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A STUDY OF RENEWABLE ENERGY IN SMART GRID TECHNOLOGY

S.Umamaheswari[1], M.Thilagavathi[2], S.Sivaranjani[3]
N. Mohananthini[4*], M.Selvakumari[5], S. Saravanan[6]
[1,2,3]UG Student, [4]Associate Professor*, [5]Assistant Professor, [6]Professor,
Department of Electrical and Electronics Engineering, Muthayammal Engineering College,
Rasipuram, Tamilnadu, India.
Corresponding author: mohananthinin@gmail.com*

ABSTRACT
Smart Grid is a concept for transforming the electric power grid by using advanced automatic control and communications techniques and other forms of information technology. It integrates innovative tools and technologies from generation, transmission and distribution all the way to consumer appliances and equipment. Renewable energies are ways to generate energy from (theoretically) unlimited natural resources. Smart grid technology is enabling the effective management and distribution of renewable energy sources such as solar, wind, and hydrogen. The smart grid connects a variety of distributed energy resource assets to the power grid. The 'smart grid' would be characterized by more distributed power generation, with an emphasis on renewable and sustainable technologies, as well as a strong emphasis on information on both supply- and demand-side. In addition, inexpensive energy storage capacity would be increased. The goal of Renewable energy integration is to advance system design, planning, and operation of the electric grid to: reduce carbon emissions and emissions of other air pollutants through increased use of renewable energy and other clean distributed generation. The need of integrating the renewable energy into power system is to minimize the environmental impact on conventional plant. In smart grids, users can influence utilities by providing DG sources such as photovoltaic modules or energy storage devices at the point of use, and reacting pricing signals.

KEYWORDS:
Electric power grid, Smart grid, Renewable energy and Security

I. INTRODUCTION

Smart Grid is a way to address an aging energy infrastructure that needs to be upgraded or replaced. It's a way to address energy efficiency, to bring increased awareness to consumers about the connection between electricity use and the environment

A smart grid entails technology applications that will allow an easier integration and higher penetration of renewable energy. It will be essential for accelerating the development and widespread usage of plug-in hybrid electric vehicles (PHEVs) and their potential use as storage for the grid.

In short, the digital technology that allows for two-way communication between the utility and its customers, and the sensing along the transmission lines is what makes the grid smart. Like the Internet, the Smart Grid will consist of controls, computers, automation, and new technologies and equipment working together, but in this case, these technologies will work with the electrical grid to respond digitally to our quickly changing electric demand.

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II. LITERATURE SURVEY AND CHALLENGES ON SMART GRID

Hammad A Khan *et al.* [1] proposed a global concern about the economic downturn and a greener Earth which is related to a better and efficient method to generate and transmit electric power. With the advent of the plug-in electric vehicles and renewable energy generators, a smarter, more efficient and customer-friendly power grid is essential. Progress is underway for the development of technologies which can improve the quality, efficiency & reliability of the existing transmitted electric power. Ilhami colak et al.[2] explained the infrastructure of the national grids of many countries is very old and includes classical technologies in terms of power production, transmission, and distributions. Their highlights the effects of the smart grid technologies on the national grids and proposes some applicable suggestions to authorities in order to convert their classical grid system to the smart grid system.

Ran Liu *et al.* [3] explained with the development of power Internet of Things technology, the communication needs of smart grid are increasing. Network slicing technology, as a key technology for 5G empowering vertical industries, uses virtual private network technology to provide the power industry with end-to-end flexible and customized 5G services which is large bandwidth, low latency and high reliability through the slicing platform. Alicia Tang Yee Chong *et al.* [4] described a brief review on smart grids. Environmental destruction that is marked by high CO2 level or green-house gas emissions due to excessive use of fossil fuels is a serious challenge that must be minimized immediately. The introduction of smart grid technology is a necessity to reduce the impact of global warming while encouraging efficiency, reliability and effective governance in the supply of electrical energy.

Rosario Morello *et al.* [5] discussed the advancement on the emergent technologies, implementations, and applications in smart power grid and city. Their work to provide readers with a clearer understanding of the current state of the art about this topic by describing some applications and suggesting new features and ideas in the field of sensors and sensing systems dedicated to smart electric grid, power networks, and smart cities. Zhiquan Dong *et al.* [6] explained the smart grid situation awareness technology is a monitoring system composed of advanced monitoring equipment, which can be more intuitive and predictable in the control of power grid. The base of analysis of fundamental theory research of future smart grid situation awareness, typical applications of it in the operation and control of smart grid are proposed

Shuo Li *et al.* [7] explored the source of electric power big data and the application of three big data technologies on the demand side of smart grid. Then, the research status of load forecasting on the demand side of smart grid was summarized, and the neural network has been used to carry out load forecasting with examples. Their results have illustrated the importance of influencing factors to accurate prediction results, and considering the new influencing factors brought about by the ubiquitous electric power Internet of Things, and the types of influencing factors were summarized.

Kartik Sharma *et al.* [8] described the Electrical Energy demand is increasing due to increasing Industry and population. There is a need to build an intelligent system to address and deal with large energy consumption with high losses to monitor & deal with it called "Smart Grid". Communication infrastructure is a necessary part to achieve an intelligent system "smart Grid". Tradition can reduce carbon fuel consumption with renewable energy sources such as wind-solar etc. A consumer can reduce energy expenditure by using smart appliances and renewable energy resources, also can avoid operation in peak hours.

Katayoun Rahbar, *et al.* [9] proposed an algorithm that jointly optimizes the energy charged/discharged to/from the shared ESS given a profit coefficient set that specifies the desired proportion of the total profit allocated to each user, subject to practical constraints of the system.
Abdulfetah Shobole et al. [10] discussed that the power balance between supply and demand is essential for reliable and stable operation of power grids. Their method is feasible in smart grid as communication and advanced information technologies are used for real time data exchange about the generation, demand, storage, market,

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environmental conditions, and other necessary data. These data are important in making decisions about real-time supply and demand balancing in the smart grid.

Mohammad Hasanuzzaman Shawon, *et al.* [11] summarized the multi-agent concept of smart grid highlighting their applications through a detailed and extensive literature survey on the related topics. Ahmed S. Musleh et al. [12] reviewed different prospects, advantages, approaches, and technical challenges of utilizing the block chain technology in the smart grid, and presents frameworks for key smart grid block chain-based applications; more specifically, it is shown that how the block chain can be used as the smart grid's cyber-physical layer.

Zeineb Rania Labidi et al. [13] proposed a holistic approach of the model-based fuzzy control design for renewable energy power plants (RPP). Michail Tyagunov *et al.* [14] simulated the work of a microgrid, based on renewable energy sources, and conduct physical modeling, based on the equipment of the laboratory complex "intelligent power systems with renewable energy sources" describing the work with software. The article provides the characteristics of the blocks, which simulate these or those aggregates in a real micro grid. Besides, the article considers the creation of a SCADA system and a special control code. The main problem of micro grids with renewable energy sources is associated with the instability of power generation in the RES-based plants due to weather changes. A complete electrical circuit to connect the units in a laboratory complex is presented.

Gareth Harrison *et al.* [15] discussed the problem of minimizing losses in distribution networks has traditionally been investigated using a single, deterministic demand level. Their work demonstrate the significant impact that considering time-varying characteristics has on the energy loss minimization problem and highlight the gains that the flexibility provided by innovative control strategies can have on both loss minimization and generation capacity.

Goran Strbac *et al.* [16] explained the increasing penetration of renewable distributed generation (DG) sources in distribution networks can lead to violations of network constraints. Thus, significant network reinforcements may be required to ensure that DG output is not constrained. Amaripadath *et al.* [17] discussed the Smart electrical grids today are increasingly integrating new technologies such as electric vehicles, smart metering, and demand side management. Their aim to create an overview of the existing power quality disturbances in traditional as well as smart grids. The techniques to measure and detect supra harmonic emissions in smart grids. The parameters and configurations to be performed during the measurements in the smart grid platform are also discussed.

Ilhami colak *et al.* [18] explained the infrastructure of the national grids of many countries is very old and includes classical technologies in terms of power production, transmission, and distributions. In addition, controllability and monitor ability of these systems are also not satisfactory. The highlights the effects of the smart grid technologies on the national grids and proposes some applicable suggestions to authorities in order to convert their classical grid system to the smart grid system.

Surekha S. *et al* . [19] explored role of smart grid in the effective integration of renewable energy to meet growing energy demand management. It's possible to manage energy demand of booming population by using smart home technology. Smart home technology emerging from smart grid sector contributes effective energy management by using concept of home area network (HAN). In the home area network (HAN) smart home appliances & smart meters communicate intelligently to manage Peak electric demand. Jizhong Zhu *et al.*[20] described that the accommodation of renewable energy has become a worldwide problem restricting the development of power grid. The development of energy internet will provide a new way to solve this problem. This paper analyzed the key factors influencing the accommodation of renewable energy in our country, as well as the basic connotation of energy internet.

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III. RENEWABLE ENERGY IN SMART GRID

SMART GRID

The Smart Grid represents an unprecedented opportunity to move the energy industry into a new era of reliability, availability, and efficiency that will contribute to our economic and environmental health. During the transition period, it will be critical to carry out testing, technology improvements, consumer education, development of standards and regulations, and information sharing between projects to ensure that the benefits we envision from the Smart Grid become a reality.

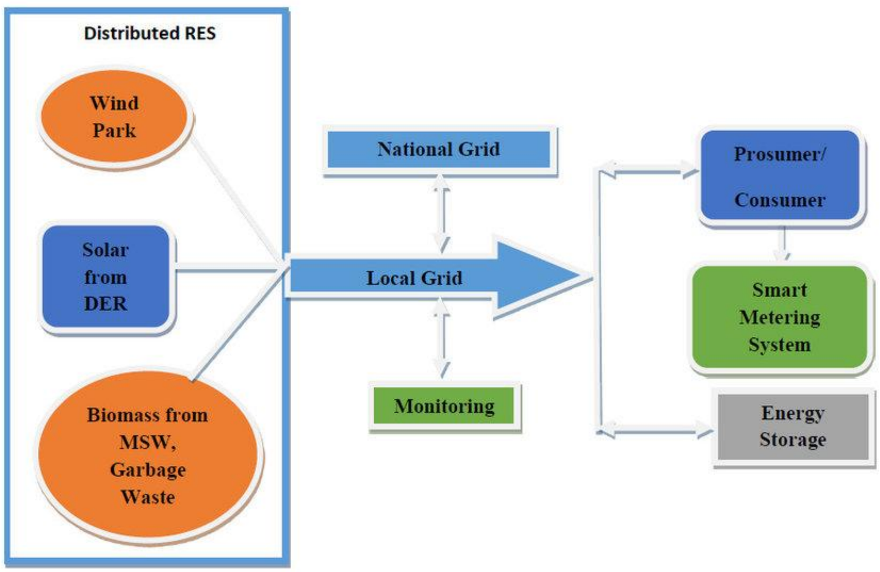

Fig 1. Block diagram of a smart grid

Major components of a power grid

The grid consists of countless complex interconnections, however there are three main sections electricity generation, transmission and distribution.

Block diagram of a smart grid as shown in figure 1. The main components of a Smart Grid basically include electric power substations, electric power generators, distribution and transmission lines, controllers, collector nodes, smart meters, and also distribution & transmission control centers. Smart Grid is used to monitor the power supply. Consumers' data is collected using a smart grid, and that data is analyzed and distributed to the consumers. The real example of a smart grid device is a smart meter

Accordingly, the Smart Grid is characterized by following goal and functionalities:

- Consumer Participation.
- Real Time Pricing.
- Distributed Generation: Incorporation of renewable energy resources into the grid.
- Power System Efficiency.
- Power Quality.

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- New products in terms of Value Added Services (VAS)

These advanced technologies include advanced sensors known as Phasor Measurement Units (PMUs) that allow operators to assess grid stability, advanced digital meters that give consumers better information and automatically report outages, relays that sense and recover from faults in the substation automatically.

Benefits of Smart Grid

- Integrate isolated technologies: smart grid enables better energy management
- Protective management of electrical network during emergency situation
- Better demand, supply/ demand response
- Increased demand for energy: Requires more complex and critical solutions with better energy management
- More efficient transmission of electricity
- Quicker restoration of electricity after power disturbances
- Reduced operations and management costs for utilities, and ultimately lower power costs for consumers
- Reduced peak demand, which will also help lower electricity rates
- Increased integration of large-scale renewable energy systems
- Better integration of customer-owner power generation systems, including renewable energy systems

RENEWABLE ENERGY SOURCES

A renewable energy source means energy that is sustainable - something that can't run out, or is endless, like the sun. It means sources of energy that are alternative to the most commonly used non-sustainable sources - like coal. These resources are either available with no time limit or replenish more quickly than the rate at which they are consumed. Renewable energy is energy generated from natural resources—such as sunlight, wind, rain, tides and geothermal heat. Renewable energy is energy that is generated from natural processes that are continuously replenished. This includes sunlight, geothermal heat, wind, tides, water, and various forms of biomass. In comparison, renewable energy sources get renewed very quickly and hence are also called non-fossil fuel. Hence these are much more efficient than non renewable energy options. For example, wind energy converts as much as 1164% of original energy into electricity.

Block diagram of a Renewable energy sources as shown in figure 3. Generating energy that produces no greenhouse gas emissions from fossil fuels and reduces some types of air pollution. Diversifying energy supply and reducing dependence on imported fuels. Creating economic development and jobs in manufacturing, installation, and more. Sun is the source of all energies. Some of these transformations result in renewable energy flows such as biomass and wind energy. Renewable energy technologies provide an excellent opportunity for mitigation of greenhouse gas emission and reducing global warming through substituting conventional energy sources.

Electricity from renewable resources such as solar, geothermal, and wind generally does not contribute to climate change or local air pollution since no fuels are combusted. Atomic energy, solar energy, and energy from wind and bio fuels are just a few of the promising alternatives for a cleaner and greener future. Other relatively new sources of energy such as fuel cells, geothermal energy, and ocean energy are also being explored.

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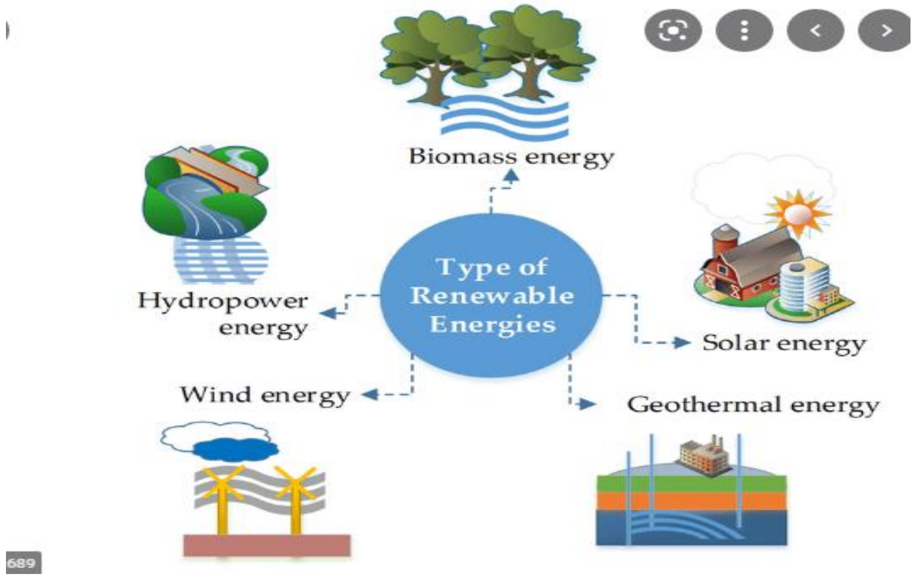

Fig 2. Block diagram of a Renewable energy sources

Renewable energy in smart grid

A smart grid system is a self-sufficient electricity network system based on digital automation technology for monitoring, control, and analysis within the supply chain. This paper discusses literature surveys of some researches and studies on Smart Grids technology. Smart Grid Technologies include integrated communications, sensing and measurement technologies, advanced components, advanced control methods, and improved interfaces and decision support. Smart Grid must have self-healing, consumer participation, resist attack, high-quality power, accommodate generation options, enable electricity market, optimize assets, enable high penetration of intermittent generation sources.

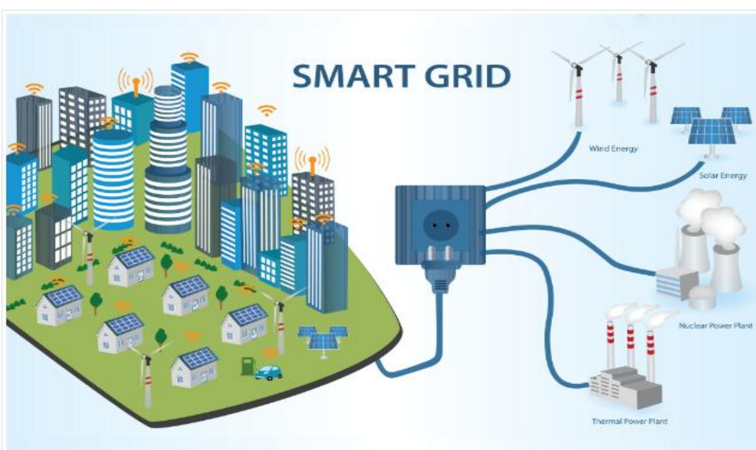

Fig 3. Block diagram of a renewable energy in smart grid

The Block diagram of a renewable energy in smart grid as shown in Figure 3. Power can only be distributed from the main plant using traditional energy infrastructure. Two-Way Distribution: While power is still distributed from the primary power plant, in a smart grid system, power can also go back up the lines to the main plant from a secondary provider.

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REFERENCES

1. Hammad A Khan, Zhen Xu, Herbert Iu and Victor Sreeram, "Review of technologies and implementation strategies in the area of Smart Grid", 2009 Australasian Universities Power Engineering Conference.
2. Ilhami colak, Ramazan bayindir and Seref sagiroglu, "The Effects of the Smart Grid System on the National Grids", 8th International Conference on Smart Grid .
3. Ran Liu, Xingyuan Hai, Siwei Du, Lingkang Zeng, Jie Bai, Junyu Liu "Application of 5G network slicing technology in smart grid Published in 2021 IEEE 2nd International Conference on Big Data, Artificial Intelligence and Internet of Things Engineering (ICBAIE)
4. Alicia Tang Yee Chong, Moamin A Mahmoud, Fung-Cheng Lim and Hairoladenan Kasim, "A review of Smart Grid Technology, Components, and Implementation" Publisher: IEEE Published in 2020 8th International Conference on Information Technology and Multimedia (ICIMU).
5. Rosario Morello, Subhas C. Mukhopadhyay, Zheng Liu, Daniel Slomovitz and Subhransu Ranjan Samantaray, "Advances on Sensing Technologies for Smart Cities and Power Grids: A Review", IEEE Sensors Journal, Volume: 17, Issue: 23, Dec.1, 1 2017, pp 7596 -7610.
6. Zhiquan Dong, Tianqi Xu, Yan Li, Peilei Feng, Xin Gao and Xueying Zhang, "Review and application of situation awareness key technologies for smart grid", IEEE Conference on Energy Internet and Energy System Integration, 2017.
7. Shuo Li, Yanchi Zhang and Zichen Li, "Application and Development Review of Big Data Technology on Smart Grid Demand Side", 2019 IEEE 8th International Conference on Advanced Power System Automation and Protection (APAP).
8. Kartik Sharma and Kalpana Chauhan, "Smart Grid System: A Review", 2020, International Conference on Smart Technologies in Computing, Electrical and Electronics (ICSTCEE).
9. Katayoun Rahbar, Mohammad R. Vedady Moghadam, Sanjib Kumar Panda and Thomas Reindl Shared, "Energy storage management for renewable energy integration in smart grid", IEEE Power & Energy Society Innovative Smart Grid Technologies Conference (ISGT), 2016.
10. Abdulfetah Shobole, Mohammed Wadi, Mehmet Rıda Tür and Mustafa Baysal, "Real time active power control in smart grid" IEEE 6th International Conference on Renewable Energy Research and Applications (ICRERA), 2017.
11. Mohammad Hasanuzzaman Shawon, S. M. Muyeen, Arindam Ghosh, Syed Mofizul Islam and Murilo S. Baptista, "Multi-Agent Systems in ICT Enabled Smart Grid: A Status Update on Technology Framework and Applications", IEEE Access, Volume: 7, Page(s): 97959 – 97973, 2019.
12. Ahmed S. Musleh, Gang Yao and S. M. Muyeen, "Blockchain Applications in Smart Grid–Review and Frameworks", IEEE Access,Volume: 7, Page(s): 86746 – 86757.
13. Horst Schulte, Florian Pöschke and Zeineb Rania Labidi, "Model-based Fuzzy Control of Renewable Energy Power Plants: A holistic approach", IEEE International Conference on Fuzzy Systems (FUZZ-IEEE), 2019.
14. Philipp Molotov, Alexey Vaskov and Michail Tyagunov,"Modeling Processes in Micrograms with Renewable Energy Sources", , 2019.
15. Luis Ochoa and Gareth Harrison, "Minimizing energy losses: Optimal accommodation and smart operation of renewable distributed generation" IEEE Power and Energy Society General Meeting, 2011.
16. Ioannis Konstantelos, Spyros Giannelos and Goran Strbac, "Strategic valuation of smart grid technology options in distribution networks", IEEE Power & Energy Society General Meeting, 2017.

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International Journal of Engineering Technology Research & Management

17. D. Amaripadath, R. Roche, L. Joseph-Auguste, D. Istrate, D. Fortune, J.P. Braun and F. Gao, "Power quality disturbances on smart grids: Overview and grid measurement configurations", International Universities Power Engineering Conference (UPEC), 2017.
18. Ilhami Colak, Ramazan Bayindir and Seref Sagiroglu, " The Effects of the Smart Grid System on the National Grids", 8th International Conference on Smart Grid, 2018.
19. Surekha S. and Bhalshankar. C. S., "Thorat Integration of smart grid with renewable energy for energy demand management", International Conference on Signal Processing, Communication, Power and Embedded System, 2016.
20. Jizhong Zhu, Pingping Xie, Peizheng Xuan, Jin Zou and Pengfei Yu, "Renewable energy consumption technology under energy internet environment", IEEE Conference on Energy Internet and Energy System Integration, 2017.