Imperial Journal of Interdisciplinary Research (IJIR)
Vol-3, Issue-6, 2017
ISSN: 2454-1362, http://www.onlinejournal.in

Hybrid Power Generation System Using Wind Energy and Solar Energy

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Abstract*: Demand of electricity is growing very rapidly for industrialization & urbanization of India. Renewable energy sources being available abundantly in nature can be considered as a better option over conventional energy sources. Solar and wind energy are available in large amount and can be considered as reliable source of power generation. Hybrid solar and wind energy systems can be used for rural electrification and modernization of remote area. However, the instability and intermittency of the wind and solar energy throw a huge challenge on designing of the hybrid system. 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 used to convert solar energy into electricity and wind turbines used to convert wind energy into electricity. This electrical power can utilize for various purpose. Generation of electricity will be takes place at affordable cost. This paper deals with the generation of electricity by using two sources i.e. solar and wind combine, which leads to generate electricity with affordable cost without damaging the nature balance.*

Key Words: *Solar energy, Wind energy, renewable energy, photovoltaic cell, hybrid solar system*

1. INTRODUCTION

Now a day's, Electricity is most needed for our day to day life. Energy is the power we can use for the transportation, for the heat and light in our homes and for the manufacture of all kinds of products. There are two energy sources: Renewable and Non-renewable source of energy

Non-renewable Source of Energy:
Most of the power we use comes from the fossil fuels, such as coal, natural gas and petroleum are the non-renewable sources. Uranium is non-renewable source, but it is not a fossil fuel. Once these natural resources are used up, they are gone forever.
The gathering of these fuels can be harmful to the biomes. Fossil fuels are put through a process called combustion in order to produce energy. Combustion release pollution such as carbon monoxide, sulfur dioxide, which may contribute to acid rain and global warming.

Renewable Source of Energy:
A Renewable source of energy can be used over and over again. Renewable source include solar energy, wind energy, geothermal energy, biomass and hydropower. They generate much less pollution, both in gathering and production, than non-renewable sources.
Solar energy comes from the sun. People are used solar panels on homes, hospitals, colleges and many other places to convert solar energy into electricity.
Wind turbines, which look like giant windmills it generates electricity.

1.1 Working of Solar Power Energy:

Solar energy is one of the major renewable energy resources that can be used for different applications such as solar power generator, solar heaters, solar calculators, solar chargers, solar lamps and so on. There are various advantages of solar energy usage in electric power generation including low pollution, cost effective generation, maintenance free power system, etc.
Solar power system consists of three major blocks namely solar panels, solar photovoltaic cells and batteries for storing energy. The electric energy(DC power) generated using solar panels can be stored in batteries or can be used for supplying DC loads or can be used for inverter to feed AC loads.

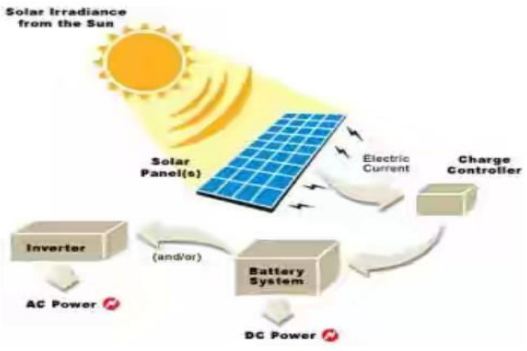
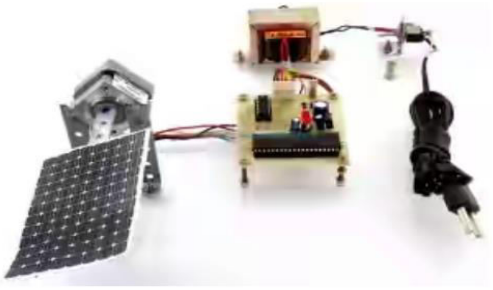


Fig. Solar Power System

1.1.1 Solar Panel's Working Principle

Solar panel is made of solar cells or solar photovoltaic cells, and is use for solar energy into electrical energy. The solar A panels utilize ohmic material for inter connection for inter connection and external terminals. Thus the electrons produce in the N type material are passed to the battery through electrode and wire from the battery electron reach P type material, where this electrons and holes are combine hence the solar panels connected to the battery behaves like another battery and hence, is comparable to the two serially connected batteries .The solar panels output is electric power and is affected by number of factors like climate, panel orientation to the sun, sunlight intensity and so on. During a normal sunlight a solar panel produces around 1 Ampere current. It is essential to design the solar panel arrangement on the roof top for efficient usage and typically solar panels are arranged such that they face the east at an angle of 45 degree.

Now, there are advanced technologies for improving the output of solar panels by using sun tracking solar panel arrangement that rotates the solar panel in all direction so as to get more light from the sun.

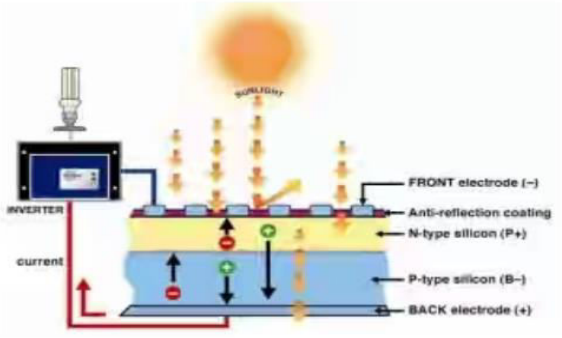


Sun Tracking Solar Panel System By Efxkits.com

Fig. Sun Tracking Solar Panel System

1.1.2 Solar Photovoltaic Cells Working

We must also know the working of the solar cells to understand how solar panels convert solar energy into electrical energy. Solar photovoltaic cells are the devices that are used for converting solar energy into electrical energy by using photovoltaic effect. Solar photovoltaic cells consist of a P type of silicon layer that is placed in contact with N type silicon layer. The electrons diffuse from the N type to the P type material. So, these electrons in the N type material moves to P type with the influence of the solar energy. Thus, the electrons and holes combine in the P-N junction. Due to this, combination of a charge on either side if P-N junction is created and this charge creates electric field.



Solar Photovoltaic Cell

Fig. Solar Photovoltaic Cell

1.2 Working of Wind Power System:

Wind energy is also one of the renewable energy resources that can be used for generating electrical energy with wind turbines coupled with generators. The various advantages of wind energy are wind turbines power generation, for mechanical power with windmills and so on .Wind turbines are made up to rotate with the biowing wind and accordingly electricity can be generated. Wind turbines consists 3 blades of a fan that rotates due to blowing wind such that the axis of rotation must be aligned with the direction of blowing wind. There are different types of wind turbuine, but the frequently used wind turbines are horizantal axis turbines and vertical axis turbines. Turbines that rotated along horizantal axis are more commonly used. Horizantal axis wind turbines have the main rotor shaft and electrical generator at the top of a tower,and must be pointed into the wind.Turbine blades are made stiff to prevent the blades from being pushed into the tower by wind.Vertical axis wind turbines have the main rotor shaft arranged vertically but, this vertical axis turbines are less frequently used.

Fig. Wind Turbines

1.2.1 Wind tracking system

Wind tracking system identifies the direction along which the maximum amount of intensity of wind blow by using wind sensor. The sensor output is in terms of milli volts.The maximum output value of sensor is considered as the point of higher intensity of wind blow by the microcontroller and windmill rotated toward the required direction.Thus the windmill rotated along the direction where the maximum wind blows.

1.3 Batteries:
The batteries in the power generation system provide to store the generated electricity from the wind and solar power.

1.4 Inverter:
The inverter converts DC power into AC power which is used to drive the electrical loads by the energy stored in the battery.

1.5 Controller:
Controller gives the signal to the perticular relay and charges tha DC battery by comparing the input of both power system.

1.6 SOLAR WIND HYBRID POWER SYSTEM:
Solar and wind hybrid power systems are designed using solar panels and wind turbine for generating electricity.According to many renewable energy expert, a "hybrid" electric system that combines home wind electric and home solar electric (photovoltaic) technologies offers several advantages over either single system.In much of the United States, wind speeds are low in the summer when the sun shines brightest and longest and the wind is strong in the winter when less sunlight is available. Because the peak operating times for wind and solar system occur at different times of the day and year, hybrid systems are more likely to produce power when you need it. For the times when neither the wind nor the solar systems are producing, most hybrid systems provide power through the batterise. In the winter when less sunlight is available. Because the peak operating times for wind and solar system occur at different times of the day and year, hybrid systems are more likely to produce power when you need it. For the times when neither the wind nor the solar systems are producing, most hybrid systems provide power through the batteries. In hybrid solar wind generator, the electrical energy generated by solar panel is in AC form which can be converted to DC using invertors and used effectively. The solar panel output is electric power which can be given by Watts or Kilo watts .These solar panels are available at the output ratings like 5 watts, 10 watts, 20 watts, 100 watts etc. Hence we can select the solar panel as per our need.
The huge wind turbines are rotated and thus kinetic energy is generated by these rotations which can be converted to electrical energy. Minimum wind speed required for connection of the generator to the power grid is known as cut in speed while, maximum wind speed required for the generator for disconnecting the generator from the power grid known as cut off speed. Generally, wind turbines are accessible to the range of speed between cut in and cut off speeds.
Wind turbine is a device consist three blades which on rotation produces the electricity in such a way that that the axis of rotation must be aligned with the direction of blowing wind. A gear box is termed as a high-precision mechanical system because it converts energy from one device to another device. Horizontal axis turbines and vertical axis turbines are the most frequently used turbines.
An electrical generator is followed wind turbine; hence it is known as wind turbine generator.
It generate electricity into battery bank with the help of solar charge controller and wind controller and after that DC load which is stored into battery is converted into AC load with the help of inverter.

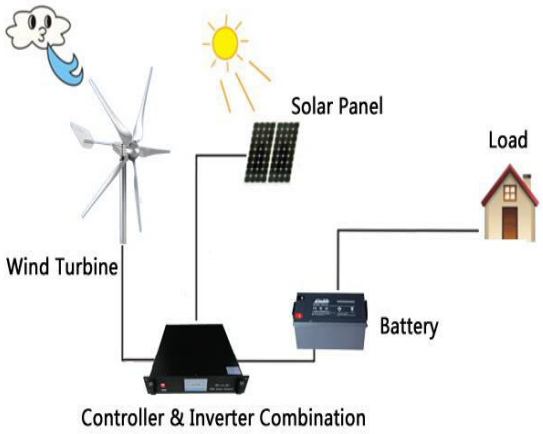


Fig. Hybrid Solar Wind Power Generator

2. METHODOLOGY

Proposed Calculation

The total power generated by this system may be given as the addition 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,
PT is the total power generated
PW is the power generated by wind turbines
PS is the power generated by solar panels
NW is the no of wind turbine
Ns is the no of solar panels used.

2.1 Calculations for wind energy

The power generated by wind energy is given by,
Power = (density of air * swept area * velocity cubed)/2
PW = ½. ρ (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).

2.2 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/ m2)

AS = area of single PV panel (m2)

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

The overall efficiency is given by,

Eff(pv)= H * PR

Where,

H = Annual average solar radiation on tilted panels.

PR = Performance ratio, coefficient for losses.

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 T++++++++++++++++++++++urbine * 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 in Rs

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**.**

Solar-wind hybrid energy systems needs only initial investment. It will efficiently work with the conventional energy sources. When accounted for a lifetime of reduced or avoided utility costs. The cost of the system is based on the factors such as system chosen, wind resource on the site, electric costs in the area, and the battery bank required. Cost of the Wind-Solar Hybrid system is minimized using non-conventional energy sources.

3. APPLICATIONS:

- In rural villages for electrification
- In home, farm house, hospitals, laboratories, college campus etc.
- Used in street lightning system

4. ADVANTAGES:

- Most Eco-friendly and clean source of power
- Low fuel consumption
- Low generating set maintenance
- Provide safety to public

ACKNOWLEDGMENT

This work is supported by PROF. RAM MEGHE INSTITUE OF TECHNOLOGY & RESEARCH, BADNERA, AMRAVTI. Thanks for valuable references provided by the authors. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect their views. I would also like to express my gratitude to all other members of the faculty of Electronics and Communication Engineering department for their cooperation. I want to thank my parents for the support they have given me so far.

5. CONCLUSION

Hybrid power generation system is good and effective solution for power generation than conventional energy resources. It can provide to remote places where government is unable to reach. So that the power can be utilize where it generated so that it will reduce the transmission losses and cost. Cost reduction can be done by increasing the production of equipment. People should motivate to use the non conventional energy resources. It is highly safe for the environment as it doesn't produce any emission and harmful waste product like conventional energy resources. It has also long life span. Overall it good, reliable and affordable solution for electricity generation

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