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# "Multi hybrid Renewable Energy Generation Based on Solar PV,Wind and Biogas Plant "- A Review

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***ABSTRACT***

**Hybrid renewable energy generation systems focusing on energy sustainability and its utilization using solar PV, wind and biogas energy sources. A hybrid energy system, consists of two or more renewable energysources used together to generate the power. The hybrid renewable energy sources consistsof different sources, such as Solar PV(photovoltaic), wind, biomass, geothermal and tides, ocean waves etc. which are used to generate power. This electrical power canutilize for various purpose. Environmental friendly power generation technologies will play an important role in future for generation of power. The important challenges in the design and energy utilization of hybrid energy systems .**

***Index Term* —Hybrid energy, Non-conventional Energy, Renewable systems, Utilization, Environment.**

## INTRODUCTION

Multi Hybrid renewable energy systems are becoming popular as stand-alone power systems for providing electricity in remote areas due to advances in renewable energy technologies and subsequent rise in prices of petroleum products. A hybrid energy system, usually consists of two or more renewable energy sources used together to generate the power. Completely renewable hybrid power plant consists of sources such as solar,wind,biomass,hydro,ocean waves and tides etc. A hybrid power plant consisting of these four renewable energy sources can be made into operation by proper utilization of these resources in a completely controlled manner. Review of hybrid renewable energy systems focusing on energy sustainability is reported.[1],[2] Electricity is most needed for our day to day life. Electricity can be generated using either by using conventional energy sources or by non-conventional energy sources. Nonconventional energy sources are solar power, wind, biogas etc. Conventional energy sources are diesel, coal, nuclear and natural gas etc. The main disadvantage of these conventional energy sources is that they pollute the environment. All the conventional energy resources are depleting day by day. So we have to shift from conventional to nonconventional energy resources. In this, the combination of two energy resources is reported i.e. wind and solar energy for generation of electricity. The simulation approach is adopted using Matlab software to observe the different characteristics of hybrid power system with wind energy and hydro power source is reported.[1]-[5]The review of various configurations based on power electronics converters and their control issues in hybrid renewable energy systems have been discussed . There is no electricity available to the remote areas in many countries. Added advantage of hybrid renewable energy systems is that, it is easy to install and use. The important role of hybrid energy and storage systems in the electrification of remote areas have been discussed .

## LITERATURE SURVEY

Municipal solid waste (MSW) disposed in landfill sites decompose under anaerobic conditions and produce gases which contain 30-40% of carbon dioxide ($CO_2$) and 50-60% of methane ($CH_4$). Methane has the potential of causing global warming 25 times more than $CO_2$. Therefore, migration of $CH_4$ gas from landfills to the surrounding environment can potentially affect human life and environment. Thus, this research aims to determine the amount of

electricity generated from bio-wast and determine the economic benefits. It is found that capturing of $CH_4$ emissions between the years 2016 and 2030 and utilizing it in electricity generation could attract revenue of up to US$ 291 million.[1] It is concluded that $CH_4$ emissions from solid waste in Oman is enormously increased with time, and capturing of this gas for energy production could provide a sustainable waste management solution.[4]This paper presents a review of different schemes of hybrid energy systems (HES) in islanding mode for remote areas with a focus on solutions for remote electrification which are basically composed by one or a mixed of different energy sources and storage systems. [2]The paper analysis the widely used mathematical approaches for optimization,sizing and modeling of HES for isolated electrification areas including the role of storagesystem.

$$C_p = \sum_{j=0}^{N_p} a_j \lambda^j = \sum_{j=0}^{N_p} a_j \frac{(\omega_t R)^j}{v_w^j} \quad (1)$$

$$P_{\mathrm{wti}} = \frac{1}{2}\rho A v_{\mathrm{wi}}^3 \sum_{j=0}^{N_p} a_j \frac{(\omega_{\mathrm{ti}} R)^j}{v_{\mathrm{wi}}^j}$$

$$= \frac{1}{2}\rho A \sum_{j=0}^{N_p} a_j R^j v_{\mathrm{wi}}^{3-j} \omega_{\mathrm{ti}}^j = \sum_{j=0}^{N_p} k_{\mathrm{ij}} \omega_{\mathrm{ti}}^j \quad (2)$$

This paper also analysis the advantages and disadvantages of different solutions proposed. Renewable energy resources energy has always been an important factor forsocio-economic development of humans. Most of the energy is generated from fossilfuels in the world.[6] Nevertheless,environmental aspects and depleting of fossil fuels causes increase of renewable energy utilization. The produced energy from renewable energy resources are transferred to grid are used in stand-alone systems.[9]As energy generation depends on environmental conditions, efficiency and energy potential of renewable energy systems changes according to region of installation. [3]In this study, introduction of the solar-wind-battery hybrid system. Solar energy is becoming increasingly popular day by day, so are grid-connected solar power generation systems.[8] This paper proposes a solar power generation system with a seven-level inverter. A DC-DC power converter is used to boost the output voltage of the solar panel, which is controlled using MPPT. The capacitors of the capacitor selection circuit are charged with multiple relationships by the DC-DC power converter. These capacitors serve as input voltage sources for the seven level inverter. The output of the seven level inverter is fed into the utility grid such that the output current is sinusoidal and in phase with grid voltage. The inverter contains only six power electronic switches which is less complex when compared with conventional multi-level inverters.

[4]Design,technical and financial analysis, and optimization of 100 kW grid connected solar photovoltaic system at each division of Bangladesh have been carried out using RET Screen along with NASA's data of location and solar radiation. Slope and azimuth of placing solar panels affect absorption of solar irradiation by the panels and this has considerable impact on the amount of electricity being generated by a solar grid, the technical and financial aspects of the solar grid.[16] Bangladesh is an Asian country having eight divisions. Due to varying geographical locations, the amount of solar radiation being incident on the divisions vary significantly. Thus, placing solar panels at the same slope and azimuth in all the divisions does not allow the panels to absorb maximum amount of solar radiation. This paper discusses about the design of 100kW grid connected solar photovoltaic system, performs technical analysis and demonstrates the optimum slope and azimuth of placing solar panels at different divisions of Bangladesh. This paper also represents financial analysis of the solar grid for all the divisions. The optimized solar grid is capable of reducing approximately 166 tons of carbon dioxide emission annually which is equivalent to eliminating the use of 30.4 cars and light trucks annually.[14],[15]

The paper presents the design, implementation, and evaluation of a fuzzy logic (FL) controller to manipulate an alternating current (AC) synchronous motor's delivered reactive power (VAr), thereby improving the power factor (PF) of an industrial plant. The FL controller mimics the action that would be carried out by a human operator when adjusting the synchronous motor to deliver the necessary VAr to achieve the desired PF value. The controller provides flexibility with its nonlinear gain characteristic and adaptive operation. The FL controller performs adequately under all test conditions.[13].The FL controller was observed to perform successfully under both rapidly and slowly changing load conditions.The FL controller

performance was highly satisfactory in tracking and improving the plant PF to achieve the set point in a reasonable time frame and motivated by the proportional integral derivative (PID) concept. The FL controller in conjunction with a synchronous motor represents an innovative new approach to the problem of PF improvement in industrial plants.[25]

Reactive power to bring the entire system to the optimum operating point is presented. The FL controller performs adequately both rapid and slow changing load condition. The FL controller performance was highly satisfactory in tracking and improving the plant PF to achieve the set point. The FL controller in conjunction with a synchronous motor represents a new practical method to take advantage of Renewable Energy Sources by dynamically monitoring plant eletrical parameters and automatically bringing the system to the optimum operating point, and could some day be implemented in an industrial plant environment that may require PF improvement with a high degree of accuracy.[22],[23].

A power factor correction (PFC) topology with fuzzy logic controller (FLC) for light-emitting diode (LED) lighting applications is presented in this paper. Nowadays, high brightness white LEDs becomes feasible in residential, industrial and commercial applications to replace the incandescent bulbs, halogen bulbs and even compact fluorescent light (CFL) bulbs. Since LED lighting represents a green technology, the issue of power factor is very important. A valley-fill circuit is combined with the single-ended primary inductance converter (SEPIC) to achieve power factor nearer to unity. [10]The fuzzy logic controller is implemented to drive the SEPIC-PFC topology. The performance of the proposed design will be analyzed in terms of power factor using the Matlab/Simulink simulation results.[5]The paper presents a two-stage, single-phase power converter system fed from PV and Wind Turbine energy sources, and a new control methodology for transferring the output power to the grid, leading to reduce harmonics in the grid current, and controlled power factor. The proposed control depends on comparing the total power from the renewable energy sources with the power required to supply the nonlinear load, leading to a controlled distribution of power requirement from the sources.[13] A key outcome of the paper is that excellent power factor and good harmonic reduction is obtained from the perspective of the grid, with no requirement for an intermediate battery due to the inherent ability to provide leading reactive power to the grid when necessary. Simulation and experimental results are used to support the proposed control methodology.

[6]This research is to formulate a paradigm that will use Fuzzy Logic as a tool to control Synchronous motor that will track and correct Power Factor of a plant. in the United States, Power Factor correction is commonly done at the local (equipment) level or through the use of a largecapacitor bank, but this work will address the solution using and appropriately sized ACsynchronous motor to match the plant in question. Many plant use synchronous motors in different areas of operation, hence eliminating the cost of purchasing extra hardware. The synchronous motor will provide a smooth transient and more precise correctional value compared to capacitor bank when correcting the power factor.[7]The feasibility of three renewable sources has been studied. These three sources generate the power in different form such as ACorDCform. This power may not be stable due to environmental conditions, but it's utilization in proper way is done through hybrid charge controller. Energy generated by every individual source is important in hybrid energy systems, and combination of available energy from these sources utilized to drive load in very efficient manner.

## EXISITING PROBLEM

The stability issue. As the power generation from different sources of a hybrid system is comparable, a sudden change in the output power from any of the sources or a sudden change in the load can affect the system stability significantly. Individual sources of the hybrid systems have to be operated at a point that gives the most efficient generation. In fact, this may not be occur due to that the load sharing is often not linked to the capacity or ratings of the sources. Several factors decide load sharing like reliability of the source, economy of use, switching require between the sources, availability of fuel etc. Therefore, it is desired to evaluate the schemes to increase the efficiency to as high level as possible.

## PROPOSED WORK

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The proposed multi- Hybrid energy system is the combination of two or more than two energy sources for giving power to the load. In other word it can defined as "Energy system which is designed to extract power by using two or more energy sources is called as the hybrid energy system." Hybrid energy system has good reliability, efficiency, less emission, and lower cost. Solar and wind are more advantageous than any other non-conventional energy sources. Both the energy sources have greater availability in all areas. It needs lower cost. There is no need to find special location to install this system. The figure 1 shows the block diagram of the hybrid renewable energy system using wind, solar power and biogas plant. This block diagram includes different blocks such as: Solar PV, Wind turbine, Biogas Plant, Hybrid Charge Controller, Battery Bank, Inverter, AC Load, DC Load, etc.

As per the load requirement so that it should fulfill the requirement of load. For calculating the battery bank size, we need to study the two parameters. (a) Find total daily use in watt-hour (Wh). (b) Find total back up time of the battery. a micro gas turbine model of capstone company is established. The relationship between the
generation efficiency $_e$ and the output power

$$Q_{MT} = p_e(1-\eta_e-\eta_l)/\eta_e$$

$$Q_{he} = Q_{MT} \cdot K_{he}$$

$$V_{MT} = (\Sigma p_e \cdot \Delta t_1)/(\eta_e l)$$

Where
$Q_1$ --Gas turbine exhaust waste heat
$Q_{MT}$ --Gas turbine heat loss coefficient

$K_{he}$ --Heat transfer coefficient of bromine cooling unit
$V_{MT}$ --Biogas consumption of gas turbine in the operating time $t_1$ -- Operating time of gas turbine
L--Minimum heating value of purified biogas.

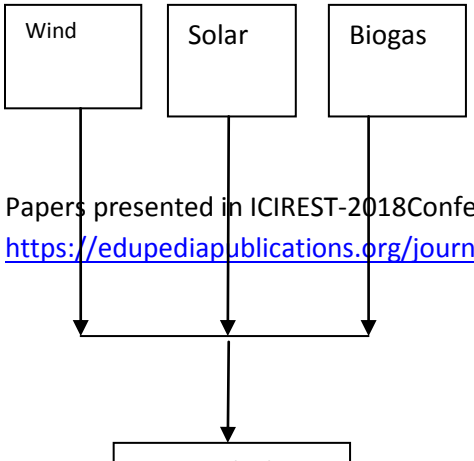


**Figure 1** Block diagram of hybrid renewable energy system

Photovoltaic rated output power is calculated at the rated.

$$P_{pv} = \begin{cases} P_{STC}\dfrac{G_{ING}}{G_{STC}}(1+K(T_C-T_r)), G_{ING} > C \\ 0, G_{ING} < C \end{cases}$$

Where $P_{pv}$--Real-time output power in light intensity
$G_{ING}$ $P_{STC}$--Maximum output power under the rated condition
$G_{STC}$--Standard light intensity
k--Correlation coefficient of temperature and power output
$T_C$--Real-time temperature of photovoltaic cells
--Standard temperature, 25 C--Basic threshold for illumination intensity $T_r$.
The storage battery is applied to optimize the capacity of the energy storage unit. The main purpose of energy storage in the hybrid micro-grid is to shift peak load and emergency supply power under emergency condition.

## CONCLUSIONS

Hybrid renewable energy generation based on Solar PV, Wind and Biogas Plant. Here we have discussed work reported on hybrid renewable energy systems and their associated controls based on the survey of available literature. Because the peak operating times for wind and solar systems occur at different times of the day and year, hybrid systems are more likely to produce power when you need. it. According to many renewable energy experts, a small "hybrid" electric system that combines wind, solar PV (photovoltaic) and biogas technologies offers several advantages over either single system. Added advantage of hybrid system is that they produce clean energy. Thus hybrid energy systems will meet the need of alternate energy sources in most effective, efficient and economical means.

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