A Review Study on Wind and Solar System for Electricity Generation

Atul Dadhich, Assistant Professor,

Department of Electrical Engineering, Vivekananda Global University, Jaipur

Email Id- dadhich.atul@vgu.ac.in

ABSTRACT: ***Hybrid power systems combine two or more renewable energy sources to improve system efficiency and energy supply balance. A hybrid power system that combines solar and wind energy is a fairly common example. Increased penetration of current energy systems may provide significant technical challenges, especially for weak networks or autonomous systems with insufficient storage capacity, due to the intermittent and unpredictable nature of solar and wind power. By integrating the two renewable resources in an optimum balance, the impacts of their fluctuating nature may be partly mitigated, and the whole system becomes more reliable and cost-effective to run. The challenges and solutions of solar hybrid photovoltaic and wind energy systems are examined in this study. Voltage, frequency, and harmonic fluctuations are significant issues for both grid-connected and stand-alone devices, with the latter having a larger effect under bad grid circumstances. The proper design, better fast response controls, and hybrid system optimization may all help to solve this issue. Combining photovoltaic and wind energy lowers storage requirements and, as a result, overall system costs. The future prospects of combining wind and solar power can provide the necessary demand for electrical power, and this hybrid system may be utilized at any time of day or night.***

KEYWORDS: ***Battery, Electrical, Hybrid, Power, Solar, Technology, Wind energy.***

1. INTRODUCTION

In particular for PV solar and wind systems, the global penetration of renewable energy into power networks is growing quickly. Renewable energy accounted for around 19% of the world's final consumption of energy in 2012 and increased in 2013 in accordance with the 2014 Global Status Report. The study emphasized that the PV system capacity was, for the first time, larger than the worldwide wind power capacity. Solar and wind power are intermittent and can provide technological problems to the supply of grid electricity especially as the integration of wind and solar power rises, or when the system cannot cope with quick variations in the level of output. Moreover, whether solar or wind are utilized to supply a standalone system with electricity, the energy storage system is vital to ensure continuous power delivery. The energy storage size is dependent on the solar or wind's intermittency[1]–[4].

Every gadget we use in our daily lives, such as electronic mobile telephone, computers, laundries, etc., need a constant operation of the electric power supply. Technological advances have also expanded the use of electrical and electronic equipment. There is thus, without a doubt, an increasing energy requirement in the world. Electricity is now generated from conventional sources discussed above.

However, only if the specific resource is accessible can renewable energy resources that function as independent or standalone generate just the needed energy. For instance, only when the wind blows, while only when the sun shines, is the energy obtained by wind. Therefore, if only one of these renewable energy sources is used simultaneously, there is a possible problem of poor availability (probability of executing necessary functions at any moment). Hybrid systems combining two renewable energy resources were therefore developed to utilize available resources and offer steady and consistent power supply. The idea seeks to mix wind and solar energy to create power. One source complements another and therefore ensures that energy is always used and transformed into electricity. The device is also fitted with a battery to store wind and solar electricity. This implies that we can still have electricity if wind and solar power are not at the same time accessible. This initiative therefore has the potential to tackle the unreliable, unsustainable and unpredictable energy supply problem[5], [6].

Non-conventional resources, however, are abundant, renewable, and regenerated spontaneously. Therefore, they are constantly inexhaustible for use. Moreover, they are clean and do not create greenhouse gas emissions, thus they do not contribute to pollution in the environment. Maintenance costs are also relatively low. Therefore, it is reasonably cost-effective/economic, pollution-free and takes very little maintenance to harness two renewable/non-traditional energy supplies. Finally, the peak operating hours of the two energy supplies used may therefore successfully be complementary to each other at different times of the day and the year.

1.1.*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.

1.2.Wind Energy:

It has some kinetic energy with it, known as wind power, as the air moves. The wind turbine, which is used to turn the generator shaft, then generates electricity, converts this cinematic energy into mechanical energy. The power generation costs are much lower. Depending on the turbine utilized, the initial investment of the system depends. The most important thing in creating wind energy is that wind is accessible approximately 24 hours a day, thus power will not be discontinued. The production depends on the wind speed.

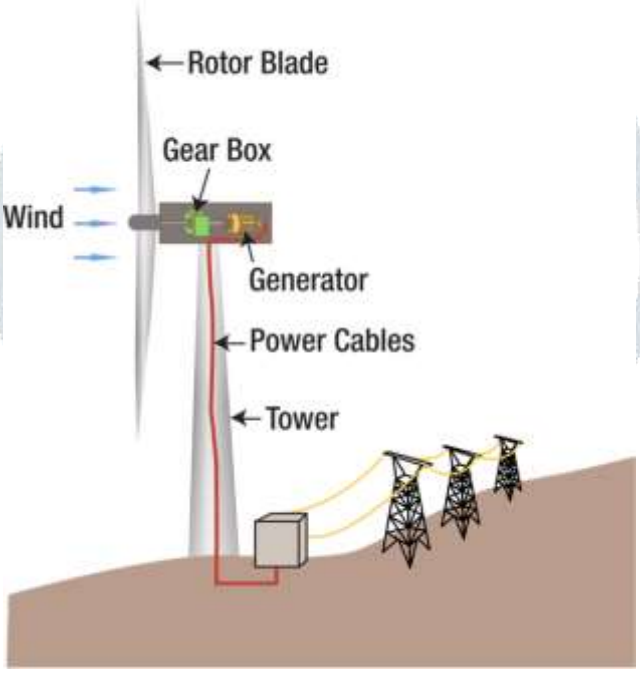

Figure 1: The Above Figure Illustrates the Labeled diagram of wind energy[7]**.**

1.3.Hybrid System:

The greatest answer conceivable for meeting the rising demands of the future are hybrid power production systems. Hybrid power systems indicate a mix of two or more electrical sources. The weather depends on renewable energy sources. The goal of hybrid energy systems is to integrate grid-connected solar and wind energy with advanced control techniques to maximize electricity output. The advantage of having a power generation unit connected to the grid is that if there is a failure in the production of solar or wind energy, the grid may function as a source or a backup system. Excess energy generated by renewable resources is stored in the grid and delivered to satisfy load demand.

1.4.Site Selection:

To utilize the area of the land as much as possible. Solar and wind resources in various locations or regions might be studied independently but Solar and wind resources should show additional production peaks at the yearly and the daily level.

This research paper explained the solar and wind interconnected system i.e. Hybrid power system. The combination of both the wind as well as solar gives a continuous output either in day or in night. This hybrid system is very useful for fulfil the required power demand. This is renewable source of energy hence there is no any kind emission of harmful geese and also the production and maintenance cost is low.

2. LITERATURE REVIEW

Bharat Raj Singh and Bal Krishna Dubey explained the 'solar-wind hybrid power generation system'[8]. The objective of the hybrid energy systems is to integrate solar and wind energy with grids for maximum power generation control approaches. The advantage of having a power generation unit connected to the grid is that if there is a failure in the production of solar or wind energy, the grid may function as a source or a backup system. Excess energy generated by renewable resources is stored in the grid and delivered to satisfy load demand. The author concluded that the hybrid system of wind and solar are more useful and it overcome the power demand.

Mergu C et al. explained about the 'Introduction to Solar Wind Hybrid Energy Systems'. The use and efficient usage of Solar Wind hybrid energy systems are presented in this article (SWHES). As the most plentiful natural source of energy, the future of energy production rests upon solar energy[9]. Conventional electricity generation, due to a lack of coal, will become a tough task in the future. The cost of a thermal power plant per unit is raised. One factor is also the loss of transmission power. The environment would be affected by pollutants emitted from traditional power generating.

Jyoti Gulia Explained the 'Wind-Solar Hybrid' in this paper author discussed As that energy transition accelerates, more choices, technologies and business models need to be explored – in addition to simple vanilla contracts to speed up the adoption of growing quantities of inexpensive but intermittent renewable energy (RE)[10]. As a feasible new renewable energy system in India, wind solar hybrid has emerged quickly. The greatest option in the approaching future is hybrid energy generation, because seasonal changes for wind and solar may be resolved by combining power and energy efficiency.

Austin W et al. explained the Solar-wind hybrid energy system for new engineering complex. Author explained In order to satisfy consumers' needs efficiently and effectively, a hybrid energy system integrates many kinds of energy generating[11]. The Solar-Wind hybrid system is composed of wind- and solar-photovoltaic electricity, and is a vital means of shifting away from fossil fuel economies. It takes advantage of existing wind systems and solar power in a given area or region. The public domain is seen by a significant increase in environmental deterioration since fossil-fuel generators are being adapted to create energy.

G.B. Hangaragi, and Rajashekar P. Mandi explained 'A Hybrid Model of Solar & Wind Power Generation System'. Author explained; however, the generation of energy by using PV cells and wind turbines has quickly grown in recent years as compared with fossil fuel output[12]. This study introduces the hybrid Solar-Wind Power System which uses electricity to create renewable energy in Sun and Wind. The main function of the system control is the micronutrient. It ensures the optimal use of resources in comparison to their particular production mode and therefore increases efficiency.

3. DISCUSSION

The overall energy production is improved by combining solar PV and wind energy sources. However, an energy storage system is necessary to provide a constant power supply and to compensate for any shortfalls in renewable energy output. Battery banks, fuel cells, and other storage systems can be used, with a concentration

on battery banks here. There have been several optimization approaches published that might be used to achieve a techno-economically optimal hybrid renewable energy system. The use of storage devices such as electrolytic double layer capacitors can help to reduce high frequency oscillations. In order to analyses the effects of wind on PV modules, an experimental study was conducted.

The hybrid project's electricity can be utilized to meet solar RPOs and non-solar RPOs in proportion to the hybrid plant's rated capacity of solar and wind power, respectively. The phase-locked loop is the most often used grid synchronization method. Detecting the zero crossing of grid voltages or employing a set of filters with a non-linear transformation are two more synchronization approaches. Using fuel cells instead of huge lead-acid batteries or super storage capacitors to combine solar and wind energy sources results in a non-polluting, dependable energy source with lower total maintenance costs.

The advantage of having a power generation unit connected to the grid is that if there is a failure in the production of solar or wind energy, the grid may function as a source or a backup system. Excess energy generated by renewable resources is stored in the grid and delivered to satisfy load demand. Because seasonal fluctuations for the sun and wind may be handled by combining the energy and output performance is increased, hybrid power production is the greatest choice in the future.

Both energies are mixed before powering the grid or load via control mechanisms. With the aid of the MPPT technology, the solar power from the sun is supplied to converter to generate a controlled DC output. The wind turbine converts mechanical energy to electricity via a generator and is supplied by an inverter. The output is mixed with the AC grid. The combination of solar and wind energy plays an important role in a hybrid system due to seasonal changes in sun and wind and continuous electricity output. The inclusion of solar-wind systems coupled in the grid can assist to reduce the total costs and improve the dependability of the supply of renewable energy. The grid draws excess renewable energy from the site and delivers power for the loads of the facility as necessary.

4. CONCLUSION

Both the grid-connected and the stand-alone systems face the major problem of intermittent solar PV and wind sources. The effects of the fluctuating nature of solar and wind resources may be partly addressed and the system is more dependable and cheap in running by combining both resources in an ideal mix. This certainly has a greater effect on the self-sufficient generation. Integration of renewable energy generation with storage systems and battery backups for diesel generators has become a cost-effective, stand-alone option. The arrangement of the wind diesel-battery hybrid can fulfil system charge including peak hours. Strategies for energy management should provide high system efficiency, dependability and affordability.

Well-planned weather, solar radiation and wind speed accurately predict can contribute to decreasing intermittent energy effect. Voltage, frequency fluctuations and harmonics are key power quality concerns, having greater influence on grid weaknesses for both networked and stand-alone systems. The appropriate design, improved rapid reaction control systems, and optimization of hybrid systems may largely overcome this problem. This is achieved.

The study presented an overview of several research efforts on optimal size design, topologies of power electronics and control for grid and standalone hybrid solar PV systems. In a shared DC or in a common AC-bus, solar PV and wind hybrids can be linked either in a grid-connected or in a stand-alone mode. The configuration may be selected depending on the demand. In order to make them self-reliable to some level, all individuals in the globe should be encouraged to employ nonconventional resources to create power. Some of the advantages are a long life, minimal upkeep. It only needs a hefty initial investment.

REFERENCES

[1] Ø. Lie-Svendsen, “The solar wind,” *AIP Conf. Proc.*, 2007, doi: 10.1063/1.2756789.

[2] I. S. Veselovskii, “Variable solar wind,” *Sol. Syst. Res.*, 2017, doi: 10.1134/S0038094617030078.

[3] M. O. Riazantseva, O. V. Khabarova, G. N. Zastenker, and J. D. Richardson, "Sharp boundaries of solar wind plasma structures and their relationship to solar wind turbulence," *Adv. Sp. Res.*, 2007, doi: 10.1016/j.asr.2007.05.004.

[4] S. V. Chalov and H. J. Fahr, "The role of solar wind electrons at the solar wind termination shock," *Mon. Not. R. Astron. Soc. Lett.*, 2013, doi: 10.1093/mnrasl/slt052.

[5] R. C. Wiens *et al.*, "Solar and solar-wind composition results from the Genesis mission," 2007, doi: 10.1007/s11214-007-9227-x.

[6] P. Wurz, "Solar wind composition," 2005, doi: 10.1888/0333750888/2303.

[7] WIKIPedia, "Wind Turbnine." https://en.m.wikipedia.org/wiki/File:Wind_turbine_diagram.svg.

[8] J.-S. Oh and K.-J. Jo, "A study on solar-wind hybrid power generation system," *J. Korean Soc. Mar. Eng.*, vol. 33, no. 8, pp. 1226–1231, 2009, doi: 10.5916/jkosme.2009.33.8.1226.

[9] M. Chandramouly and A. Raghuram, "Introduction to Solar Wind Hybrid Energy Systems," vol. 3, no. 12, pp. 1–6, 2017.

[10] J. R. IEEFA, "Wind- Solar Hybrid : India ' s Next Wave of Renewable Energy Growth An Analysis of Tariff Trends , Policy and Regulation , and Challenges in a New Market," no. 2018, pp. 1–24, 2017.

[11] M. Saulo, A. Wasonga, M. Saulo, and V. Odhiambo, "Solar-wind hybrid energy system for new engineering complex-technical," vol. 4, no. January, pp. 73–80, 2016, doi: 10.11648/j.ijepe.s.2015040201.17.

[12] G. B. Hangaragi and R. P. Mandi, "A Hybrid Model of Solar – Wind Power Generation System," no. May, 2017.