IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)
e-ISSN: 2278-1676, p-ISSN: 2320-3331, Volume 16, Issue 4 Ser. II (Jul. – Aug. 2021), PP 09-19
www.iosrjournals.org

Techno-Economic Evaluation with Operation and Design Consideration of a Hybrid WT/PV Connected Micro Grid for a Rural Area

RITU K R[1], A K WADHWANI[2], BHARAT MISHRA[3]

[1]*PhD Research Scholar, Electrical Engineering, Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalay Chitrakoot, Satna, Madhya Pradesh 485334 India*

[2.]*Department of Electrical & Electronics Madhav Institute of Technology & Science, Gwalior Madhya Pradesh 474 005 India*

[3.]*Department Of Physics Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalay Chitrakoot, Satna, Madhya Pradesh 485334 India*

Abstract

This paper shows how to simulate a PV-wind hybrid system in Matlab/Simulink. In addition, the study considers the economic feasibility of a hybrid power system for usage in rural areas in India. It is modeled using metrological data from the Chitrakoot District of Madhya Pradesh at MGCGV (25° 09'22.20"N81°07'.99"E). PV panels, a wind turbine, a power converter, and a battery for storage are all part of the planned freestanding hybrid power system. The analysis was performed by connecting a load with an effective daily energy consumption of 11.27Kwh/day and a maximum demand of 2.39KW. The National Aeronautics and Space Administration (NASA) and the National Renewable Energy Laboratory (NREL) provided the site's metrological data (NREL). The HOMER simulated results indicate cost-effective component combinations and size, leading to a sensitivity analysis to better understand which model is viable for the proposed location in terms of both efficiency and cost. The results are compared to those obtained via particle swarm optimization. On this hybrid technology, the optimization by these two methods gives a higher-quality output with a faster convergence time. Solar–wind hybrid renewable energy may be utilised to replace traditional energy sources, according to the optimization results. It will be a feasible alternative for electric power distribution as a stand-alone application in the location centre. Compared to a typical diesel generator, this approach is less damaging to the environment. When compared to a normal diesel generator, the cost of fuel is lowered by 70–80%. A Simulink model is used to simulate a hybrid PV-wind system that is isolated. The simulation results are also displayed, as well as the wind model, PV model, energy conversion, and load. The behaviour of a hybrid system that provides a constant supply of energy by combining renewable and variable-in-time energy sources.

Keywords— *PV, Wind Turbine Battery, Economical Analysis, HOMER Pro. PSO,SIMULINK/MATLAB ,MICROGRID*

Date of Submission: 20-07-2021 Date of Acceptance: 04-08-2021

I. Introduction

As the global need for energy rises, the desire for environmentally friendly renewable energy sources has risen as well. According to some estimates, worldwide energy demand will nearly treble by 2050. Renewable energy sources presently meet between 15% and 20% of total global energy demand. The most promising future energy technologies are photovoltaics (PV) and wind energy systems (WES). The usage of this energy will result in a 25% reduction in CO2 emissions. Renewable energy sources have gained international interest due to their abundance in nature and near-zero pollution. Wind power is one of the most promising renewable energy sources since high-capacity wind turbines can readily collect it. Photovoltaic (PV) electricity is another promising clean energy source since it is available all around the world and can be harvested without the use of rotating generators. Wind power and PV power are, in reality, complimentary to some extent since high winds occur at night and on overcast days, whereas bright days are generally quiet and have mild winds.

The economic elements of these renewable energy technologies appear to be sufficiently promising at this time to incorporate commercial development [1-3]. As a result, a Wind–PV Hybrid generating system may provide more consistent power production than any other individual power generation technology[4].

Several design concepts for Integrated Renewable Energy Systems [5-11] have been suggested, with a combination of wind, solar, and, in certain cases, additional renewable resources being employed.

The goal of this work is to create a hybrid power system model using metrological data, as well as to define viable technology and component prices based on resource availability. The input data is utilised to simulate various system configurations, or combinations of components, and the results are shown as a list of viable configurations ranked by net current cost[12]. This article offers a simulated model of a hybrid power system that consists of a cost-effective mix of PV and WT, as well as a converter and battery storage. [14,15]. The HOMER simulation results provide a comparative economic analysis of each design and a recommendation for the optimum option.

This is clear from the findings provided in this study. As a result, HOMER is useful for determining whether or not an energy balancing arrangement is possible for each hour. Before installation, the entire cost of operation for the same viable combination is assessed for the project's lifetime at a specific location [16].

This research was conducted out using the Hybrid Optimization Model for Electrical Renewables (HOMER), which is the most frequently used, free, and user-friendly programme. In a variety of system setups, the programme has been proven to be useful for prefeasibility, optimization, and sensitivity analysis.

HOMER is utilised in this work to design the suitable component, with net present cost as the primary criterion. The results are compared to particle swarm optimization (PSO) results. In addition, a Simulink model for the same size was created, and the output waveforms were examined[17].

A comprehensive assessment of load, site layout, and available resources for the selected building at MGCGV was done as part of the investigation. This was done outside of the Homer environment, and the results were input into the programme. The hybrid RET system is created in the HOMER study, which also includes a techno-economic analysis. . It evaluates a wide selection of equipment with varying restrictions and sensitivity to the system's technical characteristics and life-cycle cost (LCC). The LCC is a cost comparison of the original capital cost, installation expenses, and operation costs throughout the life of the system. HOMER runs simulations to see if alternative technological alternatives and resource availability can meet the demand. The best-suited configuration was chosen based on the simulation findings .The rest of the paper is as follows: Section II Methodology For Cost Analysis In Homer Section III. Hybrid Energy System Design Using HOMER IV Proposed Model In MATLAB and V The PSO Algorithm VI. Conclusion

II. Methodology

A. HOMER Software

HOMER software was created by the National Renewable Energy Laboratory (NREL) of the United States (USA). It is mostly used for hybrid system design and analysis. Electrical load, wind speed, and solar radiation statistics, component specifications, and prices are all supplied as input data to HOMER in this study.

B. Cost Analysis Procedure by HOMER [18,19,20]

1)Net present cost (NPC): NPC is the sum of the system's installation and running costs over its lifespan, computed as follows[20]:

NPC=TAC/CRF(i, Rprj)

WhereTAC, CRF, I and Rprj are the total annualised cost ($), capital recovery factor, interest rate in percentage, and project life time in year, respectively.

2)Total annualised cost: This is the total of the annualised costs of all power system equipment, including capital, operation, and maintenance. It also covers the cost of replacement and fuel [20].

3)Capital recovery factor: This is a ratio for calculating the present value of a sequence of equal yearly cash flows[20].

$$CRF=\frac{i\times(1+i)^{n}}{(1+i)^{n-1}}$$

The number of years and the yearly real interest rate are represented by,n and I respectively.

4)Real interest rate on an annual basis: It's a function of the yearly nominal rate, which looks like this:

$$i=\frac{i'-F}{1+F}$$

5)Cost of Energy (COE): This is the system's average cost per KWh of usable electrical energy generated. The coefficient of equivalence (COE) is computed as follows[20]:

$$COE=\frac{TAV}{LprimAC+LprimDC}$$

The AC primary load and the DC primary load, respectively, are represented by LprimAC and Lprim DC.

III. Hybrid Energy System Design Using HOMER

The cost of a hybrid power system has been calculated and determined using HOMER in this study. In order to assess the optimization outcomes for the various combinations specified in the next section, HOMER simulation software requires certain input data.

A Load Profile

In this study, the load profile took into account the proposed area's average energy demand, which was estimated to be 11.27k Wh/day. The peak demand, which defines the system's size, was estimated to be 2.39kW. It is estimated that the scaled yearly average (kWh/d) is 11.27 kWh/day.

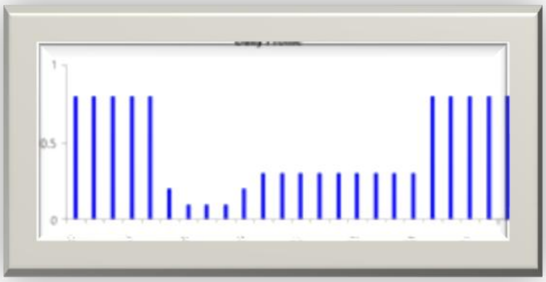

Figure 1. Load profile (daily).

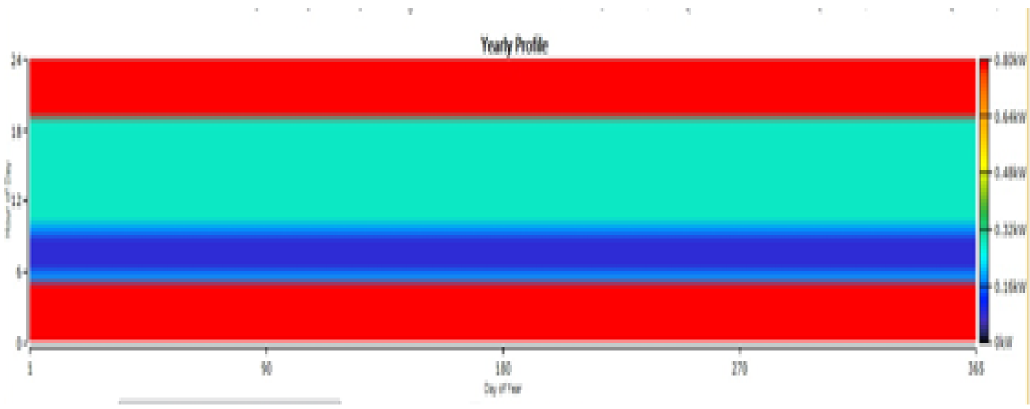

Figure 2.Load for a complete year (monthly average)

B *Wind Speed and Solar Radiation*

NASA's surface metrology and solar energy data base provided the wind speed and solar radiation data. Figure 3 shows wind speed data acquired at a height of 50 metres above sea level for the site of Chitrakoot, Madhya Pradesh [18]. The wind speed ranges from 4.26 to 4.37 m/s, as seen in the graph. In June, the greatest wind speed was recorded. Figure 4 depicts monthly average solar radiation data. The latitude and longitude of Chitrakoot District, as calculated by HOMER software, are 25° 09'22.20"N81° 07'.99"E, respectively. Solar radiation is predicted to be 4.94kWh/m2/day on a yearly basis[18].

Figure3.Wind Speed (monthly average)

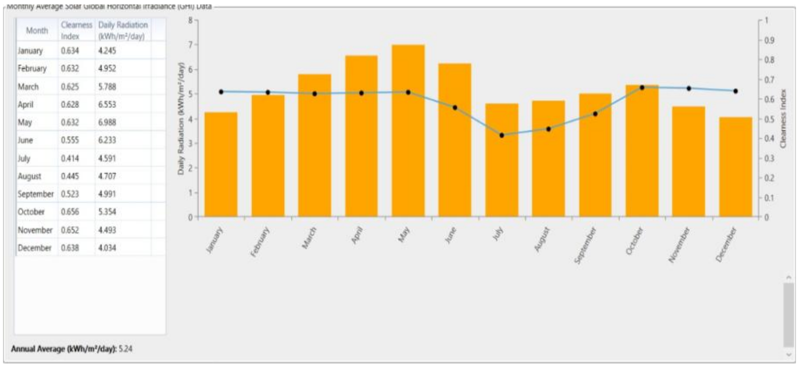

Figure4. Solar radiation and clearness Index(monthly average)

For the simulation to be run, components were picked from HOMER. Figure 5 depicts a hybrid power system with a PV array, a wind generator, a converter, a load, and a battery that is connected via HOMER.

To improve the system's performance in a variety of scenarios. HOMER replicates the aforementioned configurations at the same location and with the same load using various expenses such as anticipated installation costs, operation and maintenance costs, replacement costs, interest, and energy prices.

The grid-connected hybrid system's main components are a wind turbine, a PV array, a battery bank, and a power converter.The following values are used in economic analysis:

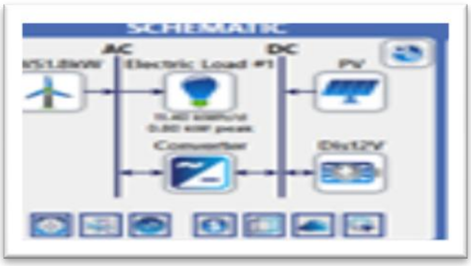

Figure.5.The arrangement of hybrid power system

C.Solar PV Panels: 1 KW is estimated to cost Rs. 620512, in capital. The costs of replacement, operation, and maintenance are estimated to be Rs.53008 and Rs. 100 per year, respectively. Furthermore, it is expected that the sizes of PV arrays (1KW, 4KW, 8KW, and 10KW) will be determined using HOMER simulation. With an 80 percent derating factor, a PV array's life is estimated to be 25 years. [21]

D.Wind Turbine**:** Ennera Energy and Mobility S.L. produced the wind turbine featured in the simulation model, which has a rated capacity of 10KW and a 220V AC output. To serve the associated load, this is connected to an AC bus. The cost of a 1KW unit is estimated to be Rs.1520,68. Replacement, operation, and maintenance are all calculated at a rate of 120512Rs per year and 100Rs per year, respectively. HOMER is used to determine the best value. Wind turbines are estimated to have a 20-year lifespan. Because the wind changes with altitude, hub height may also be considered a key component that impacts producing power; the sensitivity value for hub height is 19m[22].

E.Battery**:** Energy storage is necessary to increase system efficiency by lowering the capacity shortfall factor. For the suggested model's economic analysis, 1KWH lead acid (LA) batteries are used. One battery is expected to cost Rs.1000 in capital. The costs of replacement, operation, and maintenance are estimated to be 900Rs per year, 10Rs per year, and 10Rs per year, respectively. HOMER determines the best battery arrangement for a hybrid system[22].

F..Converter**:** A power converter should sustain the energy flow between the AC and DC buses. As a result, the capital cost of a 1KW converter is Rs. 1000. The costs of replacement, operation, and maintenance are estimated to be 900Rs per year, 10Rs per year, and 10Rs per year, respectively. The converter is expected to last 15 years.The hybrid power system is designed using wind and solar energy due to the availability of renewable energy sources in the planned location. In its off-grid mode, the system is supported by a battery energy storage system.MGCGV conducted a case study in the Chitrakoot District of Madhya Pradesh.This research is carried out by taking into account the subject area's latitude and longitude.HOMER software was used to create the model. The grid-connected hybrid (PV/Wind) system is more efficient and cost-effective than the typical hybrid system (PV/Generator/Wind/Battery) for the same load, according to the optimization results. We came at the following findings after conducting the aforementioned analysis:

(1) The optimum combination of the system with all sensitivity parameters, i.e. PV-2KW, Wind Generator-1.8KW, with 2 converters and a COE of Rs 7.79, was achieved after simulation. With a renewable component of 100%, the net current cost of the system is Rs.428641.60

(2) Although the Net Present Cost is significant, the Grid-connected system's operating and maintenance costs are minimal. The system's monthly average electricity output is as follows: (i)49.5 percent photovoltaic production Wind Turbine-50.5 percent (ii) For such a system, the total Net Present Cost (NPC), Capital Cost (CC), and Cost Of Energy (COE) are Rs.428641.60, Rs.379318, and 7.79 RskWh, respectively. The HOMER results are shown in Fig.6, Fig. 7, and Fig.8.

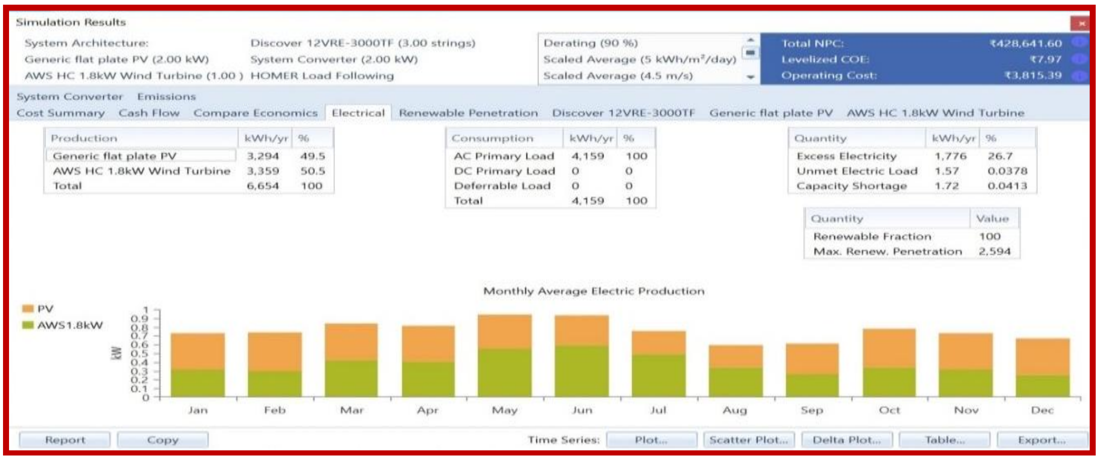

Figure.6. Obtaining the HES electrically

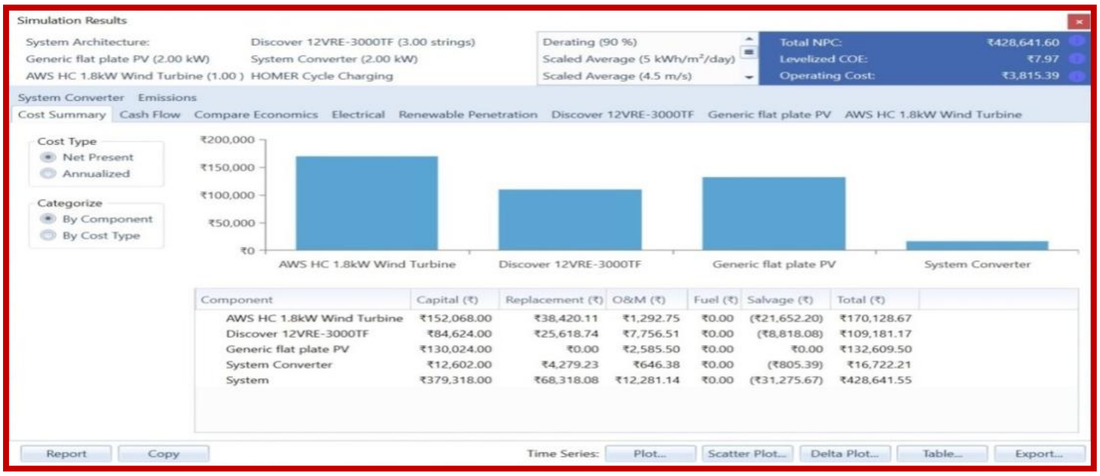

Figure.7. Analysis of the HES's different components' net present costs (NPC).

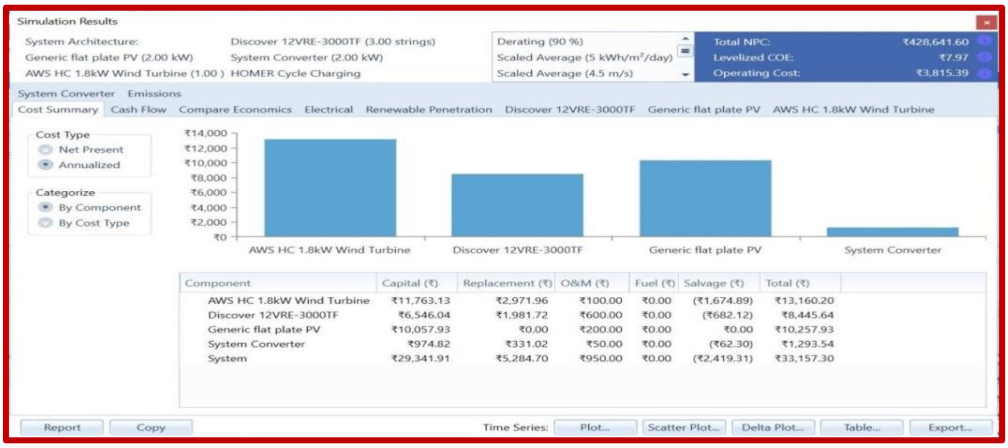

Figure.8. Cost Study Of Several HES Components On An Annualised Basis

IV. Proposed Model In MATLAB

To examine the dynamic performance of the proposed system, all of the major components of the hybrid energy system are simulated in the MATLAB/Simulink (R2018a) environment [23]. A MATLAB/Simulink model was used to run the simulation, as shown in Figure.10. Solar PV and wind turbines are used as sources in the dynamic model. Battery as a backup power source, power distribution management switching module, DC/DC chopper to boost DC voltage level, three-phase bridge inverter with LC filter, and linked AC primary load Solar PV power is generated at a low voltage DC level (48 V), which is then stepped up to a higher voltage level (100 V) using a DC to DC step up chopper. Wind turbines provide AC power, which is converted to DC and then stepped up to a greater voltage using a DC to DC step up (100 V) chopper. A three-phase transformer (230V Line-Line) raises the AC voltage level, and a DC to AC converter delivers AC electrical power to the load requirement.

IV.1.Mathematical Model Of Solar Pv

PV panels are built up of PN junctions, which are thin semiconductor wafers or layers. The output characteristic of a solar cell, i.e. IV, displays exponential properties comparable to a diode during night or in the dark. When exposed to sunlight, photons with a higher energy than the semiconductor's band gap are absorbed, forming electron-hole pairs. Internal electric fields cause these carriers to be swept away in a PN junction, resulting in a current proportional to the incoming radiation. This current is cycled internally by an intrinsic PN junction diode when the circuit is open, and it flows in the external circuit when the circuit is closed. The cells are made of crystalline silica materials the proportionate model of PV cell presented in Figure 9

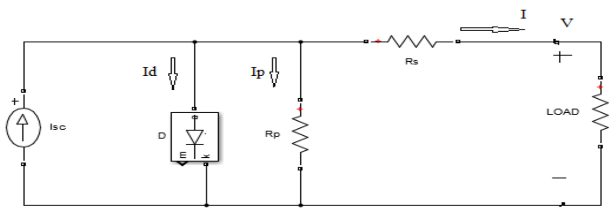

Figure9..Single Photovoltaic Cell Equivalent Circuit Diagram

By using Kirchhoff's current law we can get the load current from equation 1

$$I = Isc - IR\left[e^{\frac{q(I \cdot Rs+V)}{A \cdot K \cdot T}} - 1\right] - \left[\frac{\text{I.RS+V}}{\text{Rp}}\right] \qquad (1)$$

Where

I : output cell current (A)

V : output cell voltage(V)

P : cells power (W)

ISC: short circuit current of the cell (A)

IR : reverse saturation current (A)

q : electron charge C
K : Boltzmann constant (1.38 * 10 ^- 23 J/K)
T : temperature of module (K)
A : diode identity factor (1.3)
The bypass current IP is close to zero and the resistance in parallel R p is Fusion amount the equation 1 for the output current is re written as

$$I = Isc - IR[e^{\frac{q(I \cdot Rs+V)}{A \cdot K \cdot T}} - 1] \quad (2)$$

Single PV cell unit is not enough to extract sufficient power for satisfying for fulfilling the different demands .Many

PV cells are stacked in parallel and series combination to obtain the maximum energy for utilisation. This architecture of cells is called PV module, they have the capability to produce power as per the demand .Let's assume Np is the quantity of cells arranged in parallel while Ns is the cells in series equation(2) is transformed into equation (3)

$$I = N_p \cdot Isc - Np \cdot IR[e^{\frac{q\left(\frac{Np}{N_5} I \cdot Rs+V\right)}{A \cdot K \cdot T \cdot N_5}} - 1] \quad (3)$$

IV.2.Mathematical model Of Wind System

The wind turbine rotor consists of two or three blades mechanically coupled to an electric generator. The power captured by the wind turbine is given by the relation

$$Pw = \frac{1}{z} C_p \cdot \rho \cdot A \cdot v_w^3$$

Where ρ is the air density, which is equal to 1.225 kg/m^3

C_{Pis} the power coefficient, V_W is the wind speed in (m/s) and A is the area swept by the rotor in m^2.The amount of aerodynamic torque T_W in (N-m) is given by the ratio between the power extracted from the wind Pw and turbine rotor speed Wwin (rad /s) as follows

$$Tu = P_{\omega W_{\omega}}$$

IV.3.Modelling In MATLAB / Simulink Of A Wind-Pv Hybrid System

A theoretical preliminary study is required in order to implement a real hybrid system. Simulation models can be used to conduct such research. A simulation model is presented in [24]Fig. 7.

The simulation model is made up of the models shown above that have been linked to produce an isolated hybrid system. The simulation model may be used to conduct research such as:

- renewable energy sources electrical parameters (powers, voltages, currents, and so on); - renewable energy sources constructive parameters (blade length and number of wind turbines, quantity of PV panels);
- control methods for voltage and frequency;
- electrical energy conversion (types of DC/AC conversion);
- consumer modelling and control
- Disturbances in power quality and their analysis.
- The availability of renewable energy sources.

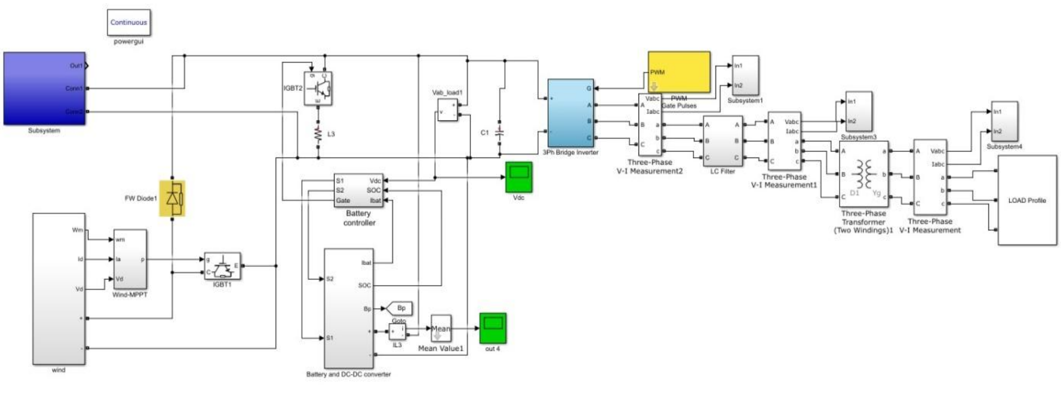

Figure.10.The proposed MATLAB Simulink model of hybrid energy system

The following are some instances of simulation outcomes. Fig . The voltage waveform observed at the AC bus bar is seen in this diagram. Electronic equipment – inverters used for energy conversion in DC/AC module[25]

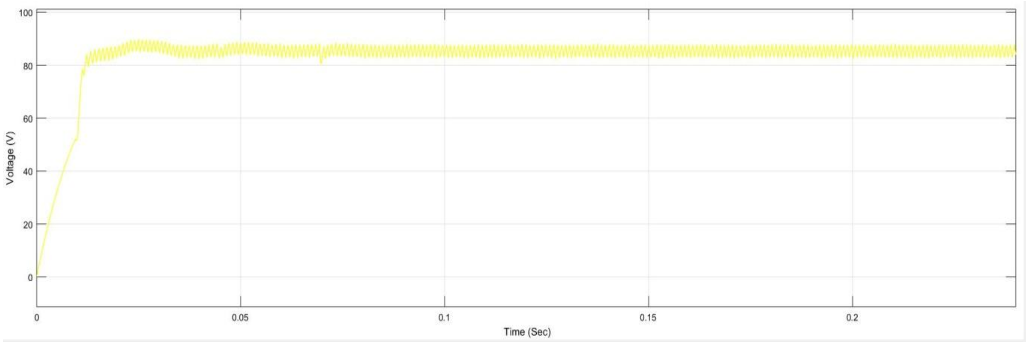

Figure.11.The voltage at the DC to DC boost converter's output

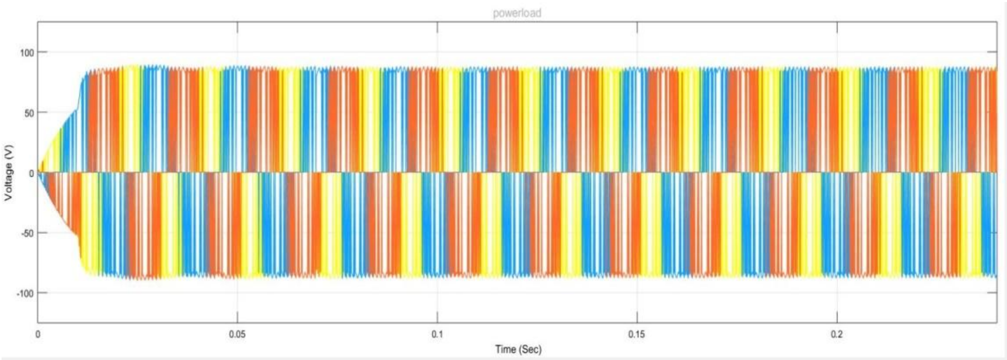

Figure..12.The voltage at the DC to AC converter output

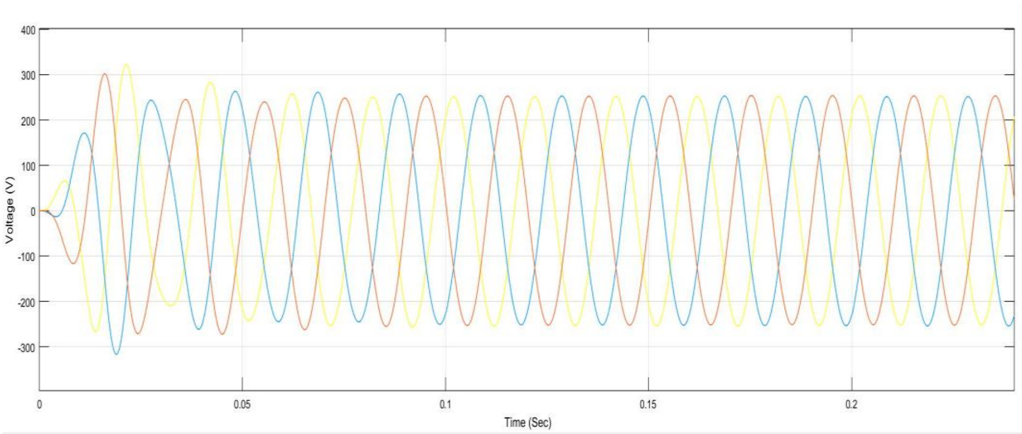

Figure.13.The LC filter with transformer transforms a stepped waveform of 100V AC to a sinusoidal waveform of 230V AC

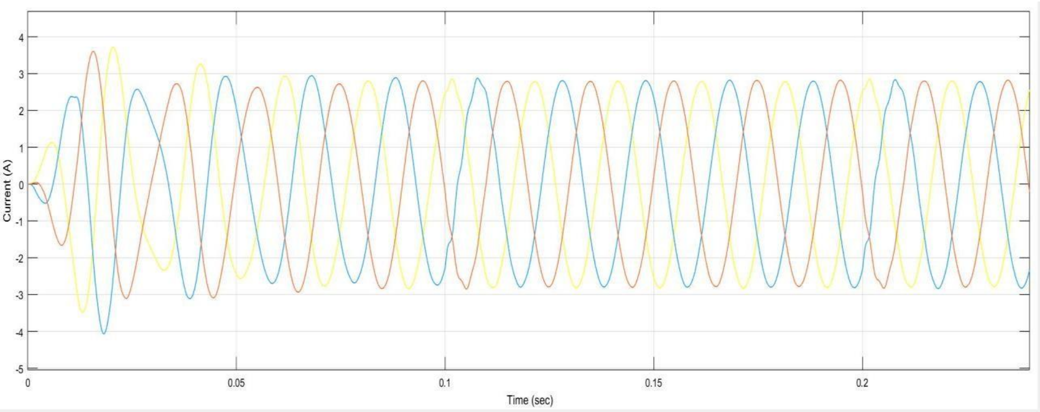

Figure.14.Waveform of the load current

V. The PSO Algorithm

In the study region of MGCGV Chitrakoot, a PSO-based MATLAB method was developed to estimate the cost for optimal size of a PV/ WT/batteries/DG system in order to deliver a specific load. The appropriate values for PSO parameters have been chosen to make the PSO quicker and more precise, as suggested in the literature and in accordance with the nature of the problem under investigation[26].

In order to deliver a specific amount of load for the field research of MGCV Chitracoot a PSO-oriented MATLAB method was developed for the optimal size of a PV/WT/batteries. The proper settings for PSO parameters are defined to enhance the PSO quicker and precise, as specified in the literature and according to the nature of the issue being studied.The population size was set at 10; a total of 100 iterations was specified, c1 and c2 were specified as 2.01, a1 and a2 were specified as 0.6 and 0.9 was specified.

The PSO method is used for the best scenario, the first and last optimization iterations, after initiation of the PSO parameters until the optimal design is shown in the table.

The PSO results were compared with those achieved by HOMER. Table shows the outcomes of the comparison. The findings of the HOMER and BPSO are virtually same, as is seen in this table. There are nonetheless clear variations between the two approaches summarized as follows in the accuracy and the speed of the access:

1. The PSO solution is the one that satisfies all of the optimization constraints and objective function, making it the precise solution. However, while the solution obtained via HOMER meets the optimization constraints and objective functions, it is possible that it is not the best option (global minimum cost). As a result, the lowest cost obtained using the HOMER will not be the optimal answer, but rather the best plausibility among the available options.

2. PSO imposes more particles for each iteration, which speeds up access to the optimal solution; however, HOMER imposes one solution for each iteration based on the experimental method, which may increase the number of iterations before the optimum solution is reached. PSO also has the capacity to handle difficult certifiable issues, as well as great flexibility and the ability to manage nonlinearity, non-differentiable functions, and functions with a large number of parameters. The HOMER is unable to address multi-constraint variant optimization difficulties caused by poorly understood goal functions.

Table.1. PSO and HOMER Results compression

Component	Capital (Rs)		Replacement (Rs)		O&M (Rs)		Fuel (Rs)		Salvage (Rs)		Total (Rs)	
	HOMER	PSO	HOMER	PSO	HOMER	PSO	HOMER	PSO	HOMER	PSO	HOMER	PSO
Wind Turbine	11763.11	11256.24	2971.96	2865.3	100	85	0	0	1674.89	1568.00	13160	12638.54
Solar PV	10057.93	9496.55	0.00	0.00	200	175	0	0	0	0	10257.93	9671.55
Battery	6546.04	6245.65	1.981.72	1885.21	600	540	0	0	682.12	652.45	8445	8018.41
Converter	974.82	800.26	331.02	311.58	50	35	0	0	62.30	55.36	1293.54	1091.48
System	29341.91	27798.7	5284.70	5062.09	950	835	0	0	2419.31	2275.8	33157.30	31491.98

VI. Conclusion

A microgrid is formed by integrating distributed energy sources (solar wind).In comparison to a conventional energy source, an integrated energy system based on a non-conventional energy source is still an expensive source of power at the moment[27]. This research looks at a solar–wind hybrid energy system. The HOMER program runs different simulations to determine the optimum set of hybrid energy system constellations, and the PSO method was used to discover possible hybrid configurations and their applicability. Using the results from the single objective tool HOMER looks to be a quick approach to acquire many objective solutions, avoiding the need to revamp the non-conventional energy assimilation problem and providing actual Pareto front solutions. The programme has a significant flaw in that it believes the system will remain stationary during the research time. Also, sensitivity studies do not give statistical confidence ranges, but rather alternative scenarios or "what if" scenarios.

The PSO is a collection of meta-heuristic approaches classified as swarm intelligence. In this investigation, the algorithms produced a higher-quality output with a quicker convergence profile. PSO and HOMER are applied to the same model for comparison reasons, and the results are tabulated based on the minimum cost and emission point of view.

This paper also describes a hybrid energy system that includes wind and PV In stand-alone mode, wind and PV producing system with a power electronic interface is used. MATLAB/SIMULINK was used to run the computer simulation. A battery system is utilised to keep the source and load in balance. The performance of a hybrid system with 15 m/s wind and 1000 W/m2 solar PV system has been studied. This system is anticipated to satisfy the needs of a rural area's power consumption. The created system's performance is assessed in the MATLAB/SIMULINK environment, and the results are displayed.

References

[1]. J .Douglas ,"Renewables on the Rise," EPRI Journal ,vol.16,no.4,pp.16-25,June 1991.

[2]. R .W. Larson, F Vignola, and R .West ,Eds" Economics of Solar Energy Technologies", Boulder ,Colorado, American Solar Energy Society, December 1992.

[3]. R. Ramakumar, et al," Economic Aspects of Advanced Energy Technologies," Proceedings of the IEEE, Vol .81, no .3,pp.318-332,March 1993.

[4]. R. Ramakumar ,I. Abouzahr, and K .Ashenayi ,"A Knowledge-Based Approach to the Design of Integarted Renewable Energy Systems ",IEEE Trans. On Energy Conv., vol. 7,no. ,pp 648-659,December 1992.

[5]. Md. Nurunnabi, N. K. Roy. "Grid connected hybrid power system design using HOMER", 2015 International Conference on Advances in Electrical Engineering (ICAEE), 2015

[6]. R. Ramakumar, P .S. Shetty and K Ashenayi, "A Linear Programming Approach to the Design of Integrated Renewable Energy Systems for the Developing Countries" IEEE Trans .on Energy Conv.,vol.EC-1,no 4,pp 18-24,December 1986.

[7]. E.S. Gavanidou and A.G. Bakirtzis ,"Design of A Stand Alone System with Renewable Energy Sources," IEEE Trans. On Energy Conv. no. 1,pp. 42-48,March 1992.

[8]. B.S. Borowy and Z.M. Salameh," Optimium Photovoltaic Array Size for a Hybrid Wind RV System," IEEE Trans.On Energy Conv. vol. 9,no. 3,pp.482-488,Seotember 1994.

[9]. R .Yokoyama, K Ito, Y .Yuasa, " Multiobjective Optimal Unit Sizing of Hybrid Power generation System Utilizing Photovoltaic & Wind Energy ,"Journal of Solar Engineering,Vol.116,November 1994,pp.167-173.

[10]. J.Castle ,J. Kallis ,S .Moite, and N. Marshall," Analysis of Merits of Hybrid Wind Photovoltaic Concept for Stand Alone System," Proc. Of the 15th IEEE PV Specialist Conference,pp.738-743,1981.

[11]. B.S. Borowy and Z.M. Salameh,"Methodology for Optimally Sizing the Combination of Battery Bank and PV Array in a Wind PV Hybrid System,"paper No.95 SM 460-6 EC ,Presented at the 1995 IEEE PES Summer Power Meeting,July 23-27,Portland,OR.

[12]. Anand Singh, PrasanthBaredar, Bhupendra Gupta, "Computational Simulation & Optimization of a Solar, Fuel Cell and Bio mass Hybrid Energy System Using Homer Pro Software", Elsevier, International Conference on Computational Heat & Mass Transfer-2015

[13]. U, .SureshKumar, P.S.Manoharan A.P.S Ramalakshmi, "Economic Cost analysis of Hybrid Renewable Energy System Using HOMER ",International Conference on Advances in Engineering Science and Management,pp.94-99,March 30-31,2012

[14]. Goel, S. majidali, „"Feasibility study of hybrid energy systems for remote area electrification in odisha, india by using homer"International Journal of Renewable Energy Research" Vol3, no. 3

[15]. B. Fulzele, SubrotoDutt, "Optimum Planning of Hybrid RenewableEnergy System Using Homer",

[16]. www.ecreee.org/sites/default/files/event-att/02_simulation.pdf

[17]. H. H. El-Tamaly et. al. ,"Design and Control Strategy of Utility Interfaced PV/WTG Hybrid System", The Ninth International Middle East Power System Conference, MEPCON'2003, Minoufiya University, Faculty of Eng., Shebin El-Kom, Vol. 2, Dec. 16-18, 2003, pp. 699-674.

[18]. www.nrel.gov/homer

[19]. Getting Started guide for HOMER Version 33.1;http://www.homerenergy.com..

[20]. H. Rezzouk and A.Mellit ,"Feasibility study and sensitivity analysis of a stand alon photovoltaic-diesel-battery hybrid energy system in the north of Algeria," Renewable and sustainable Energy Reviews,vol 43,pp.1134-1150,2015

[21]. Walid O Amor, H.B. Amar, M. Ghariani, "Energetic and Cost Analysis of Two Conversion Systems Connected to the Grid By Using Homer Pro", International Journal of Renewable Energy Research, Vol. 5, No. 3, 2015.

[22]. B.E.Turkay and A. Y .Telli, "Economic analysis of Standalone and Grid Connected Hybrid Energy System", International Conference On Electrical And Electronics Engineering,pp.1-34-1-39,5-8 Nov-2009

[23]. Gupta, S. C., Y. Kumar, and Agnihotri Gayatri. 2007. "Optimal Sizing of Solar-wind Hybrid System." IET-UK International conference on information and communication technology in electrical sciences (ICTES 2007), M.G.R. University, Chennai, Tamil Nadu, India, December 20–22, 282–287

[24]. CristianDragosDumitru, and Adrian Gligor, "Modelling and simulation of Renewable Hybrid Power system using

MATLAB/SIMULINK Environment.", Scientific Bulletin of the, PetruMaior" vol. 7 (XXIV), No. 2, 2010, ISSN 1841 - 9267 pp.122-125

[25]. F.Valenciaga and P.F. Puleston, "Supervisor Control for a Stand-alone hybrid Generation System using Wind and Photovoltaic Energy" IEEE transactions on energy conversion, vol. 20, No.2, June 2005.pp.197- 207

[26]. L4. Bounbumroong, U., N. Pratinthong, S. Thepa, C. Jivacate, and W. Pridasawas. 2011. "Particle Swarm Optimization forAC-Coupling Stand Alone Hybrid Power Systems." Solar Energy 85: 560–569.

[27]. I nternational Energy agency report, "Key Issues in Developing Renewables", 1997.

Abeer Elsayed, et. al. "12.48 uW low power consumption ultra-wide bandwidth low noise amplifier for ultra wideband wireless communication using diode connected transistor." *IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)*, 16(4), (2021): pp. 01-08.