Simulation of Electric Power Generation from Renewable Hybrid PV Wind Biomass System

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***Abstract*— To 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 .We show that India can be great market for its production. At large scale and hybrid scheme will independently provide a stable power source and everyday gas for small towns. 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, Biodiesel ,wave energy, fuel cell technologies, waste of energy municipal waste/ liquid waste/Industrial waste, small hydro. Thus we have seen that biogas is a promising tool for employment generation energy, self sufficiency and reduction of green house gases and recover global warming effect. Energy, Economy & Environment is the three inter-related areas having direct correlation for development of any nation. Per capita energy consumption is an index for development of any nation so we are tries to increase per capita energy consumption in India with use of renewable energy source.**

***Index Terms*- Biomass, Hybrid system,, Micro grid, PV array, Wind generator, Renewable energy systems**

I. INTRODUCTION

Energy plays a crucial factor in technological and economic development of present society. It has always been the key to man's greatest dream of a better world. Throughout the history of human race, major advances in civilization have been accompanied by increased consumption of energy. There is a positive relation between per capita energy consumption and per capita income. Therefore, adequate supply of energy at a reasonable cost is a key factor in the advancement of a country in almost all sectors. India is a country with numerically dominant rural population, where its village inhabits about 70 percent of its human resources. Hence, the development of country as a whole is intimately related with the rural development [1].

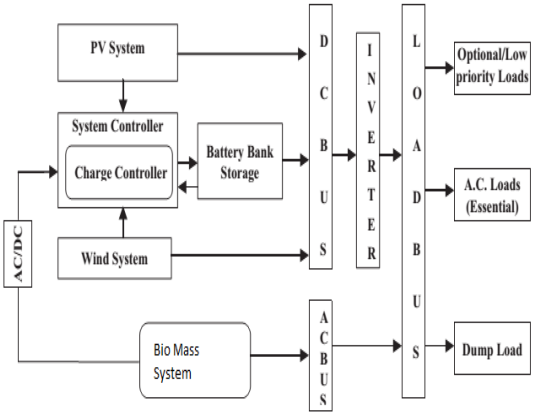
In developing countries like India, it is very difficult as well as uneconomical to transmit power over long distances through transmission lines, to electrify remote and rural areas. The lack of an electrical network in remote areas and prohibitively high connection cost of grid extension and rough topography often leads to exploration of other options. Stand-alone hybrid systems consisting of renewable sources are found promising ways to satisfy the electrification requirements of these areas [2]. The need for energy efficient electric power sources in remote locations is a driving force for research in hybrid energy system [3]. In addition to that, use of renewable help in reducing fossil fuel consumption levels and the consequent effect of carbon dioxide and other green house gases[4]. The hybrid energy systems also provide an effective solution to meet the power demand in case of shortage from the grid supply.

In the present study optimization and modelling of a hybrid energy system to meet the electrical requirements of remote area Standalone systems are intended to operate independent of electric utility. It is not being connected to main grid. Batteries are used in this system belongs to lead acid type. The main useful of this system are it requires lesser maintenance cost and as well as it is healthy as for environmental consideration. These are all pollution free and one can say eco friendly. These are available at free of cost. Fortunately, the problems caused by the variable nature of these resources can be partially

overcome by integrating the two resources in proper combination, using the strengths of one source to overcome the weakness of the other. The hybrid systems that combine solar and wind generating units with battery backup can attenuate their individual fluctuations and reduce energy storage requirements significantly. However, some problems stem from the increased complexity of the system in comparison with single energy systems. More over the low efficiency of this hybrid model is another big disadvantage, on the part of energy production. The above hybrid model use batteries as its storage system, which cannot be discharge beyond 30% from the point of view of life cycle of the batteries. • No electricity will be generated when the wind or the solar is not available. It depends upon the weather as well as geographical locations where the solar and wind is available in abundant. • Strength of wind is not constant because it varies from time to time. This means that wind turbines do not produce the same amount of electricity all the time.• Solar energy is also not constant in the night time or during the sunny days.

II. SYSTEM WORKING

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, 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%nmethane 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).



Figures1. Diagram of a typical PV–wind-Biomass hybrid system

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

III. LITERATURE REVIEW

Yuanrui Chen and Jie Wu Agent-Based Energy Management and Control of a Grid Connected Wind/Solar Hybrid Power System In this paper discus a grid-connected wind/solar hybrid power system is proposed. It contains four subsystems: wind turbine generation, solar photovoltaic (PV), storage batteries and loads. Each of them is connected to the AC bus or DC bus and operation modes, i.e., ready, stand by, run, stop, and are defined. It employs agent-based cooperative control strategy to achieve maximum power point tracking, Loads Subsystem, Agentand Multi-Agent System, Solar Photovoltaic Subsystem, Storage Batteries Subsystem, Energy Management and Control Strategy. Atideh Abbasi, and Zhenhua Jiang Design and Analysis of a Fuel Cell/Gas Turbine Hybrid Power System This paper

describes a fuel cell – gas turbine hybrid power system that aims to increase the system efficiency and decrease the costs by employing the waste heat from the fuel cell stack in the gas turbine. The plant layout of the hybrid system is described, and the dynamic model is presented. The hybrid system is optimized based on particle swarm optimization. The procedure to optimize the hybrid system is presented. The optimization problem is formulated. The proposed method to minimize the cost of the system is described. The implementation of themethod explained. Guangming LI, Yuanrui CHEN, The Realization of Control Subsystem in the Energy Management of Wind/Solar Hybrid Power System, In this paper, the hardware realization of the energy management and control subsystem of a grid-connected wind/solar hybrid power system has been introduced and give mentioned techniques and most existing literature mainly centralize the modeling, control arithmetic and theory about hybrid power system energy management and control. The emphases on its hardware, communication and how to meet its requests and functions and Experiments show that this system is competent for both grid-connected mode and stand-alone mode. Fabio Morea, Giorgio Viciguerra] Life Cycle Cost Evaluation of Off-Grid PV-Wind Hybrid Power Systems. This paper presents a design method based on an expert system for the optimization of hybrid power systems used in telecom applications The main difficulty that arises in optimal hybrid system design is the number of variables, that are intrinsically dependent on one another. This dependency tends to be affective wherever there is the need of evaluating different prices or models of components. Mayank Aggarwal, Vijit Gupta title of the paper Biogas as Future Prospect for Energy Dependency and Rural Prosperity in India: Statistical Analysis and Economic Impact and brief discussion are discussing the prospect of biogas in eradicating various problem in a developing country like India, its impact on environment, society etc The need of the hour is to develop a technology that is cheap and do very little damage to the environment or rather provide a suitable solution to above problems.

IV. METHODOLOGY

A. Modeling of photovoltaic system

The outputs of the PV fully depend on solar radiation. Hourly solar radiation on a fixed inclined surface (I_T) can be evaluated as equation 1.

$$It = I_b R_b + I_d R_d + (I_b + I_d) R_f \quad (1)$$

where I_T = solar radiation on an incident surface; I_b = direct normal and diffuse; I_d = solar radiations; R_b = the tilt factors for the beam; R_d = the tilt factors for the diffuse; and R_r = reflected part of the solar radiations.

PV power output with respect to area is calculated equation 2 by

$$P = I_T A_{pv} \eta_{PV} \quad (2)$$

A_{pv} and η_{PV} system area PV system efficiency respectively, given by equation 3.

$$\eta_{PV} = \eta_M \eta_{PC} [1 - \beta(T_C - T_R)] \quad (3)$$

where ηM = module efficiency; ηPC = power conditioning efficiency; TC = monthly average cell temperature; TR = reference temperature; and β = array efficiency temperature coefficient. In the ideal equivalent circuit of PV cell a current source is connected in parallel with diode connected PV cell with load, voltage, and current equation 4.of cell which is calculated by

$$I_{PV} = I_{PH} - I(e^{\frac{QVpv}{KT}} - 1) \quad (4)$$

where I_{PV} = is the PV current (A); I = the diode reverse saturation current (A); Q = the electron charge = 1.6 * 1019 (C); k = the Boltzman Constant = 1.38 x10-23 (J/K); and T = the cell temperature(K).

B. Modeling of wind energy system

The actual mathematical modeling of wind energy conversion process comprises wind turbine dynamics as well as generator modeling. a three blade, horizontal axis and repair free wind generator is installed for modeling. Power generation through the wind turbine can be calculated by wind power equation. The turbine is characterized by non-dimensional performance as a function of tip the speed quantitative relation. the generated output power and torque by the wind turbine by giving the formula. Equation given below

$$P_T = (C_P \lambda_P A V^3 / 2) \quad (1)$$

$$P_{PV} = \mathrm{I}_{PH} - I(e^{\frac{QVpv}{KT}} - 1) \quad (2)$$

Torque developed by wind turbine equation given as

$$T_T = \frac{P_T}{\omega M} \quad (1)$$

$$\lambda = \frac{\omega R}{V} \quad (2)$$

where P_T = output power; T_T = the torque developed by wind turbine; CP = the power coefficient = the tip speed ratio; ρ = the air density in kg/mg3; A = the frontal area of wind turbine; and V = the wind speed.
Many researchers work on different mathematical modeling for wind energy conversion. has worked on small wind turbine by controlling horizontal furling scheme. This furling scheme is used to control aerodynamic, power extraction through the wind. The system is designed in Matlab/Simulink for evaluating appropriate control approach. Two controllers are designed and simulated. For the first scheme, a controller uses rotor speed and wind speed information and controls the load in order to operate the wind turbine at optimal tip speed ratio.

C. Modeling of Biomass System

The 'Biomass Gasification – Electricity Generation' system is a technology which converts any kind of biomass energy with low heat value (such as waste from agriculture and forest and organic waste) into combustible gas and then feeds this gas to a generator for electricity generation. Discovering the method of biomass gasification for electricity generation can solve both problems of effective use of renewable energy and environmental pollution from organic waste. For this reason, the technology of biomass gasification for electricity generation attracts more and more research as well as applications.
The modeling equation 1. and 2 for the bioreactor is

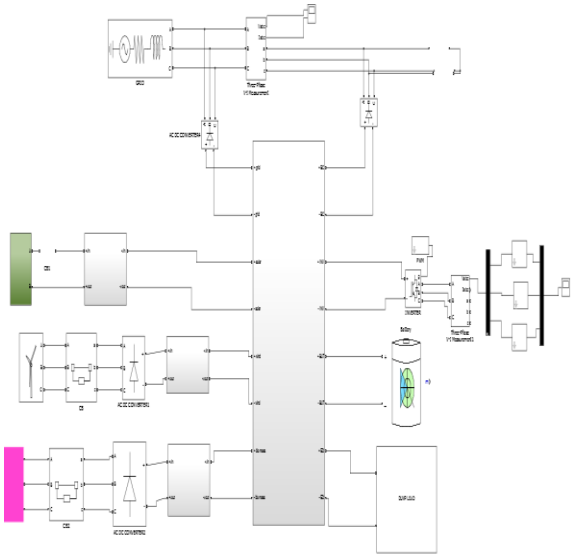
$$\frac{dx1}{dt} = (\mu - D)x_1 \quad (1)$$

$$\frac{dx2}{dt} = D(x_2\, f^{-x_2}) - \frac{\mu X1}{\gamma} \quad (2)$$

where the state variables are x = biomass (cell) concentration = mass of cells/volume, and x = substrate concentration = mass of substrate/volume
The manipulated input is
D = dilution rate = F/V = volumetric flow rate/reactor volume.

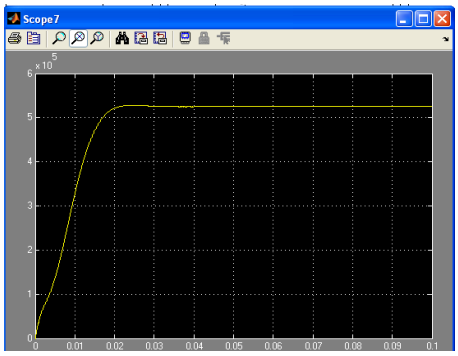
V. SIMULATION WITH MATLAB

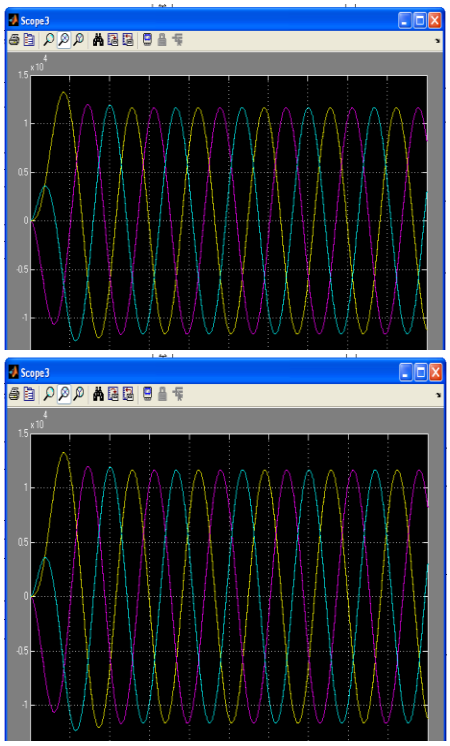
In order to implement a real hybrid system a theoretical preliminary study is required. Such study can be performed on simulation models. A simulation model is presented in Fig. 2.



Figures2. Simulation Diagram PV, Solar, Biomass

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.
Some examples of simulation results are presented below. Fig. 3 illustrates the voltage waveform measured at the AC bus bar. It can be seen a voltage waveform distortion caused by electronic devices — inverters used for energy conversion in DC/AC module.





Figures3. Waveform of PV, Solar, Biomass

VI. CONCLUSION

From the various earlier works that Hybrid system is design of power generation with renewable energy resource. This is alone and unique system produces a sufficient amount of generation which is meet demand of small village and rural areas. Hybrid system is a system which is fully used of over energy resource and gives healthy environment. The advantages of biogas are manifold. Biogas by itself can positively affect the economy of rural areas and give us clean environment.

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