

# Hybrid Renewal Energy Systems for Rural Sustainable House Buildings

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**Abstract**—In rural areas currently 2 billion peoples world- wide live without access to electricity .Grid extension is often highly costly and not feasible in isolated rural areas for the house hold uses. So such types of house building can provide centralized electricity generation at the local level using a village distribution network or house wise production and utilization. Such type mini grid project involves complex technical and financial issues. In this paper a critical and feasibility study of mini grid using renewable energy for the rural house building. The combination of renewable energy sources like solar energy ,wind energy and biogas energy selected for a hybrid system pushes for technology choices and there by economic situation of rural areas and also have cost effectiveness for long term, To increase efficiency gains and cost savings, priority given to sizing the system appropriately for the requirement. Solar photovoltaic is suitable for almost any location around the world and is also comparatively easy to install, maintain and scale up but the initial investment costs are higher than other technologies. Small wind power technology is very site specific, place to place variation of the source availability. Careful study is required before installing the wind power system. Biogas plants are very suitable for the rural houses that the biodegradable wastes are plenty. Along with these renewable energy systems storage batteries are integral component of hybrid system. Field studies and exhaustive demand analysis are a basic pre-requisite for the mini-grid for the electricity to the house building.

**Keywords**—Carbon Emissions; Copper Indium Gallium Selenide; Renewal Energy; Sustainable House Building.

**Abbreviations**—Copper Indium Gallium Selenide (CIGS); Ministry of New and Renewable Energy (MNRE); Renewable Energy Systems (REN).

## I. LITERATURE REVIEW

**R**ENEWABLE ENERGY SYSTEMS (REN) are distinguished to various natural renewable energy sources such as sun light, wind, rain, tides and geothermal heat, which are naturally replenished. According to Green piece International about 18% of global electricity generation comes from renewable in2010.The 18% share of renewable in electricity generation is divided into 15% from hydro electricity and new renewable. Nevertheless, the energy revolution scenario demonstrates how by 2020 an impressive32% of global electricity needs can be met by renewable energy [1, 2].

The renewable energy sources are basically wind, hydro, biomass, solar and geothermal energies. In order to generate electricity from these energy sources there must be sufficient resource potential. In order to benefit from the biomass energy sources, forest, animal and organic wastes can be used. Now a days, the solar and wind energy are popular renewable energy sources. The solar and wind energy sources cannot independently carry out the sustainability of energy

because of the seasonal and periodical changes. In order to overcome these constraints, bio gas and the hybrid power systems based on the wind producing elements must be combined with battery storage systems are to be used. There are many studies related to the usage of renewable energy to the production of electricity from these sources. Over the years, renewable energy sector in India has emerged as a significant player in the grid connected power generation capacity. It supports the government agenda of sustainable growth, while, emerging as an integral part of the solution to meet the nation's energy needs and an essential player for energy access. Renewable energy database is updated regularly in the country by the ministry of new renewable energy (MNRE) government of India [3, 4].

Energy is one of the significant parameters playing role in increasing the life standards and determining the socio-economic development level of countries. As convention fossil fuel energy sources decrease and the world's environmental concern about increase in global warming and acid deposition, Renewable energy sources like solar, wind,

biomass, geo-thermal , tidal etc are attracting as alternative energy sources which decreases the CO2 emissions and reaching the sustainable economic developments. They are environmental friendly, clean and abundant in nature, so said to be green energy sources .It is possible to generate electricity from the renewable energy sources which are basically wind, hydro, biomass, solar and geothermal energies. In order to generate electricity from these energy sources there must be sufficient resource potential. In order to benefit from the biomass energy sources, forest, animal and organic wastes can be used [5, 6]. Now a days, the solar and wind energy are popular renewable energy sources. The solar and wind energy sources cannot independently carry out the sustainability of energy because of the seasonal and periodical changes. In order to overcome these constraints, the hybrid power systems based on the wind producing elements must be combined with battery storage systems. There are many studies related to the usage of renewable energy sources and to the production of energy from these sources. Over the years, renewable energy sector in India has emerged as a significant player in the grid connected power generation capacity [7, 8]. It supports the government agenda of sustainable growth, while, emerging as an integral part of the solution to meet the nation’s energy needs and an essential player for energy access. Renewable energy database is updated regularly in the country. The ministry of new and renewable energy (MNRE) updated the literature and statistics of renewable energy [9, 10].

Renewable energy sources and technologies have potential to provide solutions to the long standing energy problems being faced by the developing countries. The renewable energy sources like solar energy, wind energy, biomass energy and geothermal energy can be used to overcome energy shortage in India. Our country is increasingly adopting responsible renewable energy techniques and taking positive steps towards carbon emissions, cleaning the air and ensuring a more sustainable future. Production and application of a variety of renewable energy technologies for use in different sectors .In this paper, an effort have been made to summarized the application of renewable energy for rural house buildings [11, 12].

Future House Buildings in Isolated Rural environments would enhance the quality of life using less energy. Production of the required Green energy on site with renewable sources for the improvement of house building functions by design and energy simulation methods. Renewable energy accounted for 18.37% of the total installed power capacity [13, 14].

Solar energy, Wind energy and Biogas energy including house waste is generally very suitable for the purpose and is abundantly available in southern states of India. The design process of such types of buildings with effective energy simulation methods is very suitable and cost effective for rural small type residential building of 100 square meter area [15, 16].

Table 1: Total Renewable Energy Statistics for the Past Years by IRENA

Capacity (MW)	2011	2012	2013	2014	2015	2016	2017
<b>World</b>	1329388	1441958	1563498	1692498	1845621	2007256	2181577
<b>India</b>	58127	60545	63584	71897	78604	90416	105266
Production(GWh)							
<b>World</b>	4402402	4755833	5041315	5330716	5526664	5897647	6190948
<b>India</b>	157261	176256	176101	199665	197430	190071	209181

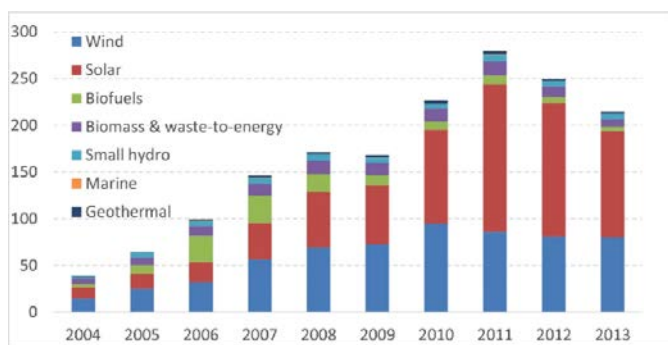


Figure 1: Total Renewable Energy Statistics for the Past Years by IRENA

## II. FEASIBILITY STUDY

With the help of rural architects and builders who had worked in the field for the past years, carryout the design process and also identifying the availability of team work, needfulness of the targeted people, site selection, estimates of energy utilization and the availability of solar, wind and biogas

collectors and other devices Implementing renewable energy utilization planning Action research, analytical and parametric studies are to be used to examine how decisions in the isolated rural housing planning process focuses on the possibilities and feasibilities for the proper solar assessment of new building requires the use of advanced new building technology, photo voltaic cells, energy efficient windows and solar shading devices that requires the use of advanced simulation tools in three cases: analysis of flat roofs, the development of new facade assessment tool and analysis of building blocks [17]. Financial consequences of varying row distances and inclination angles of solar system on flat roof. Detailed description of the process map is to be reviewed in the next stage [18].

Solar energy is the most abundant permanent energy resource on earth. solar energy experienced by us as heat and light can be used through two routes i.e, the thermal route uses for water heating, cooking, drying, water purification, power generation and other route the photo voltaic converts the light in solar energy in to electricity, which can be used for a number of purposes such as lighting, pumping,

communications and power supply in un electrified areas. Solar energy can be classified as two types [19],

1. Passive solar and
2. Active solar

Passive solar energy is making direct and indirect use of thermal energies from the sun, a southern exposure of a building guarantees the maximum exposure of sun’s rays. Special metal leaf covering over windows and roofs can block out the sun during the summer months.

Active solar energy is the use of sun’s electromagnetic radiation in generating electrical energy generally semi-conductor silicon boron solar chips are used Photovoltaic are best known as a method for generating electric power by using solar cells to convert energy from sun into a flow of electrons by photovoltaic effect. Solar cells produce direct current electricity from sunlight which can be used to power equipment or to recharge a battery. Recently available innovative PV technologies arMono crystalline silicon

Poly crystalline silicon, Amorphous silicon, Cadmium Telluride (CdTe), Polymer and organic PV And Copper Indium Gallium Selenide (CIGS).

There are two types of system configuration for solar photovoltaic namely Grid tied and Stand Alone photovoltaic system. Grid tied solar photo voltaic system is similar to any power generating plant which is connected to the grid for transmitting power. Off- grid or stand-alone photo voltaic system includes the storage of power that is generated when the demand is less than what is generated [20].

Wind is a widely distributed energy resource. Worldwide available capacity of around 75000MW, Wind energy is being developed in the industrialised world for environmental reasons. In India wind power potential is estimated as 20000MWand ranks fourth in the world. The availability of wind varies for different regions. It can be exploited the areas where wind power density at least 400W/m2 at 30 m above the ground.

Wind turbine hubs are normally mounted approximately above 10m height above the ground by obtaining the wind frequency data including wind velocity and direction measured. The average power generated by a function of its radius and the average wind speed as given by the equation.

$$P = 2.4\pi R^2c^3$$

Where R is the turbine blade radius and c is the wind speed, this equation can introduce significant errors if the wind speed is not correctly estimated due to the cubic relation of power with speed

Biomass as an energy source represents 16% of world wide energy consumption approximately. The energy is available from agriculture, biodegradable waste. When the chemical bonding of carbon, hydrogen and oxygen are broken by digestion, combustion or decomposition release stored energy Biogas is the mixture of gases produced by the breakdown of organic matter in the absence of oxygen. Biogas is produced by anaerobic digestion with methanogen or anaerobic organisms, which digest material inside a closed system, or fermentation of biodegradable materials.

A wide range of biomasses available in house hold itself food wastes manure, deep litter, vegetable waste, organic wastes etc for the production of biogas. There are several methods available to convert biogas into electricity. Biogas may be immediately used to heat the water and produce pressurised steam. This high pressure steam will then be used to power the turbine generator which will subsequently produce electricity, such as normal conventional power plant system.

Table 2: New and Renewable Sources in India

S. No.	Sources	Potential (MW)	Achievement (MW)
1.	Solar panel	20mw/km <sup>2</sup>	2mw/km <sup>2</sup>
2.	Wind	45000	20000
3.	Biomass	19500	7500
4.	Waste	1700	500

The combined system of these energy sources aims for the entire power requirement of the house including hot water supply, electricity, and cooking.

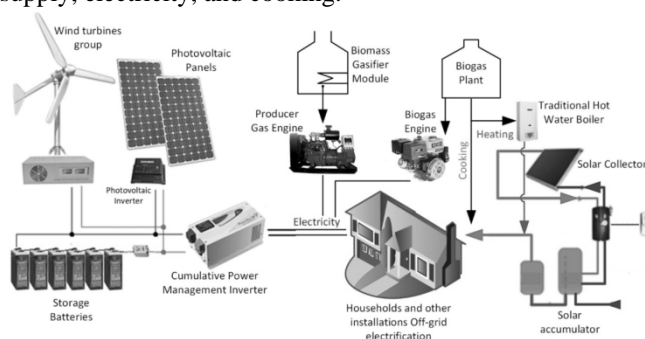


Figure 2: Combined System of the Energy Sources

### III. CONCLUSION

Renewable energy sources and technologies have potential to provide solutions to the long standing energy problems being faced by the developing countries. The renewable energy sources like solar energy, wind energy, biomass energy and geothermal energy can be used to overcome energy shortage in India. Our country is increasingly adopting responsible renewable energy techniques and taking positive steps towards carbon emissions, cleaning the air and ensuring a more sustainable future. Production and application of a variety of renewable energy technologies for use in different sectors .In this paper, an effort have been made to summarized the application of renewable energy for rural house buildings.

### REFERENCES

- [1] International Statistics Journal of Renewable Energy by IRENA.
- [2] Ministry of New and Renewable Energy (MNRE) Govt of India Publications
- [3] D. Elango, “Renewable Energy Sources”, Chennai.
- [4] A. Biswas, D. Bhanja & S. Gangwar (2015), “Cost, Reliability, and Sensitivity of a Standalone Hybrid Renewable Energy System”, *Crossmark*. 013109

- [5] “Wind Power for Remote Homes”, Bergey Wind Power. <http://bergey.com/wind-school/90-second-expert/wind-power-for-remote-homes>.
- [6] Thilo Bocklisch, “Hybrid Energy Storage Systems for Renewable Energy Applications”, 9th International Renewable Energy Storage Conference, IRES (2015) Hybrid Energy Storage Systems for Renewable Energy, ScienceDirect.
- [7] “National Agency for the Development of Renewable Energy and Energy Efficiency” (ADEREE) in association with the “GIZ” (Deutsche Gesellschaft für Internationale Zusammenarbeit)
- [8] Abdedaim Lahmouri (1989), “L'eau Souterraine: Une Ressource Vitale Pour L'alimentation En Eau Potable Du Monde Rural 2”, Pp: 103-109.
- [9] Water Manual for Refugee Situations UNHCR; (1992) Pp: 160.
- [10] American Wind Energy Association. “Wind Power Your Home” *Wind Energy Foundation*. <http://windenergyfoundation.org/wind-at-work/wind-consumers/wind-power-your-home/>.
- [11] Megan E. Phelps (2013), “Home Wind Power: Yes, in My Backyard!” *Mother Earth News*. May (2013). <http://www.motherearthnews.com/renewable-energy/wind-power/home-wind-power-zm0z13amzrob.aspx>.
- [12] “Residential Wind Energy Systems - Bergey Wind Power Bergey Wind Power” Bergey Wind Power. <http://bergey.com/wind-school/residential-wind-energy-systems>.
- [13] “One Wind Energy Plan” Climate Investment Funds. (2015). <https://www-cif.climateinvestmentfunds.org/projects/one-wind-energy-plan>.
- [14] P. Fragiacomio (2016), “Thermoelectric Characterization of an Intermediate Temperature Solid Oxide Fuel Cell System Directly Fed by Dry Biogas”, *Energy Conversion and Management*, No: 127, Pp: 90–102.
- [15] Z. Duan, M.N.C. Bournazou & C. Kravaris (2017), “Dynamic Model Reduction for Two-Stage Anaerobic Digestion Processes”, *Chemical Engineering Journal*, Pp. 1–49.
- [16] A. Galvagno, V. Chiodo, F. Urbani & F. Freni (2013), “Biogas as Hydrogen Source for Fuel Cell Applications”, *International Journal of Hydrogen Energy*, Vol. 38, Pp. 3913–20.
- [17] P.J. Cook (2017), “CCS Research Development and Deployment in a Clean Energy Future: Lessons from Australia over the past two decades”, *Engineering*, No: 3, Pp. 477–484.
- [18] F.C. Dalmo, N. Simao, S. Nebra & P.D.M. Santana (2019), “Energy Recovery from Municipal Solid Waste of Intermunicipal Public Consortia Identified in São Paulo State”, *Waste Manag. Res.*, No: 37, Pp. 301–310.
- [19] R. Red Corn, S. Fatemi & A.S. Engelberth (2018), “Comparing End-Use Potential for Industrial Food-Waste Sources”, *Engineering*, No. 4, Pp. 371–380.
- [20] A. Biswas, D. Bhanja & S. Gangwar (2015), “Cost, Reliability, and Sensitivity of a Standalone Hybrid Renewable Energy System”, *CrossMark*. 013109.