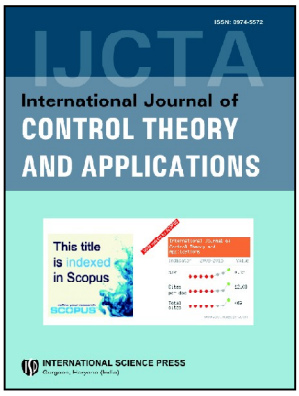

International Journal of Control Theory and Applications

ISSN : 0974-5572

Volume 9 • Number 47 • 2016

Renewable Energy Sources for Smart-Grid

[1*]Rajesh Kumar S., [2]N. Ramaraj and [3]D. Anil Kumar

Ph. D Scholar[1], Professor[2], Asst. Professor[3]
** Department of Electrical & Electronics Engineering, Vignan's University, Guntur, India*
E-mail: rajeshkumar_samala@yahoo.co.in

Abstract: Usually, the flow of electrical energy from the grid has been only in one direction i.e. from a centralized power station to the consumer. With the introduction of small generation methods at the consumer end, the electrical energy is now flowing in either direction. The traditional electric grid is a network of interconnected circuits with that the flow of electrical energy from power stations that produce electricity. After step up the voltage level that was connected directly to the transmission systems. This kind of power transmission has many disadvantages. Along with the long transmission of power problems, such networks produces greenhouse gas production, production of nuclear waste, low efficiencies also power loss, environmental distribution where the transmission lines are constructed, and security related problems. Inspiration methodologies by some National governments are driving an increasing installation of a wide variety of Distribution Generation (DG). DG stations can be directly connected to Distribution Systems (DS). The major advantage of placing a grid-connected distribution generation network is the reducing transmission losses and maintaining of a good voltage profile. For that there are many renewable methods like wind, solar and fuel cells etc., which generate alternating energy. This paper suggested an importance of locating renewable energy sources for Smart Grids (SGs) at different locations in the distribution networks.

***Keywords*:** Renewable energy sources, Smart Grid, Smart grid technology application, Micro grid.

1. INTRODUCTION

Traditional electrical power network is a complex network which includes different subsystems; they can be simply divided into demand-side and supply-side. Generally, the supply-side consists of thousands of generators and they are interconnected by a grid through transmission lines and supplying energy to various thousands of substations. The demand-side starts from every substation, where the distribution network has a simple topology and connects to a large number of users [1]. Usually the power generating stations are not located near to the end users. The transmission and distribution of the electricity is having considerable initial investments and regularly give up great loss of energy [2]. The thought introducing of smart grids in distribution system is one of the key element and is estimated to minimize the distance between production of energy and utilization [3]. SGs are become still more relevant in light of the growing introduction of small-scale power generators, individually

owned Non-conventional or renewable resources (such as wind turbines and solar panels), and electric vehicles, which gives rise to irregularly distributed energy sources.

2. SMART GRID

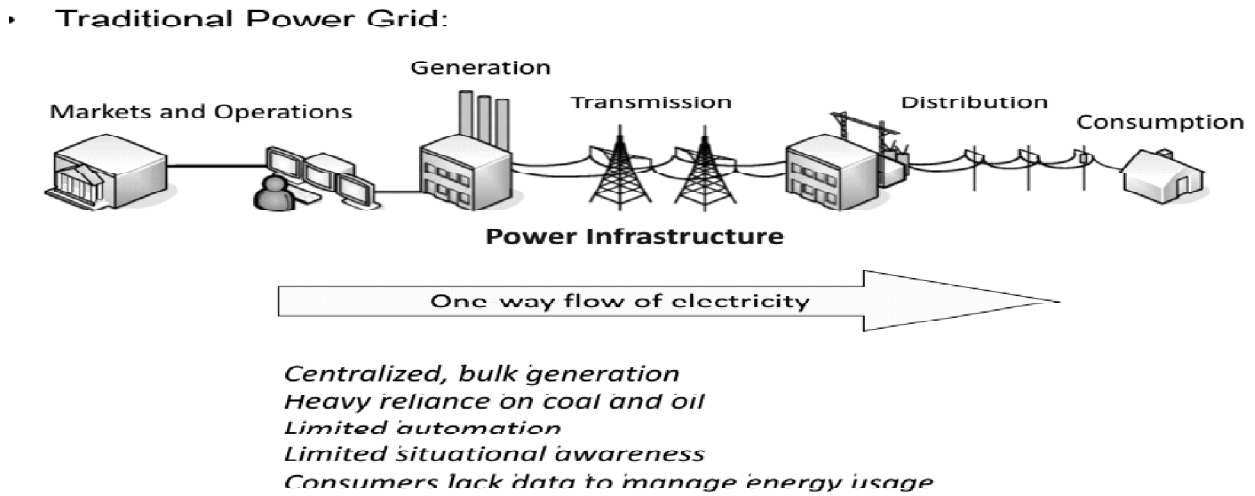

Figure 1: Traditional Power Grid

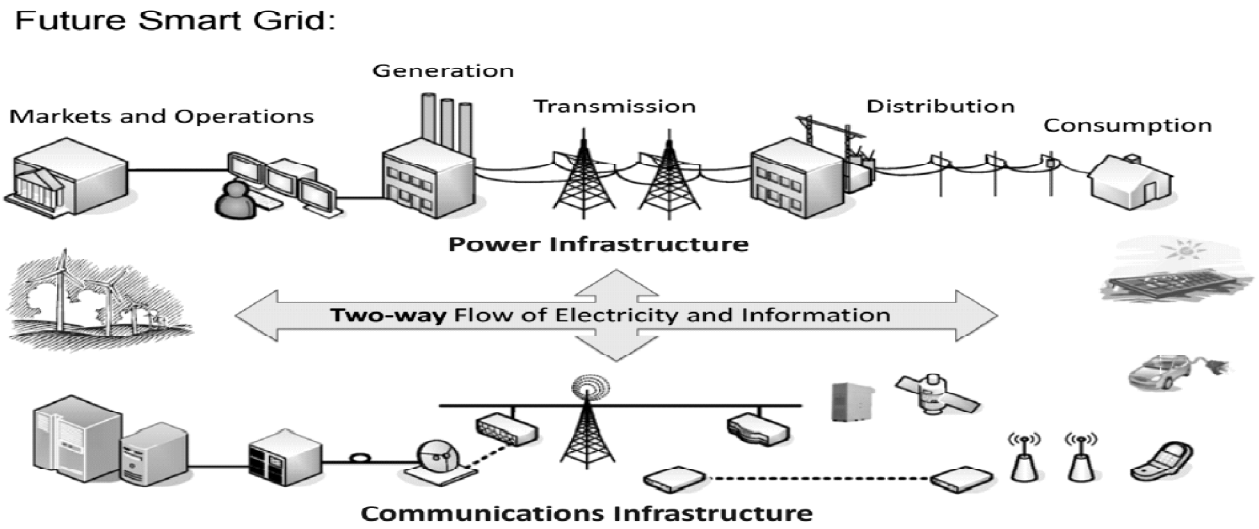

Figure 2: Future Smart Grid

"Modern Smart Grid" usually accredit to a type of technique which users can utilizing to carry utility power sending networks towards the next generation, by utilizing computerized remote operated also mechanization. Those networks can make probably with both way digital interaction techniques and digital refinement it has been utilized for many years in many organizations. Those are opening will be utilized on power systems, through the electrical energy stations also wind stations or solar cells all the way to the users of power at houses and industries. SGs present various advantages of utilities also customers - typically visible in large advancements in power effectiveness also consistency on power grid also in power utilizes houses and industries.

Similar to the conventional grids, SG is having the capability of combining such renewable electricity as wind and solar. It is the combination of various technologies like phasor measurement technology, information technology, supercomputer technology, telecommunication technology, control and managing technology. [4]

The major objectives of this paper are intended to create a possibility study on matching the energy requirement and supply. The wind and solar energy were utilized as the local energy resource, possibly with a storage part to attain an energy balance and a charging system for sustainable mobility to develop the grid. To achieve these goals, following objectives were formulated:

- Improving Energy Consistency also Quality
  - Improved controlling with sensor systems and communications
  - Enhanced and quicker matching of generation and load.
- Reducing the requirement to built stand-by (Max Demand) Power stations.
  - Improved load side organization.
  - The utilization of superior recording instruments.
- Enhancing the capacity and efficiency of available power grid.
  - Accordingly, improved organize and supply organization in real-time.

3. NON-CONVENTIONAL RESOURCES

Renewable or regenerative energy – is the power from sources that, according to individual scale, are never-ending. The essential theory of the utilization of non-conventional energy consists of extracted from that continually happening in the atmosphere and processes providing for the technical purpose. Non-conventional energy comes through ordinary sources those are solar radiation, water flows, wind, tidal and geothermal heat, which are renewable.

Renewable sources available more ample geographical places, in distinction to other energy resources; those are focused in a limited number of countries. Quick consumption of non-conventional energy sources and power efficiency is ensuing in important power safety, atmosphere variation improvement, and economic benefits.

Types of RENEWABLE ENERGY SOURCES:

- Wind generation is harnessed by locating wind-mills that is utilized for lifting water, grinding grain and producing power.
- Sun is also cause of total energy on the earth. That is very plentiful, never-ending and worldwide resource of power.
- Geothermal source is the heat from the interior of earth.
- Bio-mass refers to total plant material and animal dung when taken as a power source. Few significant verities of bio-mass are low-grade wood, municipal waste, bagasse, farm animal and human waste.

Significance of Renewable resources of power:

- They are abundant in nature.
- These are renewable resources.
- Renewable resources of power are free from pollution and eco-friendly.

Unlike the standard power grid based on conventional energy power plants, the smart grid based on renewable energy sources will gives us the best utilization of alternating sources, such as wind, fuel cells and solar. They

normally attain their maximum producing capability in off-peak using hours. This will cause a power redundancy in those times. Such power storage equipment such as batteries and novel off-peak loads as electric vehicles, which minimize the total power redundancy and improve the power operation, are included in the modern smart grid [5].

Table 1
Comparison of different characteristics between Today's Grid and the Modern Smart Grid

Today's Grid	*Principal Characteristic*	*Modern Grid*
Responds to prevent further damage. Focus is on protection of assets following system faulty	Self-heals	Automatically detects and responds to actual and emerging transmission and distribution problems. Focus is on prevention. Minimizes consumer impact.
Consumers are uninformed and non-participative with the power system	Motivates & includes the consumer	Informed, involved and active consumers. Broad penetration of Demand Response
Vulnerable to malicious acts of terror and natural disasters	Resists attack	Resilient to attack and natural disasters with rapid restoration capabilities
Focused on outages rather than power quality problems. Slow response in resolving PQ issues	Provides power quality for 21st century needs	Quality of power meets industry standards and consumer needs. PQ issues identified and resolved prior to manifestation. Various levels of PQ at various prices.
Relatively small number of large generating plants. Numerous obstacies exist for interconnecting DER	Accommodates all generation and storage options	Very large numbers of diverse distributed generation and storage devices deployed to complement the large generating plants. "Plug and-play" convenience. Significantly more focus on and access to renewables
Limited wholesale markets still working to find the best operating models. Not well integrated with each other. Transmission congestion separates buyers and sellers	Enables markets	Mature wholesale market operations in place well integrated nationwide and integrated with reliability coordinators. Retail markets flourishing where appropriate. Minimal transmission congestion and constraints

4. OPTIMAL LOAD FLOW

OLF techniques are generally grouped as Conventional and Smart. The conventional methods comprise the well known methods like Gradient technique, Newton-Raphson technique, Quadratic Programming technique, Linear Programming technique and Interior point technique. Smart technologies comprise the newly improved and accepted technique like Genetic Algorithm, Particle swarm optimization. Objective of OLF is to optimize a certain purpose, subject to the system load flow equations and network and device working restrictions. The most favorable state is reached by adjusting the accessible controls to reduce an objective purpose focus to particular working and safety requirements. Constraints may consist of generation and load balance, load flow equations, bus voltage limits and active and reactive power limits. The aim is to solve an optimal power flow difficulty with the reduction of total production cost by using utilizing an optimization technique.

5. OPTIMAL LOAD FLOW

The most important scheme is as explained before at the beginning that is to connect a smart grid as a correlation among the electric utility and industrial plant. At each time of the day there are 2 types of costs, the selling as well as buying costs. They are related with each as demand and supply. The vary of costs is depending on the time varying demand charge. The demand changes all the time in a day depends upon its utilization. And this can be considered by the load and the energy curves and patterns. The method of minimizing the cost and the energy efficiency increasing can be done by introducing the smart grid between the supply and demand making use of its technologies.

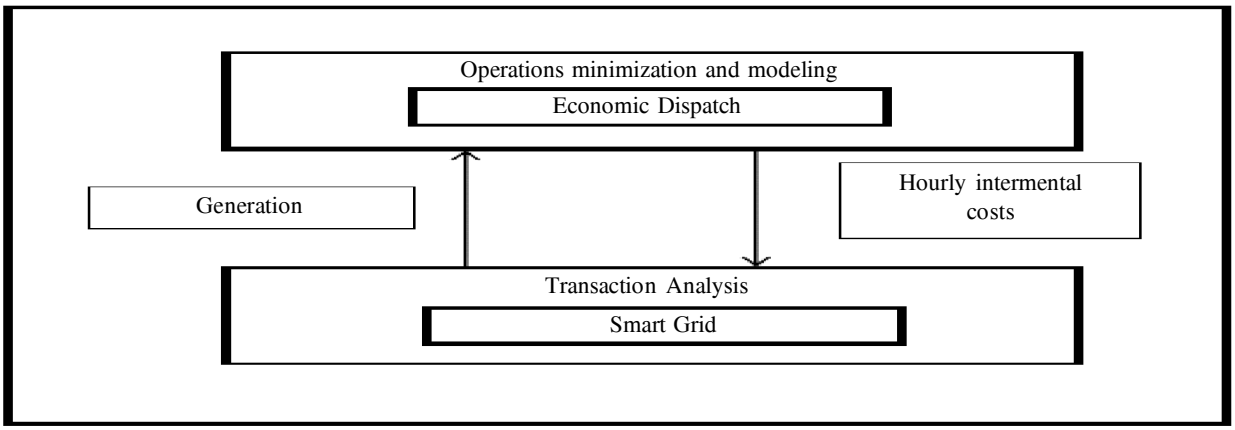

Figure 3: Interaction of transaction analysis and economic dispatch

6. SMART GRID TECHNOLOGY ADVANCEMENTS

Advanced electrical power network and upcoming networks are similar when compared with conventional networks, because the network having few of the advanced and smart equipments with the utilization of state-of-art techniques like non-conventional energy resources integration, Micro grid, Storages of Energy and Hybrid power networks regulation, excellent smart grids along with large spread function of communication and information methodology.

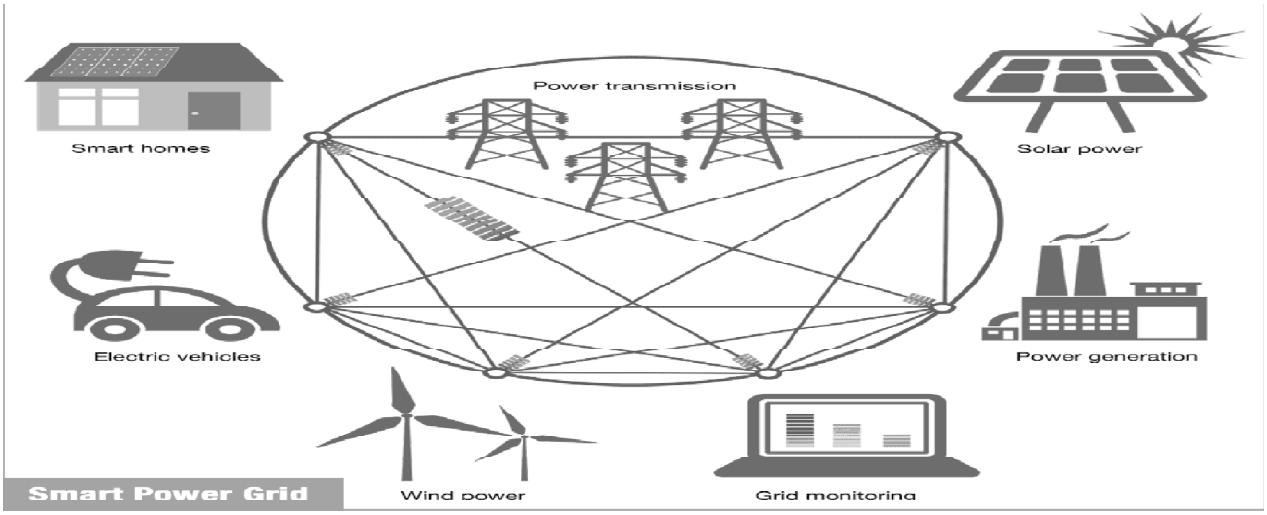

Figure 4: Smart Electricity System

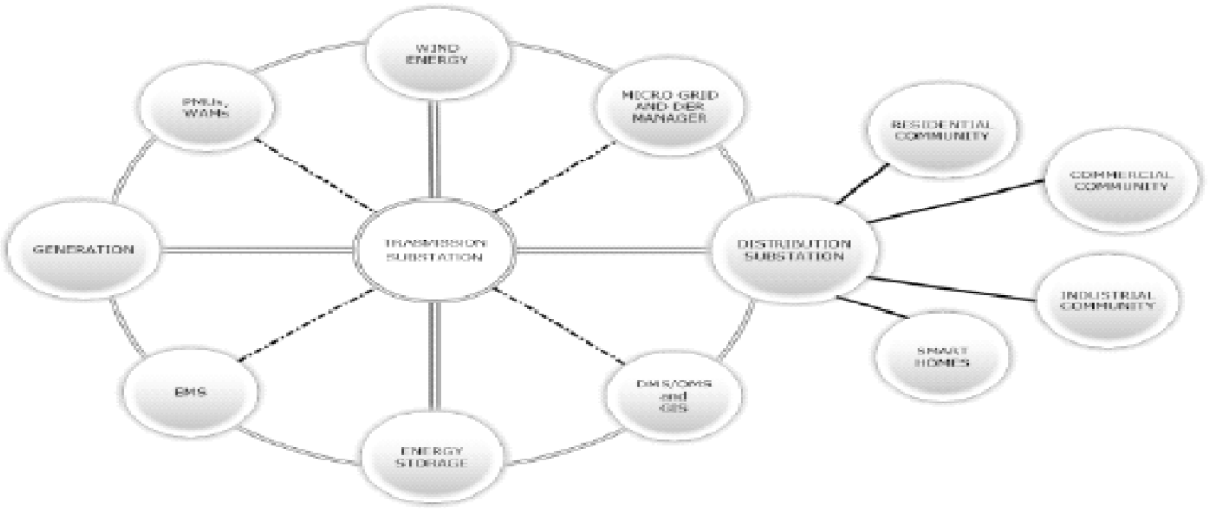

Figure 5: Indian Smart Grid Hierarchy

Table 2
Comparison of different characteristics between Today's Grid and the Modern Smart Grid

MICRO GRID PROJECTS	JOINT VENTURES	TECHNOLOGY USED/ OBJECTIVES	INSTALLED CAPACITY	REMARKS
Sagar Island Micro Grid Sundarban Region	Funded by MNRE, Govt. of India, Indo-Canadian Enviornment Facility (ICEF) and West Bengal Renewable Energy Developmnet Agency (WBREDA)	Solar Power Plant	300kW	Serving more than 1500 consumers
		Solar Home Lightning	3200kW approx.	6000 nos. serving about 10,000 people
		Bio-mass Gasifier	1000kW	Serving around 1000 consumer
		Wind Farm	1000kW	Grid connected
Asia Pacific Partnership (APP) Programmes or Asia-Pacific Partnership Development on Clean Development and Climate	Leadership of US alongwith 6 nation (Japan, Australia, Korea, China, India and Canada)	Formation of Renewable Energy and Distributed Generation Task Force (REDGTF) to conduct preliminary and feasiblity studies of development of SE	NA	Facilitate cost-effective, cheaper, cleaner, more efficient technologies and practices, pollution reduction , energy security etc.

Table 3
Micro grid Projects in India

Renewable Energy Resources	*2007-2012 (in GW)*	*Through 2012 (in GW)*	*Through 2022 (in GW)*
Wind	10.5	17	40
Hydro	1.4	3.5	6.5
Biomass	2.1	3	7.5
Solar	1	1.5	20
Total	15	25	74

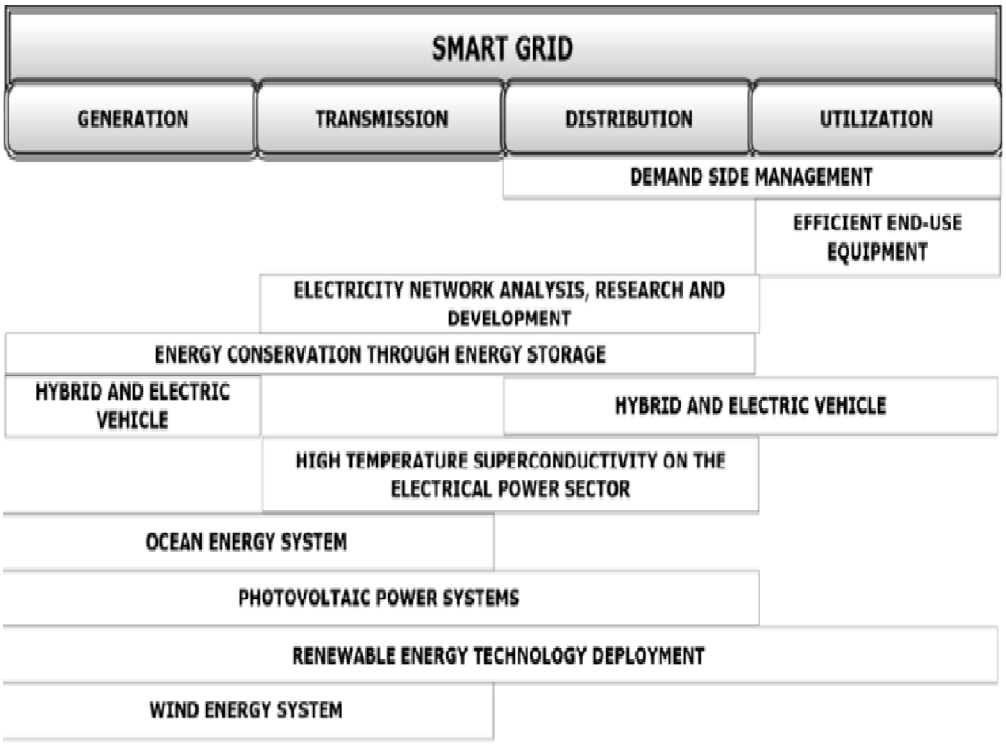

Figure 6: Renewable in Smart Grid Technology

7. MICRO GRID

The non-conventional or renewable sources in completely stand alone manner do not achieve practical because of problems of consistency related to disturbance in climate circumstances and unbalanced performance. As in that case, the generators are supported by another generating methodology or/and equipment for storage includes of two or many distribution generation network such as: diesel-wind, PV-wind, and many more to meet the regular demand. That methodology is known as Hybrid power method [6]. Hybrid relationship of various sources or/and equipments for storage improves the consistency of the network, also is economically and technically sustainable a much right method is to assemble total that methodology into Micro Grid. We have various equalities among Micro Grids and Smart Grid or Smart Micro Grids.

8. CONCLUSION

This paper presented a technology which can recognize the advantage of designing a user – (industry and utility) friendly network that improves the reliability and efficiency by promoting two-way communication to optimally replace the existing electricity with the help of smart grid methodologies.

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