e-ISSN 2320 –7876 www.ijfans.org
Vol.11, Iss.11, 2022
 UGC CARE Listed (Group -I) Journal

Role of Smart Grid Connection in Renewable Energy Sources

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ABSTRACT: ***One of the many advantages of smart grid technology is a more cost-effective and effectively run electrical system. The main advantage of smart grid technologies, which is the subject of this paper, is that they make it possible to integrate significant amounts of renewable energy into an electricity system. By expanding the capacity of grid-connected sources of clean energy like solar energy, wind energy, as well as photovoltaic systems, modern grid approaches increase the quantity of fluctuating electricity production in the power grid. Secondly, smart grid encourages power distribution energy efficiency. The primary innovations for applications in smart grids are renewable energy sources (RESs) as well as energy storage systems (ESSs), which offer excellent prospects to reduce carbon emissions in metropolitan areas, control frequency and voltage aberrations, and respond to emergency situations whenever the liabilities exceed the production. However, the erratic nature of renewable energy sources and their inherent intermittency place enormous strain on power networks are disused. This study focuses on the role and importance of smart grid in renewable energy. The results conclude that smart grids plays a crucial role in smart grid connection by improving the efficiency and the performance of distribution system which will helps to improve electric supply in future.***

KEYWORDS: ***Electricity, Renewable Energy, Smart Grid, Technology, Voltage.***

1. INTRODUCTION

The modernization of the electricity distribution system is called the "Smart Grid". Since a smart grid enables for two-way exchange of power data instead of a one-way transmission, it varies from a standard system.In order to meet the Renewable Energy for All goal of doubling the proportion of Renewable Energy (RE) in the world's energy mix by 2030, there will need to be a major rise in the production of energy from renewable sources. However, there is mounting evidence in several nations that grid parity for high penetration levels of renewable energy is both technically and financially possible[1]. This is especially true as grid parity for both solar and wind energies approaches. However, to effectively manage the continued and extended increase of the percentage of renewable energy in both centrally managed and decentralized networks, a new strategy that makes full use of "smart grids" and "smart grid technologies" is needed[2].

Smart functionality is already included into certain grid systems, however it is mostly employed to regulate supplies and requirements.Smart grids integrate information and communication technologies into every part of power production, distribution, as well as consumption in order to minimize environment impact, increase marketplaces, increase dependability, as well as improve service while also lowering costs and increasing efficiency[3]–[5]. Every level of technology, from generational devices to home appliances, may use these technologies. As a result, smart

grids can be extremely important in facilitating the transition to a sustainable energy future in a number of ways, including continuing to support the decentralized output of electricity, allowing the integration of high shares of renewable sources, enhancing flow of information, increasing consumer involvement, as well as improving system control, and enabling demand-side adaptability. The below Figure 1 shows the use of smart grid connection for the generation of renewable energy sources.

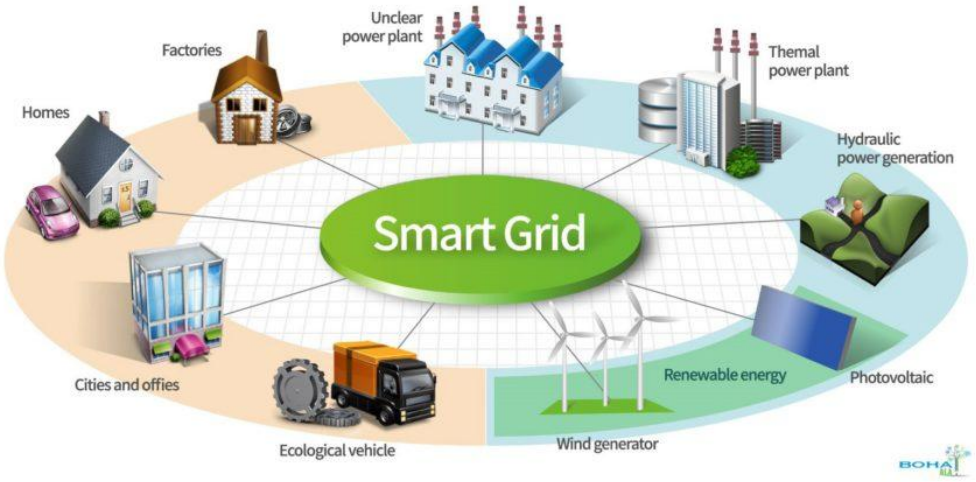

Figure 1: Represents the Generation of Renewable Energy Through Smart Grids.

The globe's population growth drives up energy demand, and approximately 1.6tonnes of oil are used year. As a result, this consumption is responsible for 3/2 of CO2 emissions. Throughout 2050, yearly consumption will have doubled if population growth keeps on its current pace. Additionally, the predicted population of the planet is close to 9 billion, and it is indisputable that consumption has an adverse impact on the environment[6]. Therefore, it is necessary to use or choose for natural, renewable, and safe sources of energy in order to lessen the negative consequences of fossil fuel-based sources. There are several renewable energy sources, including geothermal, hydropower, biomass, and the sun's energy.

1.1. Challenges of Integrated Renewable Energy in Grid System:

In recent years, the Flexible AC Transmission System (FACTS) technologies has been employed for efficient energy utilization, demand management, voltage stabilization, energy quality enhancement, reactive power compensation, as well as harmonic reduction. Reactive energy compensation, steady state and transient voltage stability augmentation, voltage control management, voltage regulation, power conditioning, and quality improvement are further uses. Power electronic devices now play a larger and more important part in efficient electrical usage, improved security, and stability of the electric utility grid thanks to the growing use of renewable and Distributed Generation (DG).Despite the advantages of integrating renewable sources of energy into the Grid, there are several number of difficulties that are seen to be a problem for this incorporation. The below Figure 2 shows the Challenges of Integrated Renewable Energy in Grid system.

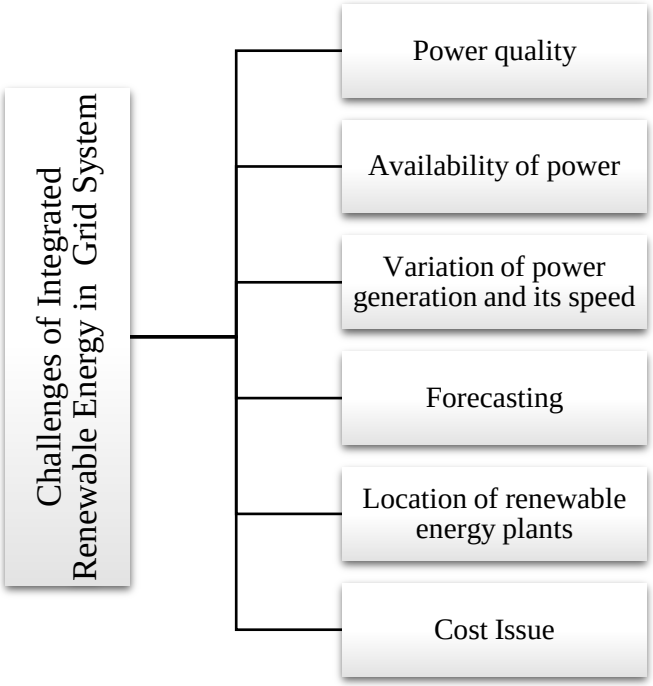

Figure 2: Depicts the Challenges of Integrated Renewable Energy in Grid System.

2. DISCUSSION

Standards and Communication Technologies Smart Grid BackgroundMetering became necessary as soon as electricity distribution systems were established. However, contemporary smart grid technology employs two-way metering and may turn appliances on or off in accordance with demand and off-peak pricing. The first devices were used for metering usage. Many barriers to smart grid technologies have been removed during the past century. The first attempt at a smart grid was Edison's 1882 Jewel Roadside Framework, which used a permanent magnets to open and shut circuit design to signal high and low wattage using various colored bulbs.

2.1. Importance of Smart Grids:

A modernized electrical grid known as a "smart grid" makes use of analog or electronic information and communication technology to automatically collect as well as act on data, such as data about the behaviours of suppliers and consumers, in order to increase the efficiency, dependability, economics, and sustainable development of the electricity generation and distribution.Our civilization has been more digitalized over the last ten years, making us more reliant on power than ever before[7]–[9]. Over the next twenty years, this requirement will quadruple. Our demand for innovative network topologies, monitoring systems, and greener electrical resources is growing. For the efficient implementation and operation of next-generation power grids, widely recognized as "smart grids", from the generation of electric power to its transmission and distribution systems, an incorporated highly performant, robust, effective, efficient, available, as well as secure communications network is essential. In this situation, the Smart grid may be viewed as a fusion of the communications infrastructure and the electrical

infrastructure. Additional knowledge, communications, and networking technologies will make it easier to better govern the available resources and future intelligent systems[10], [11].

The primary concept of smart grid system is to integrate control, communication, monitoring, and analysis into an electrical network. A smart grid uses a variety of technology ideas to accomplish this. Integrated communications is the first idea employed in smart grid technologies. Secure end-to-end networks are essential for smart grids. Modems have recently been utilized to gather data. Power-line carrier communications, fiber optics, and wireless networks are examples of network technologies utilized in smart grid technology. The technology is employed to provide data security, effective asset management, and optimized data sharing.

2.2. Benefits of Smart Grids:

In the near future, the smart grid network will operate more effectively than the current grid, delivering additional services that we expect in a cost-effective, safe, and secure manner in an era of rising costs, as well as providing significant general benefits, such as fewer negative environmental effects. The Smart grid really combines a number of different technologies. Smart grid can provide a number of possible environmental and economic advantages by judiciously combining various technologies. The below Figure 3 depicts some benefits of smart grids.

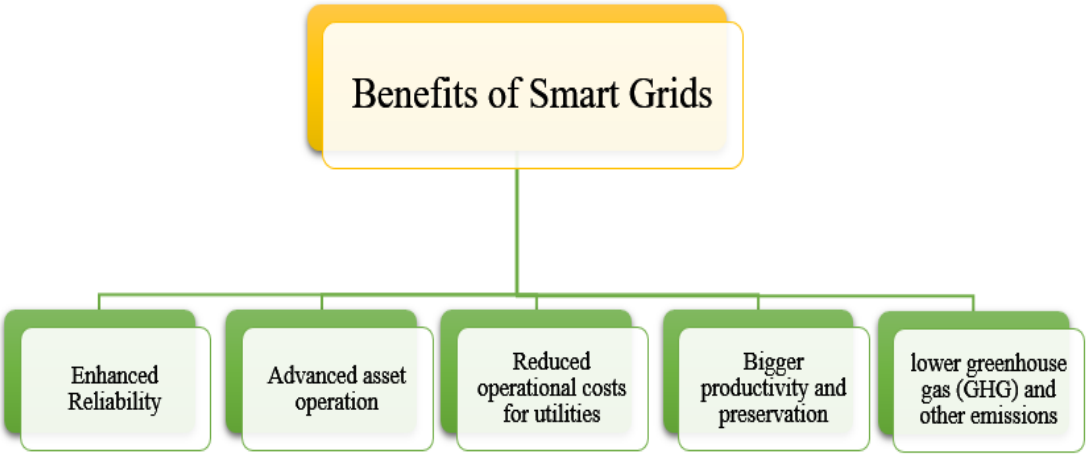

Figure 3: Representing the Advantages of Smart Grid Networks.

The creation of smart grids will alter how power is now provided and used. Modern communication, information, control, and monitoring systems all help the development of smart grids. They provide the adaptability, productivity, and mobility required to manage increased power output, growing demand, erratic use patterns, and gradually strained transmission and distribution facilities. Additionally, they offer exceptional control over power networks, which is crucial for reducing inefficient energy usage and integrating tiny, diverse energy sources into the grid. Additionally, smart grids will significantly contribute to reducing greenhouse gas emissions.

3. CONCLUSION

In order to improve the efficiency, dependability, economics, and sustainable growth of the electricity generation and distribution, a modernized electrical grid known as a "smart grid" uses analogue or electronic information and communication technology to automatically collect as well as act on data, such as data about the behaviours of suppliers and consumers. Over the past 10 years, our society has become more digitalized and power-dependent than ever. This demand will increase fourfold during the next twenty years. Our need for novel network topologies, monitoring tools, and environmentally friendly electrical supplies is expanding. However, because of the unpredictable nature of renewable energies and its innate intermittent nature, power networks are under a lot of stress. The findings suggest that smart grids are essential for connecting to other smart grids because they enhance the effectiveness and performance of the distribution system, which will assist to increase the supply of electricity in the long run.

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