



REVIEW ON WIND AND SOLAR POWERED STREET LIGHT POLE

Sasawade Summedh D. ¹, Sasawade Sudarshan S. ², Mhamane Rohit R. ³, Kamble Sumedh R. ⁴,

Prof. G. G. Deshpande ⁵

Student, Department of Mechanical Engineering, Sahakar Maharshi Shankarrao Mohite Patil Institute of Technology and Research, Shankarnagar Akluj, Maharashtra, India¹⁻⁴

Professor, Department of Mechanical Engineering, Sahakar Maharshi Shankarrao Mohite Patil Institute of Technology and Research, Shankarnagar Akluj, Maharashtra, India⁵

Abstract: Hybrid solar PV and wind generation system become very attractive solution in particular for stand-alone applications. Combining the two sources of solar and wind can provide better reliability and their hybrid system becomes more economical to run since the weakness of one system can be complemented by the strength of the other one. The integration of hybrid solar and wind power systems into the grid can further help in improving the overall economy and reliability of renewable power generation to supply its load. Similarly, the integration of hybrid solar and wind power in a stand-alone system can reduce the size of energy storage needed to supply continuous power. Solar electricity generation systems use either photovoltaic's or concentrated solar power. The focus in this paper will be on the photovoltaic's type. Detailed descriptions of the different technologies, physics and basics of PV can be found in many textbooks and papers. In this paper is wind and solar powered street light pole wherein, design of the components and their analysis has been carried out and, the fabrication of the model has been done as per the calculations that have been obtained from the design and analysis. Electricity has helped in reducing physical efforts to a very large extent, but, the way in which it is produced is quite a matter of concern. Even today, most of the electricity that we use is produced through conventional methods. These conventional methods commonly use fossil fuels to produce electricity. Not only are these methods expensive, but also cause grave damage to the environment. The use of fuels for the generation of electricity results in increased costs and emissions of hazardous pollutants. The only alternative is a new method that is not only cheap and efficient, but also eco-friendly.

Keywords: Solar, Wind, Power Generation

I. INTRODUCTION

In this project PV modules produce outputs that are determined mainly by the level of incident radiation. As the light intensity increases, photocurrent will be increased and the open-circuit voltage will be reduced. The efficiency of any photovoltaic cell decreases with the increasing temperature which is non-uniformly distributed across the cell. The solar output power can be smoothed by the distribution of solar power in different geographical areas. Electricity from solar PV and concentrated solar power plants is significantly expensive and requires significant drop in cost or change in policies by either subsidizing or forcing the use of these technologies to be able to achieve significant market penetration. Global wind report indicated that the annual market grew by around 10% to reach around 45 GW and the cumulative market growth was almost 19%.

Detailed descriptions of the wind energy can be found in references. Wind turbines (WTs) are classified into two types: horizontal-axis WT (HAWT) and vertical-axis WT (VAWT). The highest achievable extraction of power by a WT is 59% of the total theoretical wind power. Hybrid solar-wind systems can be classified into two types: grid connected and stand-alone. Now a day's major percentage of the electricity generation is contributed by generation through Coal, Diesel, Hydro, Nuclear sources of energy. The use of such fuel as a primary source of power generation produce very dangerous situation in environment. Hybrid solar & micro wind turbines consist of the small solar panel & micro wind size wind turbine as compare to the large centralized wind turbine. Working principle of the Wind turbines is to convert the kinetic energy of the wind firstly first into rotational kinetic energy in the turbine and then this rotational energy has been converted to the electrical energy via the generator or alternator that can be supplied, via the national grid, for any purpose. The energy which available in the wind and solar for conversion primarily depends on the wind velocity, swept area of the turbine & solar radiation.

II. LITERATURE REVIEW

This chapter presents the background information on the issues to be considered in the present research work and to focus the significance of the current study.

J. Godson et al. presented the 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. But the energy generated from solar and wind is much less than the production by fossil fuels, however, electricity generation by utilizing PV cells and wind turbine increased rapidly in recent years. This paper presents the Solar-Wind hybrid Power system that harnesses the renewable energies in Sun and Wind to generate electricity. System control relies mainly on micro controller. 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. This hybrid solar-wind power generating system is suitable for industries and also domestic areas.

Ali Diabat studied among the wide range of problems facing our world today, there is global consensus that greenhouse gas (GHGs) emissions have the largest negative impact on our environment. GHGs include carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydro fluorocarbons and per fluorocarbons. These gases help maintain the temperature of the earth at comfortable levels for organisms, and a decrease in their levels would result in a temperature that could be too low for us to survive. However, because GHGs allow sunlight to enter the atmosphere, but trap the heat radiated off the earth's surface, an increase in these emissions would result in an increase of the planet's temperature, or global warming, to levels that could be fatal to living organisms. Many scientists also believe that the increase in natural disasters is fueled by climate change, since atmospheric and oceanic patterns shift as the Earth's temperature increases.

Karim Mousa et al. discussed the solar and wind energy are two of the most viable renewable energy sources, little research has been done on operating both energy sources alongside one another in order to take advantage of their complementary characters. In this paper, we develop an optimal design for a hybrid solar-wind energy plant, where the variables that are optimized over include the number of photovoltaic modules, the wind turbine height, the number of wind turbines, and the turbine rotor diameter, and the goal is to minimize costs. Simulation studies and sensitivity analysis reveal that the hybrid plant is able to exploit the complementary nature of the two energy sources, and deliver energy reliably throughout the year.

Medugu et al. presented the a hybrid power system consisting of PV-arrays and wind turbines with energy storing devices (battery bank) and power electronic device was designed and constructed in this paper. The system is aimed at the production and utilization of the electrical energy coming from more than one source, provided that at least one of them is renewable. The efficiency of the designed power electronic device is about 95% and 73% for capacitive and resistive loads respectively. The integration of the hybrid is to electrify a residential house and its surrounding in order to reduce the need for fossil fuel leading to an increase in the sustainability of the power supply. This approach is techno-economically viable for rural electrification.

Rashid Al Badwawi et al. proposed that due to the fact that solar and wind power is intermittent and unpredictable in nature, higher penetration of their types in existing power system could cause and create high technical challenges especially to weak grids or stand-alone systems without proper and enough storage capacity. By integrating the two renewable resources into an optimum combination, the impact of the variable nature of solar and wind resources can be partially resolved and the overall system becomes more reliable and economical to run. This paper provides a review of challenges and opportunities / solutions of hybrid solar PV and wind energy integration systems. Voltage and frequency fluctuation, and harmonics are major power quality issues for both grid-connected and stand-alone systems with bigger impact in case of weak grid. This can be resolved to a large extent by having proper design, advanced fast response control facilities, and good optimization of the hybrid systems. The paper gives a review of the main research work reported in the literature with regard to optimal sizing design, power electronics topologies and control. The paper presents a review of the state of the art of both grid-connected and stand-alone hybrid solar and wind systems.

Yashwant Sawle et al., presented the renewable energy systems are likely to become widespread in the future due to adverse environmental impacts and escalation in energy costs linked with the exercise of established energy sources. Solar and wind energy resources are alternative to each other which will have the actual potential to satisfy the load dilemma to some degree. However, such solutions any time researched independently are not entirely trustworthy because of their effect of unstable nature.

In this context, autonomous photovoltaic and wind hybrid energy systems have been found to be more economically viable alternative to fulfill the energy demands of numerous isolated consumers worldwide. The aim of this paper is to give the idea of the hybrid system configuration, modelling, renewable energy sources, criteria for hybrid system optimization and control strategies, and software used for optimal sizing. A case study of comparative various standalone hybrid combinations for remote area Barwani, India also discussed and found PV–Wind–Battery–DG hybrid system is the most optimal solution regarding cost and emission among all various hybrid system combinations

Qusay Hassan and et al., presented the comprehensively examines hybrid renewable energy systems that combine solar and wind energy technologies, focusing on their current challenges, opportunities, and policy implications. Despite the individual merits of solar and wind energy systems, their intermittent nature and geographical limitations have spurred interest in hybrid solutions that maximize efficiency and reliability through integrated systems. A critical analysis of available literature indicates that hybrid systems significantly mitigate energy intermittency issues, enhance grid stability, and can be more cost-effective due to shared infrastructure. The review identifies key challenges, such as system optimization, energy storage, and seamless power management, and discusses technological innovations like machine learning algorithms and advanced inverters that hold the potential for overcoming these hurdles. Importantly, the review elucidates the role of policy in accelerating the adoption of these systems by highlighting successful case studies of government incentives, public-private partnerships, and regulatory frameworks that have fostered investments in hybrid renewable energy systems. The study concludes with the outcomes obtained that signify the potential for hybrid renewable energy systems to not only meet but exceed future energy demands sustainably, provided there is concerted effort in research, investment, and policymaking

Rajkumari Jagzape and et al., studied the combination of various however complementary energy generation systems supported renewable energies or mixed is understood as hybrid system. During this paper a hybrid power generation by exploitation star and wind energy with voltage electronic device system is meant with wind energy and hydro power supply using PSCAD software. Here a simulation approach is adopted to watch the various characteristics of hybrid installation. From the study it's clear that this hybrid power system provides voltage stability and automatic load sharing capability.

K. B. Mohan Krishna, and et al., presented the hybrid power generation system using Solar and Wind energy. It is fact that energy is an important resource for any country in the world to develop economically strong in all aspects. Without energy one cannot sustain the life such as transportation from one place to another, home needs, industrial purposes etc., More than 80% world energy consumption is produced by using fossil fuels it is estimated that the fossil fuel reserves will end by 2250. However this technology is already existed in two different forms, but we are giving the two technologies in one place. Most probably concentrating on the wind turbine blade design by using readily available PVC (Poly Vinyl Chloride) pipes. It is easy to get them into required size and shape by following design considerations. It is household usage purpose project which is available at low cost compared to individuals available. The reason behind combining both of them is to improve the pole efficiency for the same using in conventional methods.

Ashish S. Ingole and et al., studied the electricity is most needed facility for the human being. All the conventional energy resources are depleting day by day. So we have to shift from conventional to non-conventional energy resources. In this 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 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 paper deals with the generation of electricity by using two sources combine which leads to generate electricity with affordable cost without damaging the nature balance.

Peter Jenkins and et al., presented the energy is critical to the economic growth and social development of any country. Indigenous energy resources need to be developed to the optimum level to minimize dependence on imported fuels, subject to resolving economic, environmental and social constraints. This led to an increase in research and development as well as investments in the renewable energy industry in search of ways to meet the energy demand and to reduce the dependency on fossil fuels. Wind and solar energy are becoming popular owing to the abundance, availability and ease of harnessing the energy for electrical power generation. This paper focuses on an integrated hybrid renewable energy system consisting of wind and solar energies. Many parts of Libya have the potential for the development of economic power generation, so maps locations were used to identify where both wind and solar potentials are high.

The focal point of this paper is to describe and evaluate a wind-solar hybrid power generation system for a selected location. Grid-tied power generation systems make use of solar PV or wind turbines to produce electricity and supply the load by connecting to the grid. In this study, the HOMER (Hybrid Optimization Model for Electric Renewable) computer modeling software was used to model the power system, its physical behavior and its life cycle cost. Computer modeling software was used to model the power system, its physical behavior and its life cycle cost. The hybrid power system was designed for a building at the University of Al-Marj (MARJU). Through the use of simulations, the installation of ten 100-kW wind turbines and 150-KW solar PV was evaluated.

III. OBJECTIVES

- ❖ To study the feasibility of solar-wind hybrid power systems for rural electrification
- ❖ To analyze and evaluate the renewable energy potential mainly for those two resources, solar and wind
- ❖ To make the prefeasibility analysis and estimate the load demand;
- ❖ To assess the technical feasibility of a hybrid solar-wind power system to meet the load requirements of the specific remote village electrification.
- ❖ To evaluate a strategy to optimize the size of the energy generation and storage subsystems.

IV. 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.

V. CONCLUSION

This paper has provided a review of challenges and opportunities on integrating solar PV and wind energy sources for electricity generation. The main challenge for grid-connected system as well as the stand-alone system is the intermittent nature of solar PV and wind sources.

By integrating the two resources into an optimum combination, the impact of the variable nature of solar and wind resources can be partially resolved and the overall system becomes more reliable and economical to run. This definitely has bigger impact on the stand-alone generation. Integration of renewable energy generation with battery storage and diesel generator back-up systems is becoming a cost-effective solution for stand-alone type.

REFERENCES

- [1]. Qusay Hassan, Sameer Algburi, Aws Zuhair Sameen, Hayder M. Salman, Marek Jaszczur, "A review of hybrid renewable energy systems: Solar and wind-powered solutions: Challenges, opportunities, and policy implications", *Results in Engineering*, 20, (2023)
- [2]. Rajkumari Jagzape, Dipak Bhagat, Sayli Fulzele, Rushikesh Mahajan, Payal Bhagawate, and Snehideep Wanakhede, "Hybrid Power Generation By Using Solar And Wind Energy With Voltage Doubler", *International Research Journal of Modernization in Engineering Technology and Science*, Volume:03, Issue:12, 2021, Pp.: 514-520
- [3]. K. B. Mohan Krishna, and S. Prathap, "Hybrid Power Generation System using Solar and Wind Energy" *International Journal of Engineering Research & Technology*, Vol. 5, Issue 03, March-2016, Pp: 254-258
- [4]. Ashish S. Ingole and Prof. Bhushan S. Rakhonde, "Hybrid Power Generation System Using Wind Energy and Solar Energy", *International Journal of Scientific and Research Publications*, Volume 5, Issue 3, March 2015, Pp: 1-4
- [5]. Peter Jenkins, Monaem Elmnifi, Abdalfadel Youni and Alzarooq Emhamed, "Hybrid Power Generation by Using Solar and Wind Energy: Case Study", *World Journal of Mechanics*, 2019, 9, Pp: 81-93
- [6]. Karim Mousa, Hamzah AlZu'bi and Ali Diabat, "Design of a Hybrid Solar-Wind Power Plant Using Optimization".
- [7]. Medugu, D. W. & Michael, E., "Integrated Solar – Wind Hybrid Power Generating System for Residential Application", *Global Journal of Researches in Engineering: F Electrical and Electronics Engineering*, Volume 14, Issue 4, Version 1.0, Year 2014.



- [8]. Rashid Al Badwawi, Mohammad Abusara & Tapas Mallick, “A Review of Hybrid Solar PV and Wind Energy System”, Smart Science Vol. 3, No. 3, pp. 127-138, (2015).
- [9]. Chedid, “A Decision Support Technique for the Design of Hybrid Solar-Wind Power System”, IEEE Transactions on Energy Conversion, Vol. 13, No. 1, March 1998.
- [10]. Sandeep Kumar and Vijay Kumar Garg, “A Hybrid Model of Solar-Wind Power Generation System”, International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol. 2, Issue 8, August 2013.
- [11]. Vaibhav J. Babrekar, Shraddha D. Bandawar and Ashwini R. Behade, “Review Paper on Hybrid Solar-Wind Power Generator”, International Journal of Computer Applications Volume 165, No.5, May 2017
- [12]. Chandragupta Mauryan. K. S, Nivethitha. T, Yazhini and B, Preethi. B, “Study on Integration of Wind and Solar Energy to Power Grid”, Int. Journal of Engineering Research and Application, Vol. 4, Issue 5, (Version 1), May 2014.
- [13]. V. K. Gajbhiye, Prof. A. A. Kanaskar and Prof. S. S. Jawre, “Solar Wind Hybrid System- A Review”, International Journal of Research in Advent Technology, Vol.5, No.5, May 2017.