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Research Article

A Review on Research Aspects and Trends in Solar-Wind Hybrid Power Generation System

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Abstract

In the present innovation controlled world power is most important thing for us in everyday life exercises. We as a whole are unaware of the way that the sustainable sources of power are draining at a very rapid pace. Thus this is the ideal opportunity for us to move concentration from conventional energy resources to non-conventional source of energy to supply power. For this purpose hybrid power plant can be very useful. Hybrid power plants are the combination of two different power plants to produce energy. Among all type of combination of hybrid power plant, wind and solar based hybrid power plant is most beneficial as both sun and wind are universally available. The main aim of this paper is to examine of different aspects of solar wind hybrid power generation system. This paper also includes the reviews of the studies done based on the hybrid solar wind power generation system.

Keywords: *Hybrid, Power Plant, Solar, Wind*

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Introduction

We need power in working essentially every instrument used in our regular day to day existence. Earlier the main resources of power generation were traditional resources like coal, fossil fuels, petrol but as population of the world is increasing day by day, the demand for energy cannot fulfill by these primary resources. These sources are also hazardous to the climate. So we have to think about other resources of energy like non- traditional resources such as solar energy, biogas, wind energy etc. These sources do not harm the environment and can produce large amount of energy to fulfill the energy demand of the world. Apart from that renewable energy also have very much potential to gain energy requirement [1]. From much kind of these resources, wind and solar energy are at the top. This is because these two energies can be utilized at everywhere and is also cost effective. But is we use them separately, they have some losses like solar energy system can generate power only in daylight and wind energy production also depends on the speed of the wind. Many studies have been carried out regarding this issue and after that hybrid power system came into existence. This system contains two different types of energy system. The main advantage of this type of system is that power can be utilized at maximum day hour. When one system does not utilize power, then other can work. These systems are also less costly than a single power generating system. The cost of diesel system along with solar and wind is 13% and 7% less than the system containing only solar and diesel and only wind and diesel [2].

Solar Wınd Hybrıd System

These types of system carry two different energy systems: solar energy system and wind energy system .A hybrid solar wind power generation system generally consists wind aero generator, wind turbine, solar photovoltaic panels, batteries, charge controller and inverter. We know that we can receive maximum sunlight from 12 PM to 3 PM in daytime while wind speed is high either in early morning or in late evening. Energy yield from this type of system is in the form of direct current which can be converted in alternate current with the help of inverters.

Wind energy is gained from wind turbine. Since this energy is in unstable form so it is controlled by wind controllers and after that it is stored in a battery in Direct Current form. Solar energy is also gained from photovoltaic array of sheets and it is also controlled by solar controllers and is stored in battery. Both energies are in the Direct Current form and it is converted in Alternate Current by inverters. This Alternate Current is directly used for domestic purpose. These systems are eco - friendly to climate. Its financing cost is also very less and when climate condition is worse for any one system, other can be used for generation of power. This system is suitably used as domestic as well as industries purposes [3]. The photovoltaic and wind systems are the important power generation devices and batteries works as load carrier in the system [4].

Working of Hybrid System

There is a p-n intersection comprise two distinct layer of the semiconductor materials known as the n and p area in solar panel, n locale is strongly doped and is small in size

whereas p is gently doped and is of large size. The emission falling outwardly of p-n crossing point diode may go throughout the n side. Maximum utilization area is present in the p zone which is tenderly doped. How much the n region can be invaded is picked by the recurrence of the falling emission by the sun. Electron–opening sets are made in the n and p area, in view of the differentiation in potential the electrons move to the n region and openings towards the p area. The present begins streaming at the time an outside load is associated with the terminal of the n and p districts. To build a sun powered board, different sun oriented cells are associated in arrangement and equal mixes; they are associated so that the yield got is added substance in nature.

In wind panel, a wind turbine is utilized to change over the dynamic power of the breeze into the electrical power. The generator associated with the rotor of the sharp edges changes over the mechanical power to electrical power. The breeze turbine comprises 2 sorts relying on the turning pivot of the cutting edges, first is vertical hub breeze turbine and even hub breeze turbine. The yield of the turbine relies upon the velocity of the breeze. The power created by the turbine is oscillating. For getting ceaseless inventory of force firstly the power is put away inside the battery unit and afterward it is moved towards the heap.

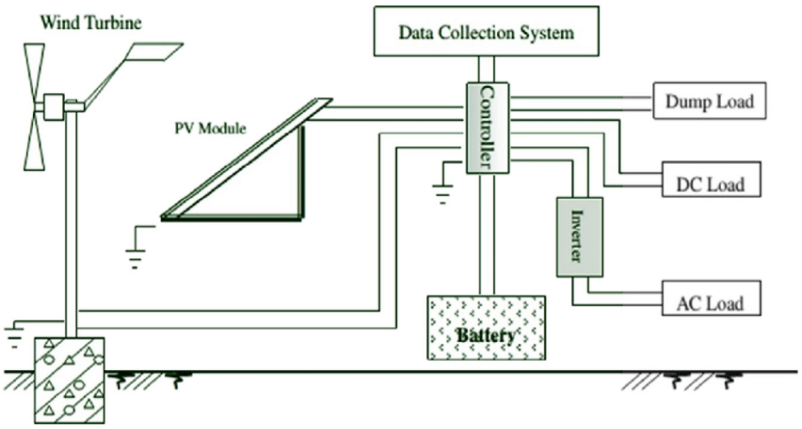

Fig. 1 Block Diagram of Solar Wind Hybrid System [5]

Research Aspects And Developments

Thei Al-enezi N. M. et al. [6] proposed a solar wind system with a back- up system of diesel engine so that in case of less electricity, power can be utilized from diesel engine also. A small model was also designed to examine its efficiency and production.

Petrakopoulou F. et al. [7] analyzed solar wind hybrid power system for an island. For this they used a methodology called “Exergy”. They found that energy yield is high in the month from august to September while in other month when sun and wind are not available regularly, this stored energy can be used to complete the demand of electricity. It was found that system generate 48% of energy demand by solar plant while 52% by using wind power plant. They analyzed that CSP plant also have better efficiency and less area requirement for establishment than other type of hybrid power plant.

Mousa K. et al. [8] designed an optimal solar wind energy plant. A number of variables were categorized like PV sheets, length of wind turbine etc. Their study shows about the

supply of a single energy plant in a hybrid system when other plant does not work or produce a little energy that does not fulfill the requirement of energy. Model was designed using GAMS. The comparison between both systems was done on the basis of power generated by them in a year.

Kabalci E. et al. [9] talks about conversion of energy gained through solar and wind plant. MPPT (maximum power point tracking) algorithm was used to control modulators. Total harmonic ratio was obtained in a standard form. It was around .69%. This type of model and calculation will be very useful in future by adding some other type of elements in this plant. THD was in standard as IEC61000 and IEEE 519-1992. Power generation in wind turbine is in alternate current form which is changed into direct current form with the help of rectifiers.

Yunna W. et al. [10] carries out their study in china. Their study is based on site selection for solar wind hybrid power plant and covers all the issue arises during a site selection. All the evaluation results were categorized and a decision making system was made for hybrid system. They used Analytical Hierarchy Process (AHP) for this evaluation.

Dalwadi P. et al. [11] also keeps a point of view regarding maximum benefit of hybrid power generation system so that maximum power can be utilized by using standalone wind power generation system.

Bhattacharjee S. et al. [12] harnessed hybrid power plant in a north east state of India 'Tripura' and used a technical and economic analysis of a solar wind plant for its better working. Tangible approaches were also evaluated for different climate conditions. The study reaches at result that power generated by wind plant is comparatively more than the power generated by the single solar plant.

Lund H. et al. [13] analyzed the problem arising due to fluctuating renewable power resources. Power generation from different sources of energy in form of production ranges from zero to 100 percent was categorized. When energy input is less than 20 percent of demanded power PV supplies 40 percent of total demand while wind only 10 percent. The analysis was done on a Denish power system which worked on fossil fuel.

Fasihi M. et al. [14] represents about the baseload electricity (BLEL) and H_2 supply. More parameters were taken into account. Simulation was performed on two different sites. At both site difeerent comparisons were carried out and it was found that this plant can provide BLEL at right cost in many area of this world.

Bakos G. et al. [15] gives a technical and economic analysis of a hybrid system in Greece. To analyze the solar and wind data, Monte Carlo Method (MCM) was used. Economic analysis was done with the help of (LCS) method. This analysis helps to meet the energy demand for that particular region.

Chedid R. et al. [16] proposed a support technique which may help in building a solar wind combined system. Analytical Hierarchy Process (AHP) method was carried out into consideration and three dimensional simulation used rather than two dimensions. Hedging analysis was also performed in case of any risk occurrence.

Ding Z. et al. [17]: In this paper, an electric heater was used along hybrid system. All the wind energy converted into heat power by this heater. Swarn optimization technique was utilized to enhance the performance of system. The study shows that solar wind system with high storage power and less solar multiple has better efficiency. The mean energy converted rate becomes less with the increment of solar multiples.

Khalid M. et al. [18] is a case study to design a solar wind system along with a battery energy storage system (BESS). This combined system is capable to match electricity with demand of supply with least cost. They also used data from two separate geographic areas to carry out this study. They found that this type of system not only generate power according to demand but also uses these resources ideally.

Bayrak G. et al. [19] implemented a new method for a hybrid system. This method checks the different parameters of circuit breakers like frequency etc. They found that this method can be easily applied in solar wind power distribution system to generate power or energy.

Rezaei M. et al. [20] did a case study in Iran. 7 area of Iran were taken into consideration on various parameters. They collected the data for wind and solar energy by a function called "Weilbull distribution" function and an equation consists of three hours long data. They found that Eghlid was the top among other options.

Amiri F. et al. [21] experimented a CSP system along with a gas turbine plant to reduce the emission of CO_2in the climate. Swarn optimization and genetic algorithm were applied. They found four hundred kilogram decay of CO_2 emission. There was also an increment in fuel efficiency about eighty five percent.

Khare V. et al. [22] reviewed on a hybrid system. Many factors were taken into consideration like feasibility, system size and modelling. Reliable issue was also discussed in this paper.

Sharma A. et al. [23] discuss about solar energy in India and world. They mainly focused on concentrating solar plant (CSP) in which there is lenses and mirrors are present that concentrated a large amount of sunlight into a single beam. They also talks about future projects of India in solar field.

Udayakanthi G. et al. [24] used software called "HOMER" for collecting data in Sri Lanka and search solar- wind availability throughout the region of Sri Lanka. Data from different government organization was also taken into consideration.

Ming T. et al. [25] discuss about the removal of Green House Gases (GHG) in the climate arising due to use of fossil fuel, coal etc. It was found that semiconductor having TiO_2 are the good for removing halogenated gases from the environment.

Reddy S. S. et al. [26] talks about challenges during the formation of non- traditional energy sources into grid form. A new way was proposed and simulations were performed on IEEE 30 and 300 Bus system. Genetic algorithm and two points estimation method was also used to carry out this design.

Jahangiri M. et al. [27] carries out their study to find best places for establishment power plant in Afghanistan. For this purpose they used two softwares namely HOMER (Hybrid

Optimization Model for Electrical Renewables) and GIS (Geographical Information System). Different region capacity of generating power was studied and it was found that highest COE was $.711 and lowest was $.612.

Natsheh E. et al. [28] develops a smart grid connected hybrid power plant. The system was designed using software called MATLAB/SIMULINK. Basic data was collected from other power plant. System was designed on different parameters.

Fasihi M. et al. [29] does a techno economic experiment for the change of power generated by hybrid solar wind plant into fuels like diesel, petrol. For this a method called syngas production was used which is the combination of CO and H_2. This method consists two different ways: H_2 generation by electrolysis and CO hydrogenation. Annually and hourly basis model was designed.

Jun D. et al. [30] finds the best site for a wind solar power plant for which they took 7 power plants into consideration. The overall evaluation was done based on ELECTRE-II. This paper also helps in finding macro site for the system.

Yang H. et al. [31] designed a techno economic model for hybrid power plant. Five variables were taken into consideration while designing this system. All the results were summarized and a good combination was found between solar and wind plant.

Ramesh M. et al. [32] analyzed hybrid energy system keeping in account of operational costs influenced by Lead acid and Li-ion batteries. Sensitivity analysis was also found after investigating the effects of discount rate, battery cost, photovoltaic cost, fuel cost, design flow rate and wind speed and reported significant effect on net cost.

Conclusion

Creating this type of hybrid frameworks is quite possibly the most advantageous and viable answer for creating power when contrasted with non- environmentally friendly power assets. It isn't just less expensive however likewise it doesn't make any harm to the climate. Something else is that it tends to be utilized to produce power in uneven zones, where it is very hard to send power by ordinary techniques. Contingent upon the prerequisite its arrangement can be chosen. All individuals in this world ought to be propelled to utilize non-customary assets to create power to make them self-solid somewhat. Long life expectancy, lower maintenance is a portion in this addition to point. It simply needs much higher starting speculation.

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