



Power Generation System using Hybrid Renewable Energy Sources

¹Prerna Rangari, ²Alisha Godari, ³Prof Pranjali Kamble

¹Student (EE) SSCET, ²Student (EE) SSCET, ³Asst. Professor (EE) SSCET

ABSTRACT:

A hybrid renewable energy source (HRES) consists of two or more renewable energy sources, such as wind turbines and photovoltaic systems, utilized together to provide increased system efficiency and improved stability in energy supply to a certain degree. Many types of clean and renewable energy sources can be used in production of electrical energy. In this project the combination of two energy resources is takes place i.e. wind and solar energy. This process reviles the sustainable energy resources without damaging the nature. We can give uninterrupted power by using hybrid energy system. Basically this system involves the integration of two energy system that will give continuous power. Solar panels are used for converting solar energy into electricity and wind turbines are used for converting wind energy into electricity. This electrical power can utilize for various purpose. Generation of electricity will be takes place at affordable cost. This project deals with the generation of electricity by using two sources combine which leads to generate electricity with affordable cost without damaging the nature balance. Keywords: Electricity, hybrid, solar, power, wind. [1] .

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Introduction:

With increasing concern of global warming and the depletion of fossil fuel reserves, many are looking at sustainable energy solutions to preserve the earth for the future generations. Other than hydro power, wind and photovoltaic energy holds the most potential to meet our energy demands. Alone, wind energy is capable of supplying large amounts of power but its presence is highly unpredictable as it can be here one moment and gone in another. Similarly, solar energy is present throughout the day but the solar irradiation levels vary due to sun intensity and unpredictable shadows cast by clouds, birds, trees, etc. The common inherent drawback of wind and photovoltaic systems are their intermittent natures that make them unreliable.[2]

Renewable Energy Generators which are often used as an alternative to conventional power supply systems are known to be run only during certain hours of the day, and if they are to be used for commercial purposes then the cost of fueling them will increasingly become difficult. The photovoltaic system and Wind power have an important role to play in today's life.

Solar Energy Solar panels is also known as modules and it contains photovoltaic cells made of silicon that transforms incoming sunlight into electricity. ("Photovoltaic" is basically electricity from light — photo = light, voltaic = electricity.) Solar photovoltaic cells are made of a positive and a negative silicon film placed under a thin slice of glass. As the photons of the sunlight strikes on silicon cells, the electrons ejects from the film. The electrons which are negatively charged are attracted to one side of the silicon cell, this creates an electric voltage that can be collected and channeled. The solar photovoltaic array is formed by collecting the current by wiring different solar panels. Fused array combiner is an electrical box in which multiple strings of solar photovoltaic array cables terminate; it is depending on the size of installation

Wind Energy The energy of wind is converted into useful form (usually electric current) is called wind energy. Wind turbine converts the wind power into useful electric power. Electric generator used inside the turbine converts the mechanical power into the electric power. Wind turbine systems are available in ranges from 50W to 2-3 MW. The energy produced by wind turbines depends on the velocity of wind acting on the turbine.[3]

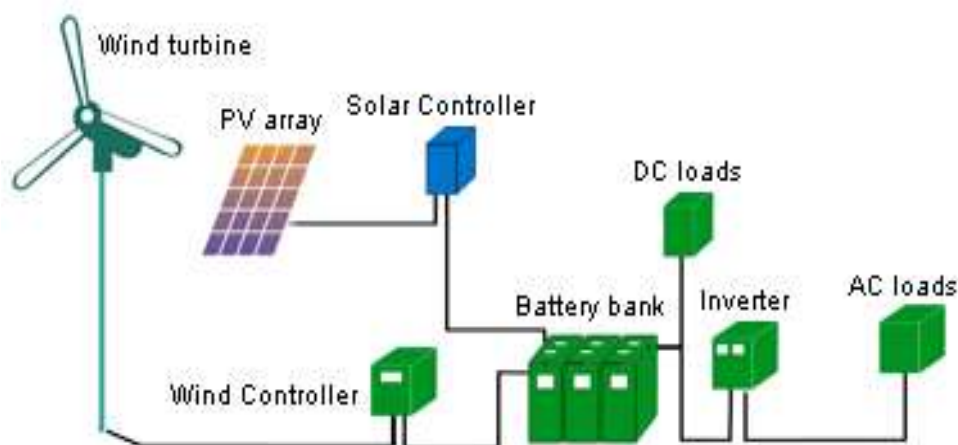
Objective of the project:

1. To Increase the usage of renewable energy sources.
2. To reduce the usage of fossil fuels.
3. To improve the living conditions of mankind.
4. To protect environment from pollution.
5. To utilize land and material optimally.[4]

Hybrid Energy System: Hybrid Wind-Solar System for the rural exchanges can make an ideal alternative in areas where wind velocity of 5-6 m/s is available. Solar-wind power generations are clear and non-polluting. Also they complement each other. During the period of bright sun-light the solar

energy is utilized for charging the batteries, creating enough energy reserve to be drawn during night, while the wind turbine produce most of the energy during monsoon when solar-power generation is minimum. Thus the hybrid combination uses the best of both means and can provide quality, stable power supply for sustainable development in rural areas. These systems are specifically designed to draw 48 volts DC power output from the solar cells/wind turbines and combine them to charge the storage batteries. The system does require availability of diesel generator, though for much reduced number of hour's operation. It is also designed to give priority to solar and wind power so that operations of generators can be minimized to the extent possible. Hybrid power systems (HPS) are any autonomous electricity generating systems, incorporating more than one type of power sources, operated together with associated supporting equipment (including storage) to provide electric power to the grid or on site. Hybridization through combining different energy sources in one supply system offers the best possibility to use the system. Hybrid energy system is including several (two or more) energy sources with appropriate energy conversion technology connected together to feed power to local load/grid. Figure gives the general pictorial representation of Hybrid energy system. Since, it is coming under distributed generation umbrella, there is no unified standard or structure. It receives benefits in terms of reduced line and transformer losses, reduced environmental.[6]

Diagram



Working of the project: To better understand the solar wind hybrid system, we must know the working of solar energy system and wind energy system.

Solar power system : Solar energy is one of the major renewable energy source that can consist of three major block namely solar panel, solar photovoltaic cell, battery. The electrical energy generated using solar panel can be stored in battery or directly used for equipment. Solar panel works by allowing photons, or particles of light, to knock electron free from atoms, generating a flow of electricity. Solar panels actually comprises many, smaller units called photovoltaic cells. Many cells linked together make up a solar panel. Each photovoltaic cell is basically a sandwich made up of two slices of semi conducting material, usually silicon. To work photovoltaic cell need to establish an electric field. Much like a magnetic field, which occur due to the opposite poles, an electric field occurs when opposite charges are separated. To get this field, manufacturers dope silicon with other materials, giving each slice of the sandwich a positive or negative electrical charge. Specifically, they seed phosphorous into the top layer of charges silicon, which add extra electron, a negative charge, to that layer. Meanwhile, the bottom layer gets a dose of boron, which result in fewer electron, or a positive charges. This all adds up to an electric field at the junction between the silicon layers. Then, when photons sunlight knocks an electron free, the electric field will push that electron out of the silicon junction. A couple of other component of the cell turn these electron into usable power. Metal conductive plates on the side of the cell collect the electron and transfer them to wires.

Wind power system : Wind energy is also one of the renewable energy source that can used for generating electrical energy with wind turbine coupled with generator. These system mainly consist of wind turbine, gear box and dc generator. Overall, when the wind is blowing, turbine are rotate, emf is induced which will cause a current flow. When shaft is rotate mechanism is rotate because mechanism is fixed on shaft. These rotary motion is converted into maximum rpm of the gear box, the g generator is directly connected to the gear box, which is directly converted into electrical energy or give the output.[7]

Features of Hybrid Power Plant

- Three Vertical Axis Wind Turbines.
- Cut in wind speed – 2.5 m/s & Cut-out wind speed- 18 m/s
- Scalable to meet user defined KW need- interconnection cables provided.
- Integrated Maximum Power Point Tracking with “smart” bus logic control technology – 48vDC
- Temperature sensing electronic for thermal protection

- Able to withstand temperature ranges from 30c to 50C
- International Protection Rating[8]

Proposed Calculations: Overall power generated by system is the summation of the power generated by the solar PV panel and power generated by the wind turbine.

Mathematically, it can be represented as, $PT = NW * Pw + Ns * PS$

Where, Total power generated= PT

Power generated by wind turbines= PW

Power generated by solar panels= PS

No. of wind turbine = NW

No of solar panels used= NW A.

A. Calculations for wind energy:

The power generated by wind energy is given by, Power = (density of air * swept area * velocity cubed)/2 $PW = \frac{1}{2} \rho (AW) (V)^3$

Where, P is power in watts (W)

ρ is the air density in kilograms per cubic meter (kg/m^3)

AW is the swept area by air in square meters (m^2)

V is the wind speed in meters per second (m/s).

B. Calculations for solar energy :

To determine the size of PV modules, the required energy consumption must be estimated.

Therefore, the power is calculated as $PS = Ins (t) * AS * Eff(pv)$

Where, Ins (t) = isolation at time t (kw/ m^2)

AS = area of single PV panel (m^2)

Effpv = overall efficiency of the PV panels and dc/dc converters.

Overall efficiency is given by, $Eff(pv) = H * PR$

Where, H = Annual average solar radiation on tilted panels.

PR = Performance ratio, coefficient for losses.

C. Cost The total cost of the solar-wind hybrid energy system is depend upon the total no of wind turbines used and total no of solar panels used.

Therefore the total cost is given as follows Total cost= (No. of Wind Turbine * Cost of single Wind Turbine) + (No. of Solar Panels * Cost of single Solar Panel) + (No. of Batteries used in Battery Bank * Cost of single Battery) $CT = (NW * CWT) + (NS * CSP) + (NB * CB)$

Where, CT is the total cost in Rs

CWT is the cost of single wind turbine

CSP is the cost of single solar panel in Rs

CB is the Cost of single Battery in Rs

NW is the number of wind turbine used NS is the number of solar panels used

NB is the number of Batteries used in Battery Bank.[9]

Applications:

- Solar Wind Hybrid Energy Systems are using in almost all field small electric power usage. Some of the applications of SWHES are given below.
- Grid connected and Stand alone
- Grid connected: The large power rating of SWHES, where the access of wind and sun irradiation is more, they can be connected to Grid. In these types of generation, if the system failed to generate power the Grid will supply the load.

- Stand alone: Almost all SWHES applications are stand - alone not connected to the grid.
- Street lighting: The foremost application of SWHES is solar street lighting. Solar Street light become as SWHES lighting. Use of this reduces the load from conventional power plants.
- Household: Residential appliances can use power generated through hybrid solar wind energy system. SWHES are used to supply electricity to different offices or other parts of the building in reliable manner.
- Remote Applications: like military services where it is impossible to provide conventional power supply these SWHES systems are useful.[10]

Conclusion:

Solar Wind Hybrid energy Systems become reliable for small power applications. To improve the solar Photovoltaic power generation efficiency, wind energy is integrated to form as hybrid energy system. The proposed systems help to reduce air pollution caused by the conventional power generation system. By installing SWHES to every house, the burden on the conventional power generating system reduces. The storage of the battery will give power for some time, even no generation takes place by this system. Almost in all field of electric power usage, the SWHES are being used. It provides the power to inaccessible convention power places. SWHES are more reliable and efficient energy generating system with less effect on the environment and almost no maintenance.[11]

Future Scope This hybrid power generation at small level that help to construct hybrid generation plant with a minimum cost with highest generating capacity. In past days vertical axis wind turbine had to be start by giving the excitation, our project aspect is to make self-starting wind turbine and another is that to reduce the power fluctuation due to the uneven wind. So that we get constant power supply [13]

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