IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

Volume 12, Issue 5, May 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.317

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|

||Volume 12, Issue 5, May 2023||

|DOI:10.15662/IJAREEIE.2022.1205015 |

Design and Simulation of Solar-Biomass Hybrid System for Electrification of Rural Areas

Surendra[1], Saurabh Gupta[2]

PG Student [Power System], Dept. of EE, Technocrats Institute of Technology & Science, Bhopal, M.P., India[1]

Associate Professor, Dept. of EE, Technocrats Institute of Technology & Science, Bhopal, M.P., India[2]

ABSTRACT:
The Energy is the basic requirements for to do any think. The Indian population are increasing day by day and energy demand are also increasing exponentially but the conventional energy sources are limited and exhaustible, not eco-friendly. Solar energy have been deemed clean, inexhaustible, unlimited and environmental friendly, But solar energy source is dependent on unpredictable factors such as weather and climatic conditions therefore PV solar system used with biomass for continuous energy supply through whole year. The cost of energy generation by PV solar system & biomass is minimum and system eco-friendly. The main objective of this thesis work is to provide the electric power in rural remote areas where transmission line are not installed or power available only for few hours therefore on the basis of survey conducted in village Shihada (MP) for electricity requirement, a stand-alone PV solar system with biomass is proposed.

KEYWORDS: Solar-Biomass, HOMER, Hybrid System, Stand Alone, MATLAB, Simulation

I.INTRODUCTION

.
The Renewable sources are available free of cost, are pollution-free and inexhaustible. Mans are using these sources for many centuries in propelling, driving windmills for grinding corn and ships pumping water, etc. Because of the poor technology then existing, the cost of harnessing energy from these sources was quite high. In this project main concentrate on only solar-biomass hybrid system. This assignment will study the suitable biomass hybrid models with solar Thermal in order to explore the possibility of optimizing fuel usage and making plants more sustainable. Biomass hybrid model may provide the solution to overcome these barriers as two renewable energy resources complementing each other with regard to availability.
The use of fossil fuels and nuclear energy replaced totally the non-conventional methods because of inherent advantages of transportation and certainty of availability; however these have polluted the atmosphere to a great extent. In fact, it is feared that nuclear energy may prove to be quite hazardous in case it is not properly controlled. The limited reserves of fuel oils and their unstable prices have significantly increased the interest in renewable energy sources. The design of hybrid solar-biomass power systems (HSBPS) has received considerable attention in the last decade.

Now day's applications with photovoltaic (PV) energy and biomass energy have been increased significantly due to the rapid growth of power electronics techniques. Generally, PV power and biomass power are complementary since sunny days are usually calm and low PV power is often occurred at cloudy days or at night time. Hence, the PV/Biomass hybrid power system therefore has higher reliability to deliver continuous power than either individual source

II. LITERATURE SURVEY

Literature review has helped to attain the conceptual clarity and to frame my theoretical perspective. . Renewable Global Status Report provides a comprehensive and timely overview of renewable energy and energy policy development worldwide, World renewable energy scenario, Global investment in renewable energy, Global demand for renewable energy, Total renewable power capacity worldwide, New Policies Scenario, Efficient World Scenario, Global warming effect onenvironment etc., annual global support for renewables in New policies Scenarios

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|

||Volume 12, Issue 5, May 2023||

|DOI:10.15662/IJAREEIE.2022.1205015 |

Z. Benhachani, B. Azoui, R. Abdessemed, M. Chabane study the sizing and economic optimization of a stand-alone photovoltaic-wind hybrid system with storage batteries. Two methods are developed. The first method is based on the average annual values in which the size of photovoltaic (PV) and wind generators is determined from the average monthly contribution monthly of each component. In the second method, the determination of the size of these two components of the system is based on the worst month.

Suresh, P. V, K. Suresh

Life cycle cost assessment of solar-wind-biomass hybrid energy system for energy centre, MANIT, Bhopal, in this communication, a study has been carried out to evaluate the life cycle cost of a hybrid renewable systems combining solar, wind, biomass energy sources to meet the demand of energy centre, MANIT, Bhopal.

III. SYSTEM DATA FOR PROPOSED MODEL

The population of study area village Sihada is around 500 peoples and itis located near to Khandwa M.P.), with Latitude 22°43' North, Longitude 75°49' West and time zone GMT+5:30 Indian Time producing an average daily radiation of 5.43 kWh/m^2/d.

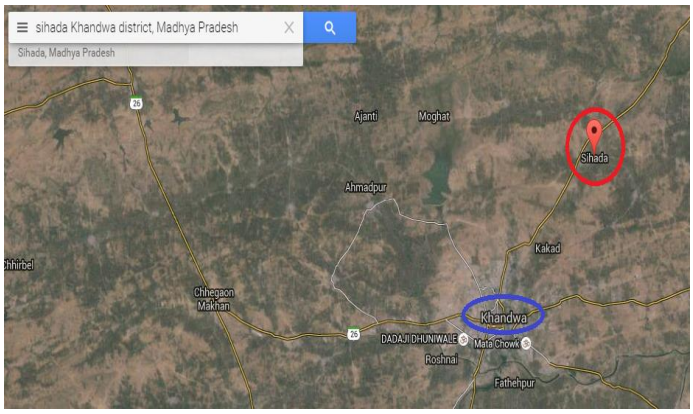


Fig. 1 A Satellite picture of Study area village Sihada (MP) INDIA

The data of electric load calculated on basis of 24 hours requirements and average data of solar collected yearly month wise and these data feed in HOMER software for proposed model.

Table: 1 Electrical Load Calculation

Houses Categery	Load Type	Rated Power (Watts)	Quantity	Hours	Energy Wh/day	Total Energy KWh/day
Small 97 Houses	Light	15	97	5	7275	21.43
	Radio	15	56	4	3360	
	Fan	60	30	6	10800	
Medium 56 Houses	Light	20	56	5	5600	15.35
	Radio	15	35	6	3150	
	Fan	60	10	6	3600	
	TV	200	3	5	3000	
Large 28 Houses	Light	30	28	5	4200	22.67
	Radio	15	19	6	1710	
	Fan	60	28	7	11760	
	TV	200	5	5	5000	
			Total Load (KWH/Day)			60.59

Source: The Electric load data of study area is provided by a survey conducted in village Sihada [37].

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|

||Volume 12, Issue 5, May 2023||

|DOI:10.15662/IJAREEIE.2022.1205015 |

IV.MODERNIZATION OF GRID SYSTEM

Solar-Biomass hybrid model the AC bus bar is connected to biomass generator and DC bus bar is connected to PV panels both bus bars are connected through the converter (AC to DC & DC to AC). The primary electric load 61 kWh/day is connected to AC bus and the load requirement is fulfill by both the systems biomass generator and PV panel the excess electric power is stored in battery backup.

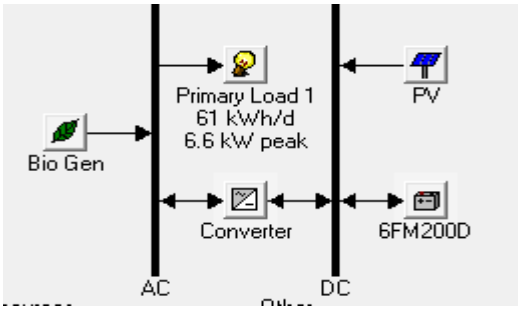


Fig. 2 Solar-Biomass Hybrid Model

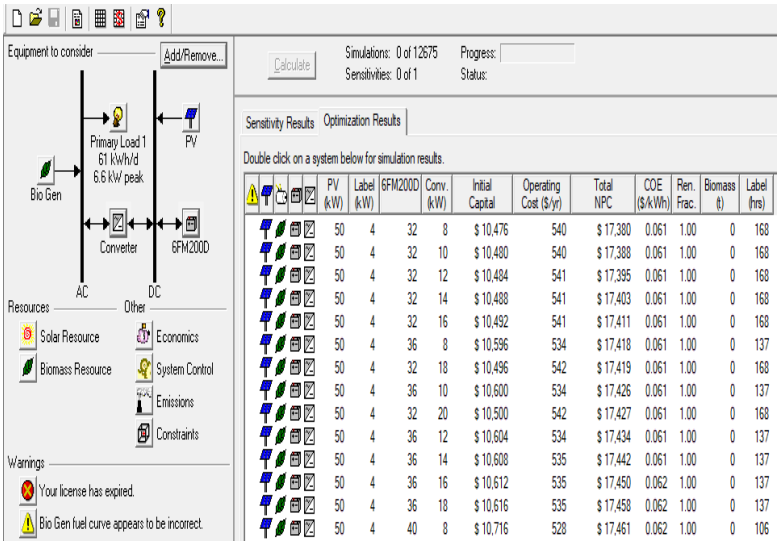
The primary load is ful fill by PV panels and biomass generator operates in backup time as in night and battery backup used when both the system output is low as compare to load requirements.

The designed load for the hybrid system must be higher than the total electrical load of the location because at the time of operation load fluctuations and power losses are occurs in the system.

The designed load for the hybrid system (ED) = 61 kWh/day

V. SIMULATION RESULTS

The proposed solar-biomass hybrid model simulates in HOMER software and generates the number of feasible combination of system with optimized result as shown in fig.3. It is difficult manually to finalize the feasible combination of components, which are actually used in Installation of solar –biomass system. We provide the number of different combinations to HOMER software, on the basis of different combination, HOMER calculate the solar radiation of whole year and other devices prices.



PV (kW)	Label (kW)	6FM200D	Conv. (kW)	Initial Capital	Operating Cost ($/yr)	Total NPC	COE ($/kWh)	Ren. Frac.	Biomass (t)	Label (hrs)
50	4	32	8	$ 10,476	540	$ 17,380	0.061	1.00	0	168
50	4	32	10	$ 10,480	540	$ 17,388	0.061	1.00	0	168
50	4	32	12	$ 10,484	541	$ 17,395	0.061	1.00	0	168
50	4	32	14	$ 10,488	541	$ 17,403	0.061	1.00	0	168
50	4	32	16	$ 10,492	541	$ 17,411	0.061	1.00	0	168
50	4	36	8	$ 10,596	534	$ 17,418	0.061	1.00	0	137
50	4	32	18	$ 10,496	542	$ 17,419	0.061	1.00	0	168
50	4	36	10	$ 10,600	534	$ 17,426	0.061	1.00	0	137
50	4	32	20	$ 10,500	542	$ 17,427	0.061	1.00	0	168
50	4	36	12	$ 10,604	534	$ 17,434	0.061	1.00	0	137
50	4	36	14	$ 10,608	535	$ 17,442	0.061	1.00	0	137
50	4	36	16	$ 10,612	535	$ 17,450	0.062	1.00	0	137
50	4	36	18	$ 10,616	535	$ 17,458	0.062	1.00	0	137
50	4	40	8	$ 10,716	528	$ 17,461	0.062	1.00	0	106

Fig.:3 Simulations results of Solar-Biomass Hybrid System

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|

||Volume 12, Issue 5, May 2023||

|DOI:10.15662/IJAREEIE.2022.1205015 |

The HOMER software use the data feed by us and after simulation, display the number of feasible combination of solar –biomass system and also suggest the optimized combination of system. The data in both hybrid model on-grid and off-grid feed on the basis of month wise collected data. The load demand data vary day to day but these are the traditional based hybrid system so we use month wise data. In this system these data updated time to time using digital GPS based device. In both proposed systems on-grid, we find the scope where data may be updated with real time, so we proposed these systems.

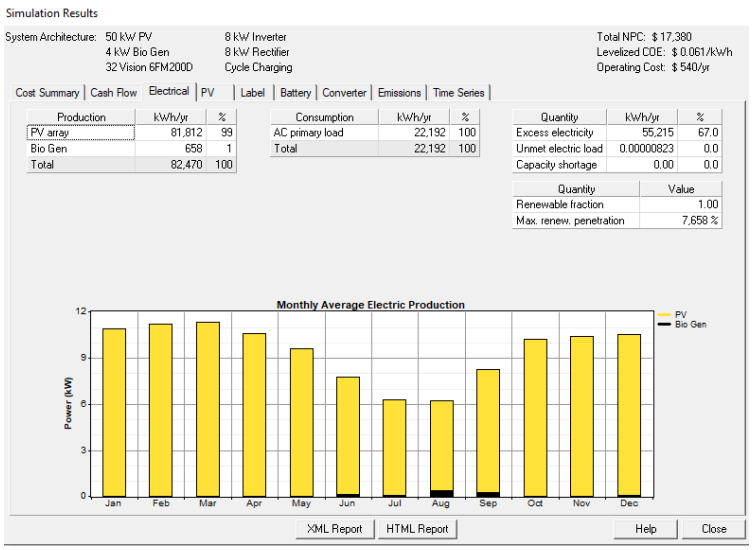


Fig.4 Renewable output power

In solar-biomass hybrid system the number of PV array is used 50 kW, 32 battery bank 16V each and 4 kW biomass generators to fulfill the electric load requirement 61 kWh/d. The total production of power is 82,470 kWh/yr, in which power 81,812 kWh/yr is by PV array & 658 kWh/yr by biomass. 22,192 kWh/yrpower is consumed by electric load and 55215kWh/yr power is excess power in hybrid system this excess power is stored in 32 batteries and in low power production as compare to electric load requirement stored power supply to load. The bar graph show the electricity production by solar and biomass as upper yellow color bar show the solar panels output power and lower color show the biomass generator output.

The Total Electricity Production Solar Biomass = 82,470 kWh/yr , Solar Panel Output (81,812 kWh/yr), Biomass Output (658 kWh/yr), AC Primary Load (22,192 kWh/yr), Excess Electricity (55,215 kWh/yr)
The Cost of Energy = $ 0.061 (Approx. Rs.4.27/Unit)

The Solar-Biomass Hybrid System is best regarding eco-friendly and economical point of view. The raw material easily available as solar energy is free of cost and other biomass material easily available.

VI. CONCLUSION

In India number of villages is un-electrified and some village which are electrified but suffering the power supply or power failure problem due to lack of power generation or transmission line installation problem. In the situation the Solar-Biomass based Hybrid is the best option for electrification of villages which are suffering power problem since independence of India.

The Solar power is available free of cost and Biomass product like wood chips, saw dust, rise husk and wheat husk etc. available in village area in lot of amount. Solar power converted into electric power by solar panel which is eco-friendly and biomass energy converts into electric power by gasifier system which is also eco-friendly system. On the basis of economical point of view Solar-Biomass Hybrid system is also best system the cost of energy is 4.27 rupees per unit in installation year and from next year the cost of energy is reduced from 4.27 rupees per unit.

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 8.317|

||Volume 12, Issue 5, May 2023||

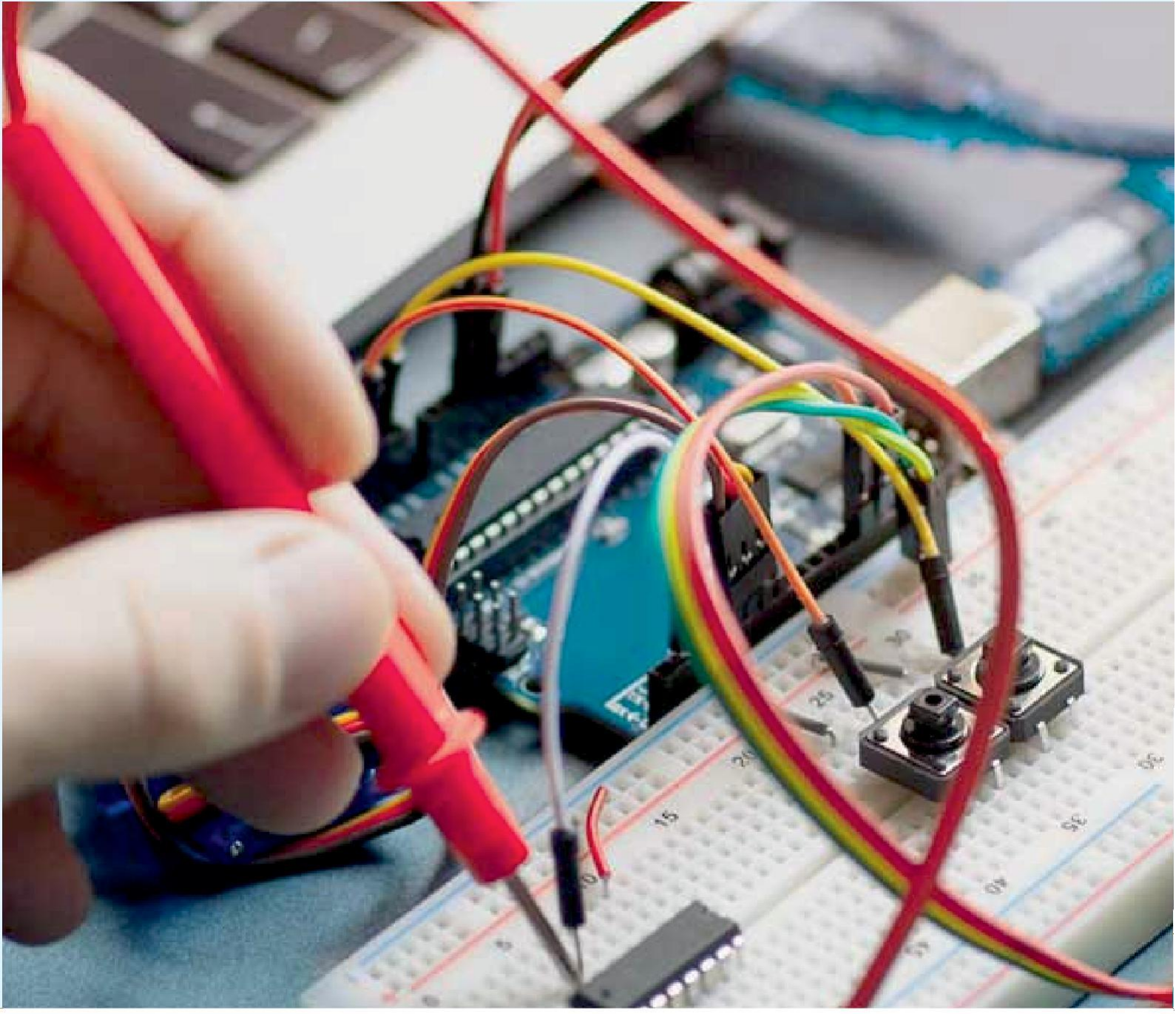
|DOI:10.15662/IJAREEIE.2022.1205015 |

VII. FUTURE SCOPE

In future the solar- biomass hybrid system may be replaced by other source of energy like wind energy for wind-biomass hybrid system or biomass with diesel backup system but not fullyeco friendly system. The solar system may be used updated like Neno-Antenna based Solar system for more output.

REFERENCES

[1] Life cycle cost assessment of solar-wind-biomass hybrid energy system for energy centre,MANIT Bhopal, Suresh, P.V.; Sudhakar, K.GreeComputing , Communication and Conservation of Energy (ICGCE), 2020 International Conference.
[2] A hybrid solar-wind power generation system as an industrial resource for industrial technology students'- By Dr. Recayi Pecen, Dr. MD Salim, & Dr. Marc Timmerman, 2018
[3] Optimal Sizing and Operation Strategy of Hybrid Renewable Energy System Using HOMER-Nurul Arina bte Abdull Razak,Muhammad Murtadha bin Othman, member, IEEE, Ismail Musirin, member, IEEE, 2019
[4] Anil Kumar, Rajesh Mandapati, "Designing and Lifecycle Assessment of SPV System for Conference Hall at Dept. of Energy, MANIT, Bhopal", International Journal of Wind and Renewable Energy, Volume 1 Issue 2, pp 79-83, ISSN: 2277-3975, 2020
[5] Muhamad, M.I, Radzi, M.A.M. ; AbdWahab, N.I. ; Hizam, H. '' Optimal design of hybrid renewable energy system based on solar and biomass'', published in Innovative Smart Grid Technologies - Asia (ISGT Asia), 2019 IEEE
[6] Francois Giraud and Zyiad M. Salameh :Steady-State Performance of a Grid-Connected Rooftop Hybrid Wind–Photovoltaic Power System with Battery Storage.IEEE Transactions on Energy Conversion (Volume: 16, Issue: 1, Mar 2019)
[7] Hiroshi Asano: Influence of photovoltaic power generation on required capacity for load frequency control. IEEE Transactions on Energy Conversion (Volume: 11, Issue: 1, Mar 2018)
[8] J. Bhagwan Reddy and D.N. Reddy :Probabilistic Performance Assessment of a Roof Top Wind, Solar Photo Voltaic Hybrid Energy System IEEE Annual Symposium Reliability and Maintainability,2017 - RAMS
[9] Yann Riffonneau, Seddik Bacha, Franck Barruel, and StephanePloix: Optimal Power Flow Management for Grid Connected PV Systems With Batteries.**Published in:** IEEE Transactions on Sustainable Energy (Volume: 2, Issue: 3, July 2019)
[10] Kalpesh A. Joshi, and N. M. Pindoriya: Impact Investigation of Rooftop Solar PV System: A Case Study in India. **Published in:** 2018 3rd IEEE PES Innovative Smart Grid Technologies Europe(ISGT Europe)
[11] Anchuleeporn Chersin, Weerakorn Ongsakul and JoydeepMitra : Improving of Uncertain PowerGeneration of Rooftop Solar PV Using Battery Storage.**Published in:** 2019International Conferenceand Utility Exhibition on Green Energy for Sustainable Development (ICUE)
[12] K.Muruga Perumal, Dr.Ch Saibabu, GRKD SatyaPrasad : Performance optimization of a Rooftop Hybridized Solar PV-AC Grid assisted power system for peak load management.Publishedin- International Journal of Engineering Research and Applications (IJERA) 2019
[13] Mr.B.Gopinath, A Rooftop Hybridized solar PV-Wind Energy Power System International Journal of Advanced Information Science and Technology (IJAIST-2020)
[14] B. Gopinath: Performance of a 2-KW Grid Connected PV-wind Energy Power System without Battery storage.
[15] Optimal Sizing of Hybrid Wind/Photovoltaic/Battery Considering the Uncertainty of Wind AndPhotovoltaic Power Using Monte Carlo- M. Bashir, J. Sadeh, 2020



INNO SPACE
SJIF Scientific Journal Impact Factor

doi cross ref

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

निस्केयर NISCAIR

Impact Factor: 8.317

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

9940 572 462 6381 907 438 ijareeie@gmail.com