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"A STUDY ON HYBRID SOLAR WIND ENERGY SYSTEM USING MULTI OBJECTIVE CONTROL CONVERTER "

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ABSTRACT

An analysis of wind and solar PV hybrid systems provides valuable insights into the feasibility, performance, and economic viability of integrating these renewable energy sources to meet electricity demand efficiently and sustainably. An analysis of wind and solar PV hybrid systems involves evaluating the combined performance, economic viability, and technical considerations of integrating wind turbines and photovoltaic (PV) panels to generate electricity. The analysis begins with a thorough assessment of the wind and solar resources at the site where the hybrid system will be deployed. This involves collecting data on wind speeds, solar irradiance, and other relevant environmental factors to determine the energy potential of both resources.

Key Words: *Hybrid, Renewable, wind turbines and photovoltaic (PV).*

I. INTRODUCTION

Hybrid wind and solar photovoltaic (PV) systems combine two renewable energy sources to generate electricity. These systems leverage the complementary nature of wind and solar resources to enhance reliability, increase energy production, and improve overall system efficiency. Here's an overview of hybrid wind and solar PV systems:

1. Complementary Nature of Wind and Solar Resources:

Wind and solar resources often exhibit complementary characteristics, with wind energy production peaking at different times than solar energy generation. Combining these two sources in a hybrid system can help mitigate intermittency issues and ensure a more consistent power output.

2. System Components:

Wind Turbines: Wind turbines convert kinetic energy from the wind into mechanical power, which is then converted into electricity through a generator.

Solar PV Panels: Solar PV panels convert sunlight directly into electricity using semiconductor materials, such as silicon.

Power Electronics: Inverters are used to convert the DC electricity generated by solar panels and wind turbines into AC electricity suitable for grid connection or local use.

Energy Storage (optional): Batteries or other energy storage technologies can be integrated into hybrid systems to store excess energy for later use during periods of low wind or sunlight.

3. Advantages of Hybrid Systems:

Increased Reliability: By diversifying energy sources, hybrid systems can improve reliability and resilience, ensuring a more stable power supply even when one energy source is unavailable.

Optimized Energy Production: Hybrid systems can maximize energy production by harnessing wind and solar resources simultaneously or sequentially, depending on prevailing conditions.

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Better Grid Integration: Hybrid systems can be designed to better match energy production with demand, reducing the need for backup power and enhancing grid stability.

Reduced Infrastructure Costs: Combining wind and solar resources in a single system can lead to cost savings in infrastructure, land use, and maintenance compared to deploying separate systems.

4. System Design Considerations:

Resource Assessment: Comprehensive analysis of local wind and solar resources is essential for optimizing system performance and sizing components appropriately.

Hybrid Controller: Intelligent control algorithms are used to manage the operation of wind turbines, solar PV panels, and energy storage devices to maximize energy capture and grid integration.

Grid Connection: Hybrid systems can be connected to the grid for exporting surplus energy or operated in standalone mode to provide power to remote areas.

Maintenance and Operations: Regular maintenance and monitoring are crucial to ensuring the efficient and reliable operation of hybrid systems, including routine inspections, component replacements, and performance optimization.

5. Applications:

Hybrid wind and solar PV systems are suitable for a wide range of applications, including residential, commercial, industrial, and utility-scale installations.

They are particularly well-suited for off-grid or remote areas where access to the grid is limited or unreliable, providing a cost-effective and sustainable energy solution.

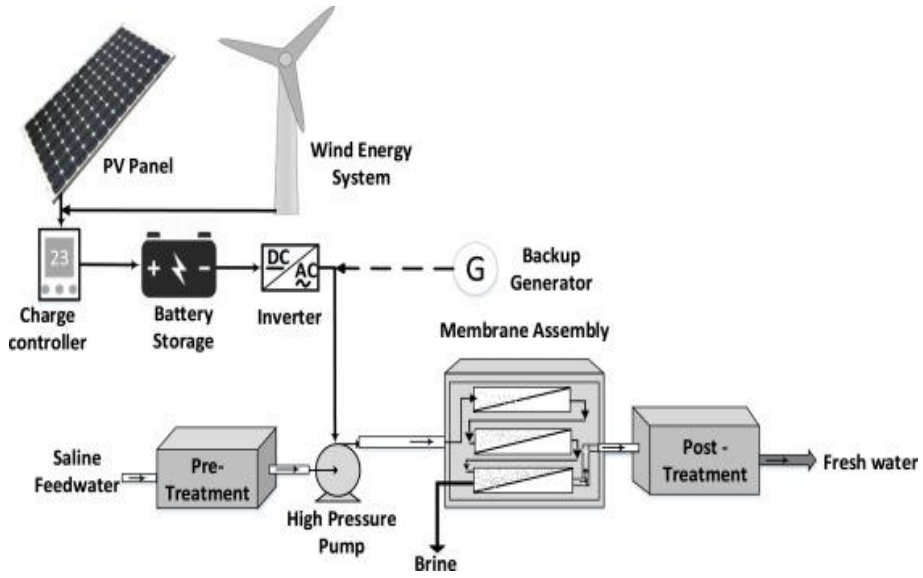

Fig.1 Hybrid wind and solar PV systems

II. LITERATURE REVIEW

J. Godson et al. (2013) Renewable energy sources, namely H. Energy from solar, wind, biomass, hydropower, geothermal energy, and marine resources are considered as technological options for generating clean energy. However, although the amount of electricity generated through the use of solar cells and wind turbines has increased rapidly in recent years, the energy produced from solar and wind power is much less than the energy produced from fossil fuels. Introducing the "Solar/Wind Hybrid Energy System," which generates electricity using renewable energy from sunlight and wind. System control is mainly based on microcontrollers. This ensures optimal use of resources and increases efficiency compared to individual production methods. It also improves reliability and reduces dependence on a single source. This hybrid solar wind power generation system is suitable for both industrial and civil use.

Ali Diabat (2014) Among the many issues facing the world today, there is global consensus that greenhouse gas emissions (GHG) have the greatest negative impact on the environment. Greenhouse gases include carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons. These gases help keep Earth's temperature at a comfortable level for living things, and if their levels drop, temperatures may drop to the point where

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we can't survive. However, because greenhouse gases draw sunlight into the atmosphere but trap heat radiated from the earth's surface, increases in these emissions could increase the Earth's temperature, or global warming, which could be deadly for living things. may be raised to a certain level. . Many scientists also believe that the increase in natural disasters is being caused by climate change, as patterns in the atmosphere and oceans change as the Earth's temperature rises.

Chandragupta Mauryan K.S et al. (2014) Renewable energy now plays an important role in energy systems around the world. Integrating renewable energy resources into the power grid is a difficult challenge. In the integration of renewable resources, communication systems are used as a key technology and play a very important role in the monitoring, operation and protection of both renewable energy generators and power systems. This article introduces the integration of renewable energy, mainly wind and solar energy, into the power grid.

Karim Moosa et al. (2014) Solar energy and wind energy are two of the most profitable renewable energy sources, but there is little research on operating both energy sources in parallel to take advantage of their complementary properties . In this article, we develop an optimal design for a solar-wind hybrid energy system. Variables that are optimized include the number of photovoltaic panels, wind turbine height, number of wind turbines, and turbine diameter. The goal is to minimize costs. Simulation studies and sensitivity analyzes show that hybrid systems can exploit the complementarity of two energy sources and provide reliable energy supply all year round.

Medugu et al. (2014) In this study, a hybrid power system consisting of a PV array and wind turbine with energy storage (battery bank) and power electronics devices was designed and constructed. The system is intended to generate and use electrical energy from multiple sources, as long as at least one is renewable. The efficiency of the designed power electronics device is about 95% for capacitive loads and about 73% for resistive loads. By integrating hybrids, the aim is to electrify residential buildings and their surroundings in order to reduce the need for fossil fuels and increase the sustainability of the electricity supply. This approach makes technical and economic sense for rural electrification.

Ashish S. Ingole et al. (2015) Currently, electricity is the most necessary resource for humanity. All conventional energy resources are being depleted day by day. Therefore, there is a need to switch from conventional energy sources to non-conventional energy sources. This involves combining two energy resources: wind energy and solar energy. This process violates sustainable energy resources without harming nature. The adoption of a hybrid energy system ensures uninterrupted power supply. Basically, this system integrates two energy systems to ensure continuous power supply. Solar panels are used to convert solar energy, and wind turbines are used to convert wind energy into electricity. This electrical energy can be used for various purposes. Electricity is generated at an affordable cost. This article describes power generation that combines two sources to produce electricity at an affordable cost without affecting the balance of nature.

Rashid Al Badwawi et al. (2015) argue that due to the fact that solar and wind energy are inherently intermittent and unpredictable, the further penetration of these types of energy into existing power grids makes them particularly vulnerable to inadequate and adequate performance. He suggested that large-scale power grids and island systems pose and have the potential to create major technical challenges. Storage capacity. By integrating the two renewable resources into an optimal combination, the effects of the variable nature of solar and wind resources can be partially eliminated, increasing the reliability and economics of the entire system. This paper provides an overview of the challenges and opportunities/solutions of integrated hybrid solar photovoltaic and wind energy systems. Voltage and frequency fluctuations and harmonics are major power quality issues in both grid-connected and isolated systems, and have a greater impact when the grid is weak. This problem can be solved primarily through proper design, advanced and fast-response control options, and proper optimization of the hybrid system. This article reviews the main research papers published in the literature regarding optimal sizing design, power electronics topology, and control. This paper provides an overview of the state-of-the-art technology for both grid-connected and stand-alone hybrid solar and wind power systems.

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III. CONCLUSION

Through a systematic analysis of existing literature and real-world examples, the review provides valuable insights for researchers, policymakers, and industry practitioners seeking to maximize the efficiency, reliability, and economic viability of integrated solar PV and wind energy systems. While certain areas for improvement exist, the overall quality and relevance of the review contribute to advancing knowledge and fostering innovation in the field of renewable energy.

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