

Modeling of a Hybrid Alternative Renewable Energy Source System

Pragati Rathi¹, Radharaman Shaha²

Research Scholar, Abha Gaikwad Patil College of Engineering, Nagpur, Maharashtra, India¹

HOD(Electrical Engg), Abha Gaikwad Patil College of Engineering,, Nagpur, Maharashtra, India²

ABSTRACT: With respect to stationary power requirements, there are many solutions available such as consumption reduction and overall energy efficient. Demand side management and energy conservation will mitigate the problem, is it likely that more power generation will be required. Nowadays it is effort to use as much as possible renewable (alternative) sources of electricity based on the sun radiation (biomass, hydro, wind or solar power). These plants are environmentally friendly and do not pollute the environment and also overcome form global warming effect, economic and statistical impact on prosperity and dependency. In the hybrid system energy has a higher reliability, can be cost efficient and get better the quality for small town .we design the power system with ecosystem friendly as much as it was in traditional coal power plants. These sources are at present in a large number were connected to the existing distribution network. Due to the increase of these sources in distribution networks is necessary to examine their impact on the overall operation of the network as in normal operation as well as a fault condition. The aim of this paper is to point out of impact location of connection newly built alternative energy sources, especially biomass power plants (BPP) to the size of short-circuit current during fault in the distribution network. Hybrid scheme for power system that aspire to enhance the system efficiency and enhance use of renewable energy based hybrid scheme power system. In order to get continuous load demands during varying conditions, different renewable energy sources need to be incorporated with each other like solar ,wind ,ocean, geothermal ,biomass/biogas Energy, Economy & Environment is the three inter-related areas having direct correlation for development of any nation.

KEYWORDS: Biomass, Hybrid system,, Micro grid, PV array, Wind generator, Renewable energy systems, internal combustion engine

I. INTRODUCTION

Hybrid systems are usually a combination of photovoltaic with wind turbines and/or generators running on diesel or bio fuels/biogas is also used. Power generated by the PV array during the day is stored in the battery bank through an energy manager, which controls the complete system. Diesel generators are expensive to run, and may also require frequent maintenance support. A judicious mix of solar and other renewable technologies, coupled with a diesel generator / grid, can offer a techno-commercially viable solution that will power the backbone of rural connectivity. The resultant hybrid system thus offers an optimal solution at a substantially lower cost. It is ideal for electrification of remote villages in India. Cutting edge technologies based on latest research to integrate dual power sources in the most ideal way.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 5, May 2018

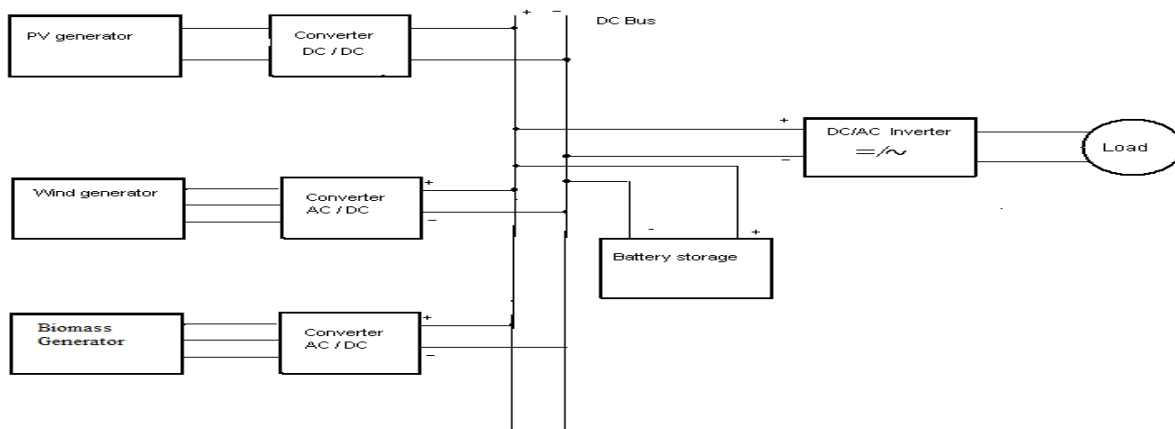


Figure .1. A hybrid PV biomass and wind system

However more than one form of renewable energy to be used, e.g. wind/geo-thermal and solar/biomass/biogas. The photovoltaic power generation serves to reduce the consumption of non renewable fuel.

The solar generation is combining with biogas generation. The output is stored in the battery bank. This energy is drawn by the electrical loads through the inverter, which converts DC power into AC power. The inverter has in-built protection against short-circuit, overheating, low battery voltage and overload. The battery bank is designed to feed the loads up to a certain number of days with no sun or wind/biogas, depending upon the system requirement. The solar panel is the power source of all photovoltaic installation. Photovoltaic (PV) are solid-state, semi-conductor type devices that produce electricity when exposed to light. The word photovoltaic actually means "electricity from light." Many hand-held calculators run off power from room light, which would be one example of this phenomenon. Larger power applications for this technology are also possible. Prime over system is running by I.C. Engines use of biogas in diesel engines. Existing diesel engines can be modified to run on dual fuel while still retaining the ability to use diesel fuel only, Petrol engines: These engines can run on 100% biogas Biogas is a type of gas that is formed by the biological breakdown of organic matter in an oxygen deficient environment. It is counted as an eco-friendly bio-fuel. Biogas contains 60% methane and carbon dioxide. It can be employed for generating electricity and also as automotive fuel. Biogas can be used as a substitute for compressed natural gas (CNG) or liquid petroleum gas (LPG).

The system wind generator starts generating power when wind reaches the cut-in speed of 3m/s and the wind turbine is self-regulated with a patented pitch control mechanism which guarantees a stable energy output during strong winds. It also ensures storm protection and is much lighter than conventional small wind turbines. During very windy periods, the excess energy is dissipated through a dump load, which can be used for heating purposes. Solar complementary system makes use of solar and wind power to generate electricity simultaneously, therefore it can utilize weather resources more effectively. Generating electricity day and night can be realized. In appropriate weather conditions, Wind and Solar complementary system can improve the continuity and stability of generation. As there is always strong wind at night, the product can complement well, it would reduce the system's solar panel deployment and greatly cut the cost. The initial investment and generation cost of system's unit capacity are lower than independent photovoltaic system. Prime over system is running by I.C. Engines use of biogas in diesel engines. Existing diesel engines can be modified to run on dual fuel while still retaining the ability to use diesel fuel only, Petrol engines: These engines can run on 100% biogas Biogas is a type of gas that is formed by the biological breakdown of organic matter in an oxygen deficient environment. It is counted as an eco-friendly bio-fuel. Biogas contains 60% methane and carbon dioxide. It can be employed for generating electricity and also as automotive fuel. Biogas can be used as a substitute for compressed natural gas (CNG) or liquid petroleum gas (LPG).

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 5, May 2018

II. LITERATURE REVIEW

Janani Chakravarthi [1] presented a paper of biogas and energy production biogas can be produced from a number of sources such as municipal waste, corn husk, farmland manure, to name a few. Treating animal waste with the technology of anaerobic digestion can reduce environmental pollution and generate relatively cheap and readily available source of energy in dairy farms. Some advantages of biogas production. Weidong Gu, Chufu Li, Ming Gu [2] in his paper study on the wind/biogas integration system for power generation give the fermentation temperature range and integration system overcomes the difficulties involving low fermentation temperature of biogas production and uncertainty and fluctuation of wind power in the large-scale use of power, by using the innovative technologies. Structure of the wind/biogas integration system to reduce costs of the whole system and the use of innovative technologies are developed and adopted in the proposed wind/biogas integration system for power generation and to reduce costs of the whole system, the use innovative technologies to increase the efficient wind turbine is developed. A. Gupta, R. P. Saini, M. P. Sharma [3] his presented a paper about performance and use of software program developed in C++computer program at hybrid system and presents a wind, photovoltaic, biomass small/micro hydro and diesel generator based hybrid energy system to generate a continuous power irrespective of the intermittent power outputs from the wind and photovoltaic energy sources and hybrid energy systems using developed computer program and flowchart. The optimization results of hybrid energy model for different values and monthly average streamlines flow in study area and daily average biomass availability in study area. Ajai Gupta, R. P. Saini, M. P. Sharma [4] presented a paper about Hybrid Energy System for Remote Area An Action Plan for Cost Effective Power Generation proposes evaluation criteria presents a general methodological outlook for the formulation of an action plan for the small scale hybrid energy system for small village. The specific values chosen and the assumptions made are subject to large variations depending on a variety of local conditions. Modeling a stand-alone hybrid energy system capable of utilizing various resources, for supplying the basic energy needs of small village or areas has been presented and discussed. The section summarizes step by step for planning hybrid energy systems for small village, and gives the details previous work with respect to the design of small-scale hybrid energy systems. Ajai Gupta, R. P. Saini, M. P. Sharma [5] presented a paper about Hybrid Energy System for Remote Area An Action Plan for Cost Effective Power Generation proposes evaluation criteria presents a general methodological outlook for the formulation of an action plan for the small scale hybrid energy system for small village. The specific values chosen and the assumptions made are subject to large variations depending on a variety of local conditions. Modeling a stand-alone hybrid energy system capable of utilizing various resources, for supplying the basic energy needs of small village or areas has been presented and discussed. The section summarizes step by step for planning hybrid energy systems for small village, and gives the details previous work with respect to the design of small-scale hybrid energy systems. Barsoum, N.N. Vacent, P.[11] presented a paper about Balancing Cost, Operation and Performance in Integrated Hydrogen Hybrid Energy System a cost and environmental impact. The paper concern with an investigation of the cost related to hydrogen hybrid system. It was found that under which conditions wind turbines and PV systems could feasibly power electrolyzers to generate and store hydrogen for remote power generation using fuel cells and diesel engines. A system of the combination of different sources has the advantage of the balance and stability. This paper investigates on the modeling of a standalone power system focusing on photovoltaic hydrogen energy systems. Starting from the analysis of the models of the system components. Hooman Dehbonei, Chem v. Nayar, Liuchen Chang [12] This paper presents a new modular hybrid power system incorporating photovoltaic and small scale wind generators connected to an AC bus., with engine-driven generators and battery storage. is widely recognized as a viable alternative to conventional small area power supplies, where the renewable energy source and the battery bank are sized to reduce the run-time of the engine driven generator. These systems provide sufficient storage to allow the load to be shifted, therefore ensuring that the generator is always substantially loaded and classified according to their configuration as series or parallel. Use a very high degree of reliability as compared to single-source systems.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 5, May 2018

III. MODELING OF THE HYBRID PV/WIND /BIOMASS SYSTEM COMPONENTS

Modelisation is an essential step before any phase of optimal sizing For a hybrid PV/wind system with storage battery, as shown in Fig.1, three principal subsystems are included, the PV generator, the wind turbine and the biomasse. A methodology for modelling HPWS components is described below.

2.1 MODELING OF PV GENERATOR

As the operation and the performance of PV generator is interested to its maximum power, the models describing the PV module's maximum power output behaviours are more practical for PV system assessment. In this paper, a mathematical model for estimating the power output of PV modules is used. The estimation is carried out using a computer program which uses a subroutine for determining the power output of a PV module. Using the solar radiation available on the tilted surface, the ambient temperature and the manufacturers data for the PV modules as model inputs, the power output of the PV generator, P_{PV} , can be calculated according to the following equations

$$P_{PV} = \eta_g N A_m G_t \quad (1)$$

Where, η_g is the instantaneous PV generator efficiency, A_m is the area of a single module used in a system (m^2), G_t is the global irradiance incident on the titled plane (W/m^2) and N is the number of modules.

All the energy losses in a PV generator, including connection losses, wiring losses and other losses, are assumed to be zero.

The instantaneous PV generator efficiency is represented by the following equation

$$\eta_g = \eta_r \eta_{pt} [1 - \beta_t (T_c - T_r)] \quad (2)$$

Where η_r is the PV generator reference efficiency, η_{pt} is the efficiency of power tracking equipment which is equal to 1 if a perfect maximum power point tracker is used, T_c is the temperature of PV cell ($^{\circ}C$), T_r is the PV cell reference temperature and β_t is the temperature coefficient of efficiency, ranging from 0.004 to 0.006 per $^{\circ}C$ for silicon cells.

the PV cell temperature can be expressed as follows:

$$T_c = T_a + G_t \left(\frac{\tau \alpha}{U_L} \right) \quad (3)$$

where

T_a , IS THE AMBIENT TEMPERATURE ($^{\circ}C$), U_L IS THE OVERALL HEAT LOSS COEFFICIENT (W/M^2 PER $^{\circ}C$), τ AND α REPRESENT, RESPECTIVELY, THE TRANSMITTANCE AND ABSORPTANCE COEFFICIENTS OF PV CELLS.

The overall heat loss coefficient ($\tau \alpha / U_L$) can be estimated from the nominal operating cell temperature (NOCT) as follows

$$\left(\frac{\tau \alpha}{U_L} \right) = \frac{NOCT - 20}{800} \quad (4)$$

Consequently, the instantaneous PV generator efficiency can be expressed as follows:

$$\eta_g = \eta_r \eta_{pt} \left\{ 1 - \beta_t (T_a - T_r) - \beta_t G_t \left(\frac{NOCT - 20}{800} \right) (1 - \eta_r \eta_{pt}) \right\} \quad (5)$$

η_{pt} , β_t , NOCT, A_m ARE PARAMETERS THAT DEPEND ON THE TYPE OF MODULE, AND GIVEN BY THE MANUFACTURER OF THE MODULES.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 5, May 2018

IV. SIMULATION WITH MATLAB

In order to implement a real hybrid system a theoretical preliminary study is required. Such study can be performed on simulation models. A simulation model is presented in Fig. 2.

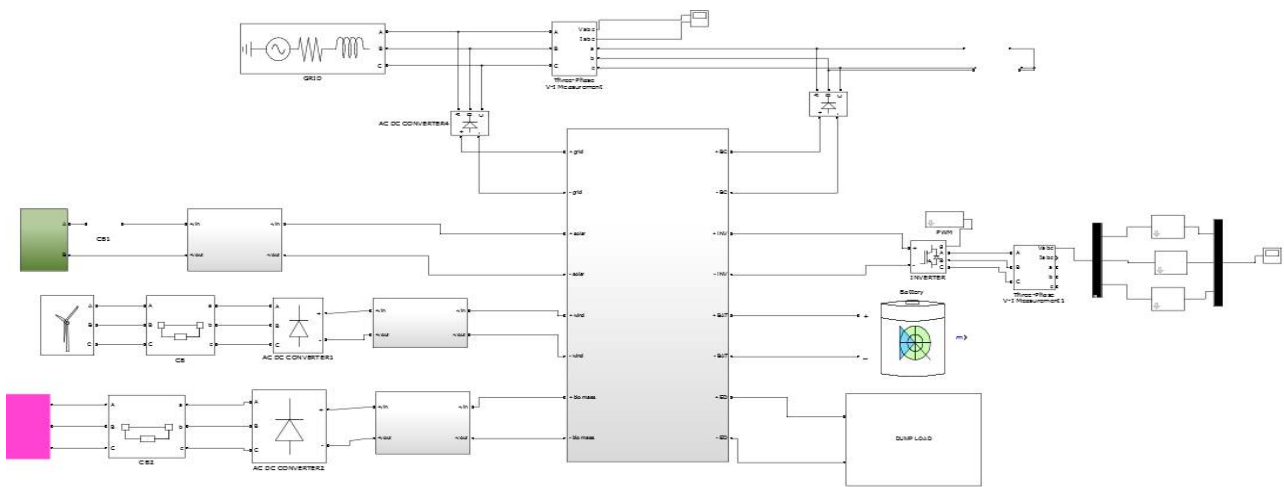


Figure 3. Simulation Diagram of Solar-Wind-Biomass without fault

The simulation model basically consists of the models presented above connected together to form an isolated hybrid system. The proposed model allows studies of modeled DC and AC consumers.

We introduced a fault system in our paper to check whether our system will stable even if fault occur in line

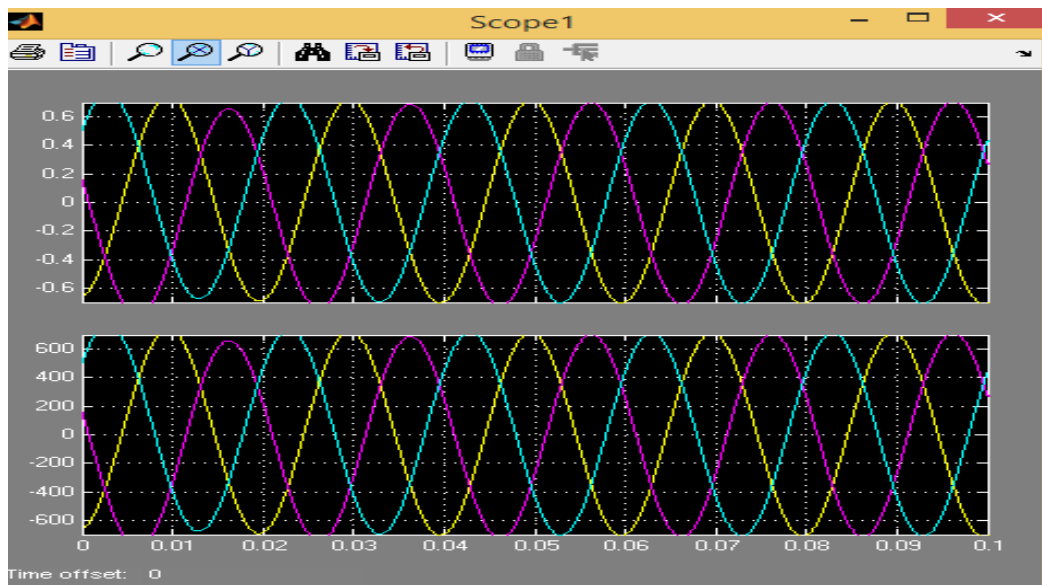


Figure 4. Waveform of Solar-Wind-Biomass voltage and current across grid

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 5, May 2018

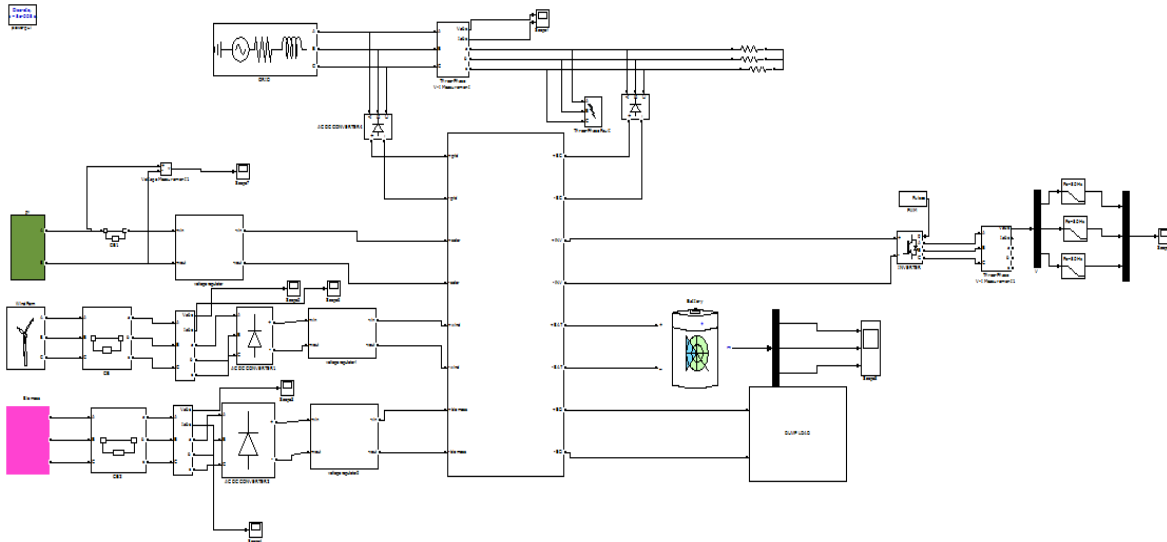


Figure 5. Simulation Diagram of Solar-Wind-Biomass with fault

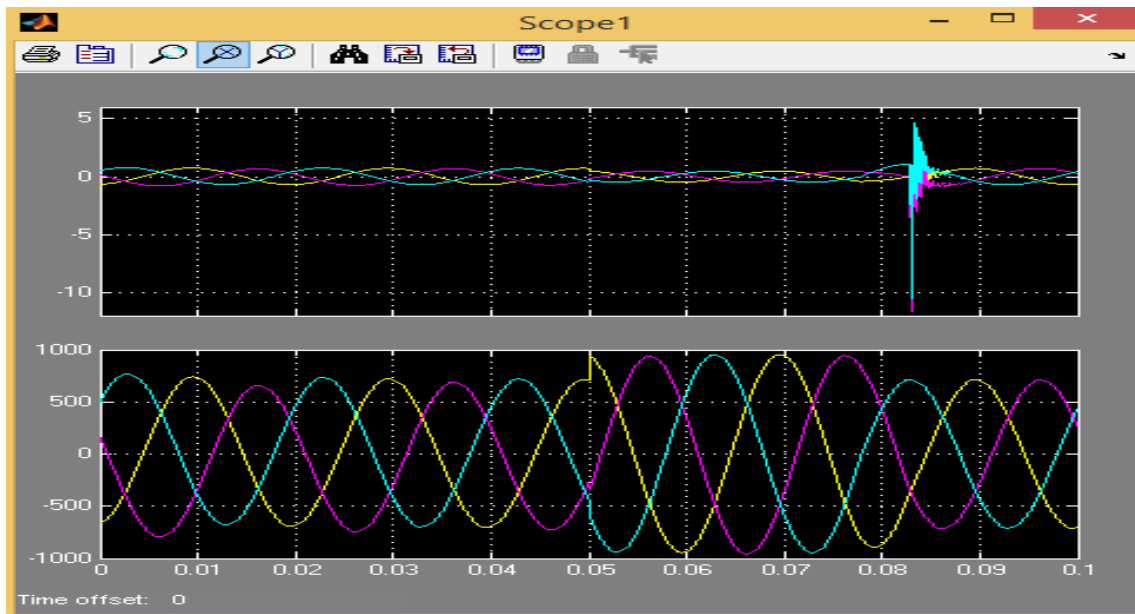


Figure 6. Waveform of Solar-Wind-Biomass voltage and current across grid with fault

V. CONCLUSION

After analysis of waveform we concluded that after applying the fault in our system we get stable output with the help of hybrid system. Expanding biomass energy to a scale capable of impacting the global emissions of greenhouse gases will require improvements in the growth of feedstock as well as the efficiency of conversion pathways. The majority of the losses in

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 5, May 2018

current biomass energy systems are due to the relatively inefficient photosynthesis process, the high energy requirements of plant processes that support the growth and development of plants, and industrial energy inputs during cultivation and processing. Engineering plants to more efficiently produce photosynthetic or microorganisms to directly produce other energy carriers such as hydrogen could relax many of the barriers associated with land, water, and nutrient requirements. Biological conversion processes promise efficiencies higher than thermo chemical conversion, but require research to improve microorganisms and molecular level biological processes. Advances in understanding of genetics and biological conversion processes at the molecular level will allow more control over the efficiency and economics of these pathways. Biomass energy has the potential to make a significant contribution to a carbon constrained energy future, but technological advances will be required to overcome the low energy densities and conversion efficiencies characterizing present and historical utilization

REFERENCES

- [1] Gianni Celli, Emilio Ghiani, Massimo Lodo, Fabrizio Pilo, Simone Pani "Optimal Location of Biogas and Biomass Generation Plants" Universities Power Engineering Conference, UPEC . IEEE 43rd International, pp:1 – 6,2008M. Bertalmio, G. Sapiro, V. Caselles, and C. Ballester, "Image inpainting", in Proc. SIGGRAPH, pp. 417–424, 2000.
- [2] Clint (Jito) Coleman "Hybrid power system operational test results wind/pv/diesel system documentation" IEEE Balancing Cost, Operation and Performance in Integrated Hydrogen Hybrid Energy pp:15.2/1 - 15.2/7 vol.2 1989
- [3] Steven Durand, Andrew Rosenthal "Photovoltaic hybrid system performance comparison" Southwest Technology Development Institute, Las Cruces, NM Mike Thomas, Sandia National Laboratories, Albuquerque,1996 IEEE.1996 82
- [4] Silkyung Kim Changbong Kim Jinsoo Song Gwonjong Yu Youngseok Jung "load sharing operation of 14 kw photovoltaic/wind hybrid power system" IEEE Photovoltaic Specialists Conference, 1997., Conference Record of the Twenty-Sixth E pp:1325 - 1328 ,199
- [5] Vicente Salas and Emilio Olias Miguel Raschn, Manuel Vbquez and Carlos Quiiiones "Hybrid Powering System for Stand-Alone Remote Telecom Applications" Telecommunications Energy Conference, IEEE INTELEC. Twenty-second International pp: 311 - 316 .2000.
- [6]] Barsoum, N.N. Vacent, P. "Balancing Cost, Operation and Performance in Integrated Hydrogen Hybrid Energy System", IEEE The First Asia International Conference on Modelling & Simulation (AMS'07). Page(s):14 – 18, 2007
- [7] Hooman Dehbonei, Chem v. Nayar, Liuchen Chang "A New Modular Hybrid Power System" IEEE Industrial Electronics, ISIE '03. IEEE International Symposium pp:985 - 990 ,vol. 2, 2003.
- [8]] J.T. Bialasiewicz, E. Muljadi, S. Drouilhet, G. Nix "Hybrid Power Systems with Diesel and Wind Turbine Generation", IEEE American Control Conference, Proceedings of the pp:1705 - 1709 vol.3, 1998
- [9] Ajai Gupta, R. P. Saini, and M. P. Sharma "Computerized Modelling of Hybrid Energy System Part I: Problem Formulation and Model Development" IEEE Alternate Hydro Energy Centre, India 5th International Conference, ICECE 2008
- [10] Zhanping You, Shijun You1, Xianli Li, and Changsheng Hao "Biogas Power Plants Waste Heat Utilization Researches, IEEE Power Electronics and Motion Control Conference IPEMC 6th International pp:2478 – 2481, 2009.
- [11] Tao CHEN, Jin Ming YANG "Research on Energy Management for Wind/PV Hybrid Power System" School of Electric Power, IEEE 3rd International Conference on Power Electronics Systems and Applications,2009
- [12] Yuanrui Chen and Jie Wu "Agent-Based Energy Management and Control of a GridConnected Wind/Solar Hybrid Power System" China The research work is supported by the key project of the National Natural Science Foundation of China under Grant No.60534040.IEEE
- [13] S.Hasan Saeed, D.K.Sharma "Non Conventional Energy Resources" Publication kataria and sons [2006-2007]
- [14] Miss.A.Mazumdar "consolidation of information" hand book pilot edition Tata energy Research Institute General information program and UNISIST United Nations Educational Scientists and Cultural Organization.
- [15] http://www.hybridsynergydrive.com/en/petrol_engine.html
- [16] <http://www.ganesh.co.uk/Articles/Biogas%20Technology%20in%20India.htm>
- [17] http://purkrt.net/p/Solar_land_area.png [30] www.tutorvista.com
- [18] <http://www.renewableenergyworld.com>