

# A Design & Analysis of Hybrid Energy System

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**Abstract:** Energy is an important factor for a country for its socio-economic development. The renewable energy sources are solar, wind, ocean, thermal, geothermal and biomass energy. These are inexhaustible, environmental friendly and they help to reduce the usage of fossil fuels. The maximum daily solar radiation in chitradurga is 5.61kWh/m<sup>2</sup>/day. Installation of PV power systems makes it possible for the best use of available solar energy. The characteristics of PV systems are determined by using MATLAB software. The maximum wind speed in chitradurga is 9.7 m/s. Installation of hybrid systems makes it possible for the best use of available wind and solar energy thereby meeting the load demand and reducing the cost of electricity. Hence design of wind turbine and photovoltaic system using HOMER software as a design optimization tool and the results obtained are found to meet the calculated values.

**Key words-** Energy demand, energy potential of renewable sources, wind turbines, solar panels, hybrid system energy.

## 1. INTRODUCTION

Energy is an important commodity for a country for its socio-economic development. Main energy source on earth is the fossil fuels. However the usage of fossil fuels causes global warming whose negative impacts have recently been felt by all over the world. Also because it is limited on earth, increased energy demand and high energy prices increased the usage of renewable energy sources, as it does not cause greenhouse effect in contrary to the fossil fuels. The renewable energy sources are solar, wind, ocean thermal, geothermal and biomass energy. These are inexhaustible, environmental friendly and they help to reduce the usage of fossil fuels. Solar energy can be a major source of power. Its potential is 178 billion MW which is about 20,000 times the world's demand. Sun's energy can be utilized as thermal and photovoltaic. The energy radiated by the sun received by the earth on a bright sunny day is approximately 1kW/m<sup>2</sup>.

Around two billion people world-wide do not have access to electricity services, of which the main share in rural areas in developing countries. The fact that rural electricity supply has been regarded as essential for economic development. It is nowadays a main focus in international development cooperation. A renewable energy sources is a favorable alternative for rural energy supply. In order to handle their fluctuating nature, however, hybrid systems can be applied. These systems use different energy generators in combination, by this maintaining a stable energy supply in times of shortage of one the energy resources. Main hope attributed to these systems is their good potential for economic development.

## 2. SOLAR CELL OPERATING PRINCIPLE

Solar cells are the basic components of photovoltaic panels. Most are made from silicon even though other materials are also used. Solar cells take advantage of the photoelectric

effect: the ability of some semiconductors to convert electromagnetic radiation directly into electrical current. A solar cell is basically a p-n junction which is made from two different layers of silicon doped with a small quantity of impurity atoms: in the case of n layer, atoms with one more valence electron, called donors, and in the case of p-layer, with one less valence electron, known as acceptors. When the two layers are joined together, near the interface the free electron of the n-layer are diffused in the p-side, leaving behind an area positively charged by the donors. Similarly, the free holes in the p-layer are diffused in the n-layer, leaving behind a region negatively charged by the acceptors. This creates an electrical field between the two sides that is a potential barrier to further flow. As shown in fig.1

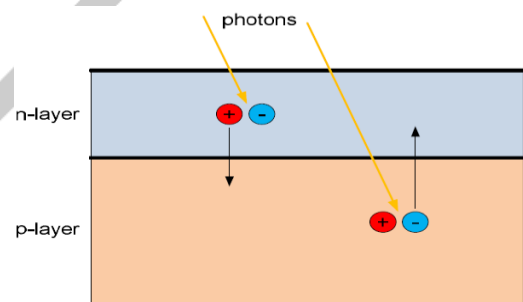


Fig. 1: electrical field

### 3. PHOTOVOLTAIC SYSTEM GENERATING ELECTRICITY

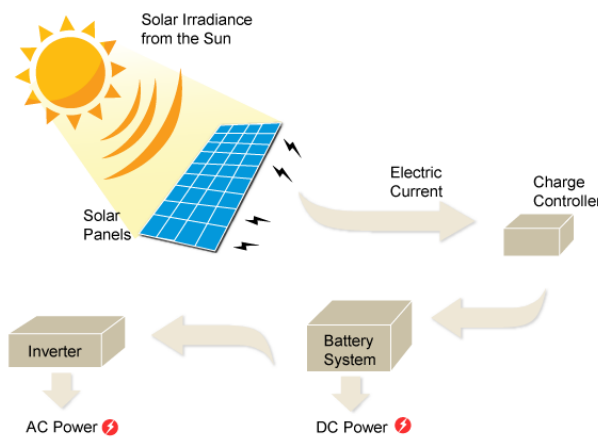


Fig.2 electricity generation through PV

A basic photovoltaic system electricity generation is shown in Fig.2. It permits solar generated electrical power to be delivered to a local load. It consists of:

- Solar Panels, large or small, which converts the insolation to useful DC electrical power.
- A charge controller, which lets the solar panel generated power flow only towards the battery system. Without the charge controller the battery would discharge back through the solar panels during times of no insolation.
- Battery storage, in which the solar generated electric energy may be stored
- Inverter/converter, usually solid state which converts the battery bus voltage to AC of frequency and phase to match that needed to integrate with the utility. Thus it is typically a DC-AC inverter.

### 4. HOW THE WIND MACHINE WORKS

Like the old fashioned windmills, today's wind machines use blades to collect the wind kinetic energy. Windmills work because they slow down the speed of the wind. The wind flows over the airfoil shaped blades causing lift, like the effect on plane wings, making them turn. The cutting edges are associated with a drive shaft that turns an electric generator to create power. With the new twist machines, there is still the issue of what to do when the wind isn't blowing. At those times, different sorts of force plants must be utilized to make power. At the point when wind strikes an article, it applies a power trying to move it off the beaten path some of wind's vitality is exchanged to the item, for this situation the windmill, making it move.

A wind turbine, which is introduced on a top of a tall tower, gathers dynamic vitality from the wind and changes over it to power that, is perfect with a home's electrical framework.

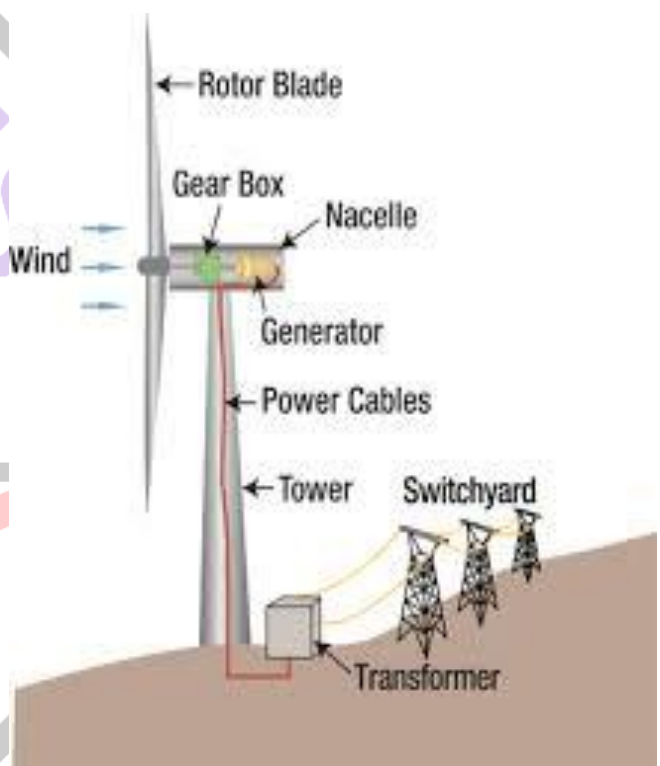
In an ordinary private application, a house is served all the while by the wind turbine and a neighborhood utility. In the event that the winds rates are beneath cut in pace i.e., 7-10mph there will be no yield from the turbine and the

greater part of the required force is acquired from the utility. As wind pace expand turbine yield increments and the measure of force obtained from the utility is proportionately diminished. At the point when the turbine creates more power than the house needs, the additional power is sold to the utility. Every one of this is done consequently. There are no batteries in a present day private wind framework. Little twist frameworks for remote applications work to some degree in an unexpected way.

Fig 3: wind turbine machine working

### 5. DESIGN OF HYBRID ENERGY SYSTEM FOR SITE A BY USING HOMER SOFTWARE

**HOMER:** The HOMER energy modeling software is a powerful tool for designing and analyzing hybrid power systems, which can a mix of generators, wind turbines, solar



photovoltaic, hydro power, batteries, fuel cells, biomass & other inputs. HOMER helps to determine how variable resources such as wind & solar can be optimally integrated into hybrid systems. HOMER is computer model that

Month (2014-2015)	Generation in kWh	Wind speed in m/s	CF in %
March-14	58477	5.30	13.00
April-14	57443	5.26	12.55
May-14	207172	7.90	47.50
June-14	234579	8.95	51.27
July-14	278030	9.70	65.30
August-14	274572	9.65	62.71
September-14	220105	8.06	48.71
October-14	100111	5.60	22.62
November-14	211230	6.25	49.70
December-14	106155	6.18	22.00
January-15	82092	5.50	20.01
February-15	38890	4.26	9.69
March-15	73269	5.00	17.20

Table.1 Monthly data of wind speed with respect to generation.

Components	Component Ratings
PV	80 kW
Battery	12 V
Converter	30V
Diesel Generator	80 kW

Table 2: components and its ratings

simplifies the task of designing systems-both on & off grid. Homer can model both the technical & economic factors involved in the project. For longer systems, HOMER compares the cost & feasibility of different configurations.

The clearness index values for the location of chitradurga to obtain the daily solar radiation in a year are shown in fig.4 below in HOMER software.

The graph obtained from daily radiation and clearness index. From this graph, it is clear that the maximum radiation of about 6.7kWh/m<sup>2</sup>/day is available to PV system in the month of April.

Variation of daily radiation and clearness index for the location of chitradurga showing below

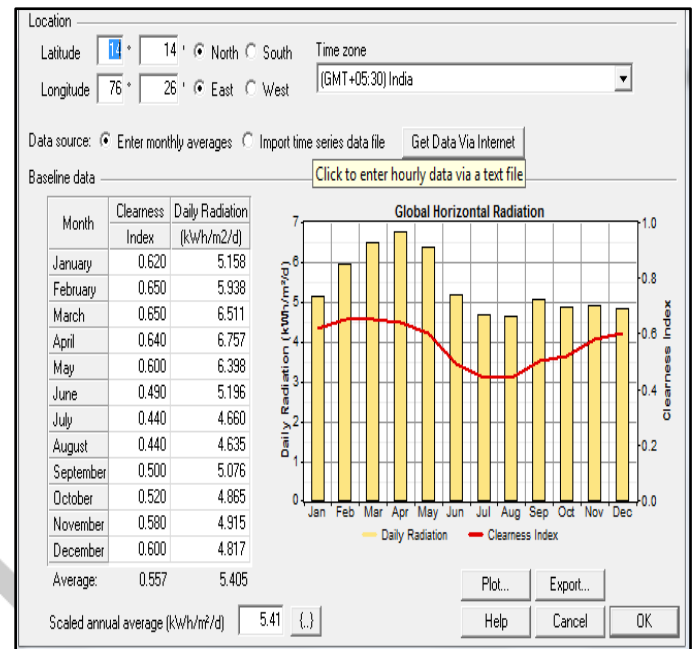


Fig.4 Daily radiation &amp; clearness index

ARCHITECTURE DESIGN OF HYBRID ENERGY SYSTEM WITHOUT GRID BY HOMER SOFTWARE FOR SITE A SHOWN IN FIG.5 BELOW

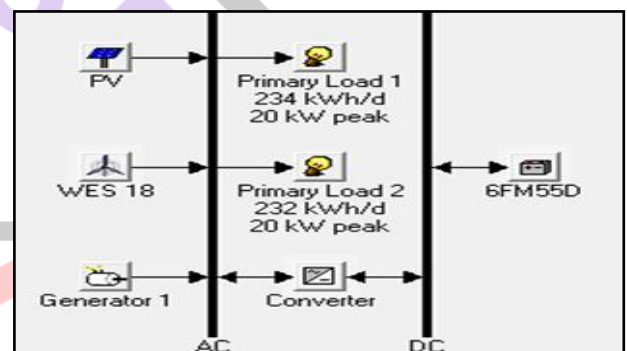


Fig.5 Design of hybrid energy system without grid

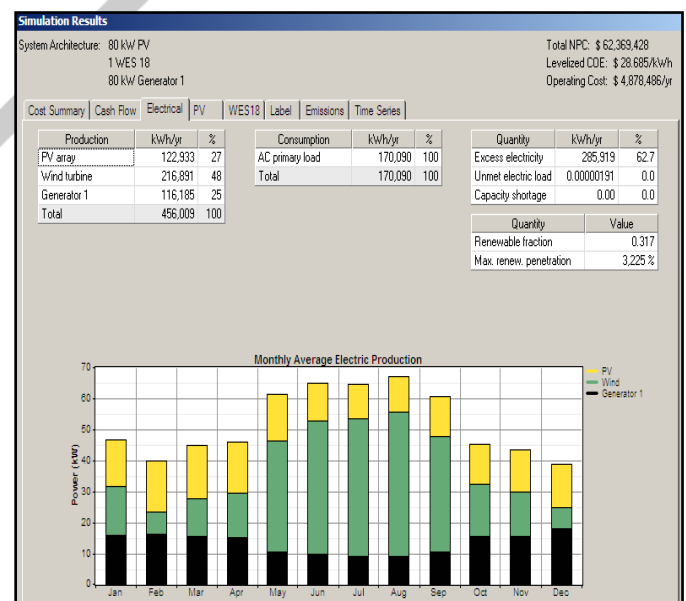


Fig.6 Monthly average electric production without grid for site A

HOMER generated data of emission for a without grid hybrid energy system for site A

Pollutants	Emissions(kg/yr)
Carbon dioxide	225,594
Carbon monoxide	557
Unburned hydrocarbons	61.7
Particulate matter	42
Sulfur dioxide	453
Nitrogen oxides	4,969

Table.3 Emission for hybrid energy system

## 6. CONCLUSION

1. The after conclusions were drawn from the above subject that the configuration of cross breed vitality framework is renewable vitality sources are unlimited and naturally amicable to help and diminish utilization of fossil fills.
2. Best strategy for taking care of the heap demand by utilizing sun oriented and wind vitality sources.
3. Reduces the nursery gas impact
4. Electricity emergency in country zones can give continuous force supply
5. Feasible to install the solar panels with wind turbine and making hybrid energy system for load demand when wind turbine cannot do.

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