, no. 12, pp. 1265–1274, Nov.2017.

F. Wu, J. Wang, Z. Sun, T. Wang, L. Chen, and X. Y. Han, “An optimal wavelet packets basis method for cascade hydro-PV-pumped storage generation systems to smooth photovoltaicpowerfluctuations,”Energies,vol.12,no. 24,pp.4642,Dec.2019.

Q.Y.JiangandH.S.Hong,“Wavelet-basedcapacityconfigurationandcoordinatedcontrol of hybrid energy storage system for smoothing out wind power fluctuations,” IEEE Transactions on Power Systems, vol. 28, no. 2, pp.1363–1372, May 2013.

K. C. Divya and J. Østergaard, “Battery energy storage technology for power systems-Anoverview,”ElectricPowerSystemsResearch,vol.79, no.4,pp.511–520,Apr.2009.

S. Hajiaghasi, A. Salemnia, and M. Hamzeh, “Hybrid energy storage system for microgrids applications: A review,” Journal of Energy Stor- age, vol. 21, pp. 543–570, Feb.2019.

H. J. Jia, Y. F. Mu, and Y. Qi, “A statistical model to determine the capacity of battery-supercapacitor hybrid energy storage system in autonomous microgrid,” International JournalofElectricalPower&EnergySystems,vol.54,pp.516–524,Jan.2014.

M. E. Choi, S. W. Kim, and S. W. Seo, “Energy management optimiza- tion in a battery/supercapacitor hybrid energy storage system,” IEEE Transactions on Smart Grid, vol.3, no. 1, pp. 463–472, Mar.2012.

L. Kouchachvili, W. Ya¨ıci, and E. Entchev, “Hybrid battery/supercapacitor energy storage system for the electric vehicles,” Journal of Power Sources, vol.374, pp. 237–248, Jan. 2018.

J. Huh, S. W. Lee, W. Y. Lee, G. H. Cho, and C. T. Rim, “Narrow- width inductive power transfer system for online electrical vehicles,” IEEE Transactions on Power Electronics, vol. 26, no. 12, pp. 3666– 3679, Dec.2011.

W. H. Hu, C. Su, Z. Chen, and B. Bak-Jensen, “Optimal operation of plug-in electric vehicles in power systems with high wind power penetrations,” IEEE Transactions on Sustainable Energy, vol. 4, no. 3, pp. 577–585, Jul.2013.

H. Fathabadi, “Novel grid-connected solar/wind powered electric vehicle charging station with vehicle-to-grid technology,” Energy, vol. 132, pp. 1–11, Aug.2017.

R. Loisel, G. Pasaoglu, and C. Thiel, “Large-scale deployment of electric vehicles in Germany by 2030: An analysis of grid-to-vehicle and vehicle- to-grid concepts,” Energy Policy, vol. 65, pp. 432–443, Feb.2014.

Y. Cao, T. Wang, O. Kaiwartya, G. Y. Min, N. Ahmad, and A. H. Abdullah, “An EV charging management system concerning drivers’ trip duration and mobility uncertainty,” IEEE TransactionsonSystems,Man,andCybernetics:Systems,vol.48,no.4,pp.596–607,Apr.2018.

J. Aghaei, A. E. Nezhad, A. Rabiee, and E. Rahimi, “Contribution of plug-in hybrid electric vehicles in power system uncertainty manage- ment,” Renewable and Sustainable Energy Reviews, vol. 59, pp. 450– 458, Jun.2016.

H. C. Zhang, Z. C. Hu, Z. W. Xu, and Y. H. Song, “Evaluation of achievable vehicle- to-grid capacity using aggregate PEV model,” IEEE Transactions on Power Systems, vol. 32, no. 1, pp. 784–794, Jan.2017.

B. H. Qiao and J. Liu, “Multi-objective dynamic economic emission dispatch based on electric vehicles and wind power integrated system using differential evolution algorithm,” Renewable Energy, vol. 154, pp. 316–336, Jul.2020.

X. Zhang, K. W. Chan, H. Z. Wang, B. Zhou, G. B. Wang, and J. Qiu, “Multiple group search optimization based on ecomposition for multi- objective dispatch with electric vehicle and wind power uncertainties,” Applied Energy, vol. 262, pp. 114507, Mar.2020.

C. H. Zheng, W. M. Li, and Q. Liang, “An energy management strategy of hybrid energy storage systems for electric vehicle applications,” IEEE Transactions on Sustainable Energy, vol. 9, no. 4, pp. 1880–1888, Oct.2018.

S. Gao, K. T. Chau, C. H. Liu, D. Y. Wu, and C. C. Chan, “Integrated energy management of plug-in electric vehicles in power grid with renewables,” IEEE Transactions on Vehicular Technology, vol. 63, no. 7, pp. 3019–3027, Sep.2014.

L. J. Zhang, X. M. Ye, X. H. Xia, and F. Barzegar, “A real-time energy management and speed controller for an electric vehicle powered by a hybrid energy storage system,” IEEE Transactions on Industrial Informatics, vol. 16, no. 10, pp. 6272–6280, Oct.2020.

Q. Niu, K. C. Jiang, and Z. L. Yang, “An improved, negatively correlated search for solving the unit commitment problem’s integration with electric vehicles,” Sustainability, vol. 11, no. 24, pp. 6945, Dec.2019.

K. Seddig, P. Jochem, and W. Fichtner, “Integrating renewable energy sources by electricvehiclefleetsunderuncertainty,"Energy,vol.141,pp.2145–2153,Dec.2017.

J. Y. Zhang, T. L. Shen, and J. Kako, "Short-term optimal energy management of power-split hybrid electric vehicles under velocity tracking control," IEEE Transactions on Vehicular Technology, vol. 69, no. 1, pp. 182–193, Jan.2020.

D. K. George and C. H. Xia, "Fleet-sizing and service availability for a vehicle rental system via closed queueing networks," European Journal of Operational Research, vol. 211, no. 1, pp. 198–207, May2011.

K. Kaur, A. Dua, A. Jindal, N. Kumar, M. Singh, and A. Vinel, "A novel resource reservation scheme for mobile PHEVs in V2G environment using game theoretical approach," IEEE Transactions on Vehicular Technology, vol. 64, no. 12, pp. 5653–5666,Dec. 2015.

W. Zhou, L. Yang, Y. S. Cai, and T. X. Ying, "Dynamic programming for new energy vehicles based on their work modes part I: electric vehicles and hybrid electric vehicles," Journal of Power Sources, vol. 406, pp. 151–166, Dec.2018.

W. Zhou, L. Yang, Y. S. Cai, and T. X. Ying, "Dynamic programming for new energy vehicles based on their work modes Part II: Fuel cell electric vehicles," Journal of Power Sources, vol. 407, pp. 92–104, Dec.2018.

Y. S. Sun, Z. X. Zhao, M. Yang, D. Q. Jia, W. Pei, and B. Xu, "Overview of energy storage in renewable energy power fluctuation mitigation," CSEE Journal of Power and Energy Systems, vol. 6, no. 1, pp. 160–173, Mar.2020.