

Vertical Axis Wind Turbines and Solar Power Generation Hybrid System

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Abstract—The aim of this paper is to solve the problem of energy crisis which is considerably serious issue in today's period. Although solar and wind energy are two of the most viable renewable energy sources, This Paper deals with the detailed of a hybrid model of a solar and wind which is using battery as its storage system. The purpose of the project is to generate electricity without using non-renewable resources and pollution. Since, renewable standalone energy generation system has disadvantages, which need to be overcome by hybrid systems. Wind and solar energy have being popular ones owing to abundant, ease of availability and convertibility to the electric energy.

Index Terms—Hybrid, Photovoltaic, Wind turbine etc.

I. INTRODUCTION

Energy is essential to our society to ensure our quality of life and to underpin all other elements of our economy. Renewable energy sources i.e. energy generated from solar, wind, biomass, hydro power, geothermal and ocean resources are considered as a technological option for generating clean energy. Solar-Wind hybrid Power system that harnesses the renewable energies in Sun and Wind to generate electricity. It ensures the optimum utilization of resources and hence improves the efficiency as compared with their individual mode of generation. Also it increases the reliability and reduces the dependence on one single source. Sources have increased interest in renewable energy sources. Clearly, if this demand is to be met, then the world's electricity generating capacity will have to continue to grow. This hybrid solar and wind power generating system is suitable for industries and also domestic areas energy sources. We require electricity for

operating almost all the appliances we use in our day-to-day life. So, it has become an indispensable part of our life. Now there are two ways to produce electricity first by using non-renewable sources of energy and second by renewable sources of energy. Simultaneously, with increase in population and advancement of technology we have to increase the production of electricity also in order to meet the demands of growing population. The biggest disadvantage with the usage of conventional resources is that their usage causes pollution. So we have to find some other methods to produce electricity. The best possible way is by using non-conventional sources of energy. Out of all the possible options available in non-conventional sources of energy, solar and wind are the best methods.

Solar Energy

Solar energy is that energy which we get from the sun in form of radiation. It does not cause any kind of pollution, it is inexhaustible. It is available free of cost. Specially, in a country like India where sun shines for almost 300 days in a year, it is therefore a convenient mode of electricity production. Meager amount of investment is involved in setting up a solar power plant and also it is quite easy to maintain. The efficiency of the system is also quite good. Long life span and less emission of pollutants are its major advantages.

Wind Energy

When air flows then it is having some kinetic energy with it which is known as wind energy. This kinetic energy is converted into mechanical energy by the wind turbine, which is used to rotate the shaft of the

generator and then electricity is produced. The cost of generation of electricity is quite less. The initial investment of the system varies depending on the type of turbine used. The best part about producing electricity with the help of wind energy is that wind is available for almost 24 hours in day.

Hybrid System

Now we have become even more interested in usage of renewable energy sources as an alternative method of producing electricity. Hybrid systems are basically an integration of solar panels and wind turbine, the output of this combination is used to charge batteries, this stored energy can then be transmitted to local power stations. In this system wind turbine can be used to produce electricity when wind is available and solar energy panels are used when solar radiations are available. Power can be generated by both the sections at the same time also. This system requires high initial investment. But the reliability, long-life span and less maintenance make up for that disadvantage.



Motivation

Now-a-days with the growing population the demand for energy resources is also increasing. Therefore it is necessary to increase the population of energy, but this is practically not possible with the available non-renewable resources such as coal, petrol, and the other

fossil fuels. Therefore the only option is the use of renewable resources such as ocean tides, hydro-power, winds, sun, biological wastes, etc. By the use of biological waste we can create energy that is sufficient only for half of the living universe. Therefore to satisfy the need of the whole universe we need such a resource that in non-conventional, freely available in the nature also it should be inexhaustible and it should not cause pollution and other hazards. In this situation the only option that can fulfill all these demands is the solar energy. As per increasing demand of energy we motivated to do project on solar wind power generation system.

Objectives

- [1] Generate electrical energy with help of solar energy.
- [2] Generate electrical energy with help of wind energy.
- [3] Store energy using battery which drive from solar system and wind system.
- [4] Drive load with using combine power of solar and wind energy.
- [5] Efficient utilization of solar energy and wind energy.

II. LITERATURE REVIEW

The utilization of hybrid solar wind is necessity for the development of the country. The different researches were carried out on the development and performance assessment of the solar and wind hybrid system.

- [1] Makbul A.M. Ramli, presented case study model on the hybrid solar and wind system on the techno-economic energy analysis for in Saudi Arabia. The study is carried out for economic production for the electric using the hybrid system; the different parameters are taken into consideration for economic production.
- [2] Vikas Khare, presented the review on the Hybrid power generation. The presented research concentrated on the different issues related with Hybrid power generation such as optimum sizing, feasibility analysis, modelling, control aspects and reliability.
- [3] Binayak Bhandari, in this paper author differentiates power produced from both the

photovoltaic (pv) and wind turbine base on weather conditions. They found that by using storage system for backup we can improve the system and make it more convenient. According to that they apply various optimization techniques for hybrid system make component specifications according to that. Again they focus on the present scenario of environmental crises.

[4] Renu Sharma, this paper main focus is on rural development in India by using separate hybrid system. They study combinations of hybrid system for generating power. By calculating load demand for rural villages, load is divided into phase on that basis further analysis is done.

[5] Getachew Bekele, design the hybrid wind and photovoltaic power generation system for the Ethiopian remote area. The research studies design the system for basic electrification requirement. The data for the study collected from national agency. The simulation of that hybrid system is analyzed by using the HOMER software. The results of the study concluded with satisfied working of the system and the shortage of electricity is covered up to 20.

[6] Y.M.Irwan, Asserted the new techniques in Perlis Malaysia for hybrid power generation. The power generation form the wind is used for cooling of the PV module. The combination of Savinius and Darrieus is used with PV module. The new approach for hybrid system design can improve the performance.

III. ANALYSIS AND DESIGN APPROACH

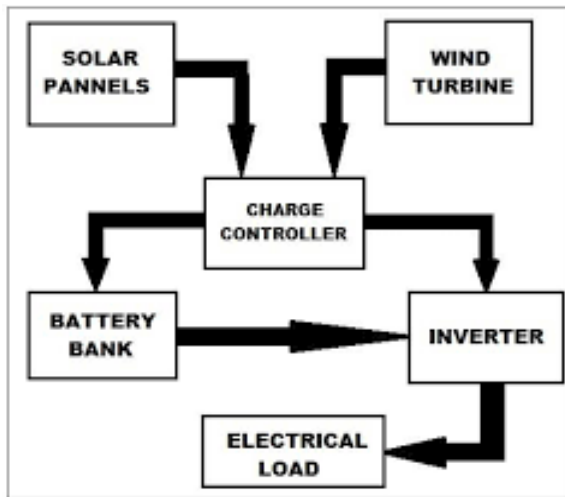


Fig 1 shows the block diagram of project

For design of the hybrid energy system we need to find the data as follows

Data required for Solar System:

- [1] Annual mean daily duration of Sunshine hours
- [2] Daily Solar Radiation horizontal (KWH/m2/day)

Data required for Wind System:

- [1] Mean Annual Hourly Wind Speed (m/sec)
- [2] Wind Power that can be generated from the wind turbine

Above figure shows the block diagram of the hybrid power generation system using wind and solar power. This block diagram includes following blocks.

- A. Solar panel
- B. Wind turbine
- C. Charge controller
- D. Battery bank
- E. Inverter

A. Solar panel

Solar panel is use to convert solar radiation to the electrical energy. A solar panel works by allowing photons, or particles of light, to knock electrons free from atoms, generating a flow of electricity, according to Live Science. That's a technical way of saying that the panel's photovoltaic cells convert the energy in sunlight to electricity (specifically, direct current (DC)). Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. Solar panels are the medium to convert solar power into the electrical power.

B. Wind turbine

Wind turbine is that system which extracts energy from wind by rotation of the blades of the wind turbine. Basically wind turbine has two types one is vertical and another is horizontal. As the wind speed increases power generation is also increases. The power generated from wind is not continuous its fluctuating. For obtain the non-fluctuating power we have to store in battery and then provide it to the load.

C. Charge controller

Charge controller has basic function is that it control the source which is to be active or inactive. It

simultaneously charge battery and also gives power to the load. The controller has over-charge protection, short-circuit protection. It also the function is that it should vary the power as per the load demand. It add the both the power so that the load demand can fulfill. And when power is not generating it should extract power from battery and give it to the load.

D. Battery Bank

We have to choose battery bank size per the load requirement so that it should fulfill the requirement of load for calculating the battery bank size we need to find following data

(1) Find total daily use in watt-hour (Wh).

(2). Find total back up time of the battery

For increase in battery bank size we need to connect cell in series so that we can get the larger battery bank size.

E. Inverter

We have to choose greater rating inverter than the desired rating .The pure sign wave inverter is recommended in other to prolong the lifespan of the inverter. Inverter is need to convert DC power into AC power. As our load working on the AC supply so we need to convert DC power. The input voltage Output voltage and frequency, and overall power handling depends on the design of the specific device or the circuitry. The inverter does not produce any power. The power is provided by the DC source.

3.1. 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

A. Calculations for wind energy

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

$$PW = \frac{1}{2} \cdot \rho (AW) (V)^3$$

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

$$PS = Ins (t) * AS * Eff(pv) \text{ Where,}$$

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

$$\text{Total cost} = (\text{No. of Wind Turbine} * \text{Cost of single Wind Turbine}) + (\text{No. of Solar Panels} * \text{Cost of single Solar Panel}) + (\text{No. of Batteries used in Battery Bank} * \text{Cost of single Battery})$$

$$CT = (NW * CWT) + (NS * CSP) + (NB * CB)$$

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 compete well in generation with the conventional energy sources. When accounted for a lifetime of reduced or avoided utility costs. The cost of the system depends on the 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 to be minimized. For minimize the cost of the system we need to increase the use of non-conventional energy sources. So that production of solar and wind power generator will be increase. That will reduce cost of the whole system.

IV. ADVANTAGES

- [1] Very high reliability (combines wind power, and solar power)
- [2] Long term Sustainability.
- [3] High energy output (since both are complimentary to each other)
- [4] Cost saving (only one time investment)
- [5] No pollution.

V. APPLICATION

- [1] Street lighting, Traffic signals.
- [2] Powering up for communication system.
- [3] As per requirement of electrical energy the system can be either designed or updated for higher energy requirement.
- [4] When Ac mains supply is not available, the proposed system can be used as emergency system with only few changes.
- [5] Commercial Power generation.
- [6] The0 system is used for domestic purpose.
- [7] It can be used for almost every electronic, mechanical system require electric energy to work on.
- [8] The system can be designed for both off-grid and on grid applications.

VI. CONCLUSION

As our demand for electrical power grows, it becomes increasingly urgent to find new alternatives. By this project many villages can be lighted. For villages which are much away from the construction site of large power generating stations such as, Hydro and nuclear can be provided power. Also, to satisfied the increasing demand of electricity with clean hybrid power stations by solar-wind can be used. It reduces the dependence on one single source and has increased the reliability. Hence, we could improve the efficiency of the system as compared with their individual mode of generation.

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