IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-8, Special Issue-1, Feb 2020 E-ISSN: 2347-2693

The Smart Architecture of Smart Grid

A. Sen[1*], S. Pal[2], R. Paul[3]

[1,2,3]EDPS, JIS College of Engineering, MAKAUT, Kalyani, Nadia, India

[*]*Corresponding Author: anirban.sen@gmail.com, Tel.: +91-8232982165*

Available online at: www.ijcseonline.org

Abstract— This paper state the analysis of change of structure of a power system by implementing modern grid network and also focus of modern structure of advanced power system for fulfilment of demands Energy is the basic necessity for the economic development of our country, many functions necessary to present day living grind to halt when the supply of energy stops. The main challenge today is to upgrade the existing technologies and to promote development, demonstration, scaling up and commercialisation of new and emerging technologies for widespread adaptation. India is resourceful country so India will be able to achieve a smooth transition from fossil fuel economy to sustainable renewable –energy-based economy and brings "Energy for all" and "Energy for ever" era for equitable, environment friendly and sustainable development. With increasing efforts worldwide to de-carbonise energy supply, a wide variety of generating plant types is being connected to electrical distribution network. So, in this paper we will focus different sectors of distribution generation.

Keywords— Smart Grid, Grid Architecture, Renewal Energy, Smart Metering

I. INTRODUCTION

The main aim of power system network is to maintain power supply economically and secure. At present, distributed generation is seen primarily as a means of producing electrical energy and making a limited contribution to the other ancillary services that are required in any power system. Now changing with transmission connection requirements (the so-called Grid Codes) that specify the performance required from renewable generation connected to transmission networks being applied increasingly to large distributed generation schemes.

II. BASIC STRUCTURE OF SMART GRID

Our conventional grid has a number of advantages but main disadvantages is security reasons, they are unidirectional power flow so any faults occur in the system may create other faults in subordinate systems and huge power loss. To earn revenue from the system we must change the structure of distribution power network, generations are not implementing in central. It will be implementing in distributed ways and monitoring system should be better to run the system as profitable. For that reasons Smart Grid Networks is implement in present system.

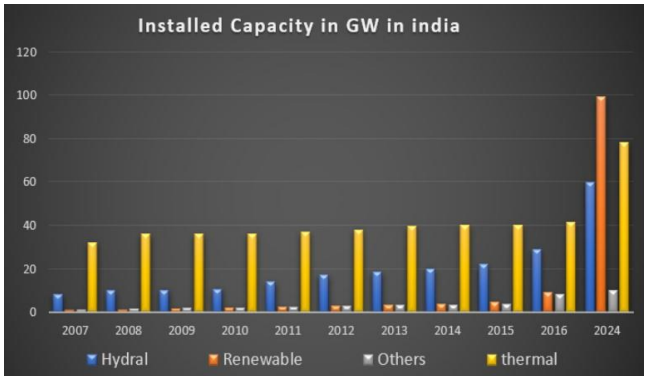

Fig. 1

So, there is immense scope for renewable energy.

The European Technology Platform for smart Grids has published a defination "A Smart Grid is an electricity network that can intelligently integrate the actions of all users connected to it-generators,consumers and those that do both-in order to efficiently deliver sustainable,economic and secure electricity supplies."

Table 1

Energy mix in India by 2016 (April- Oct 2016)				
Gen of Renew	**for the month of**		**cumulative for the period**	
	Oct 2016	**Oct 2015**	**August 2016-Oct 2016**	**Apr 2015-Oct 2015**
Wind	3607.68	2023.14	35217.57	25402.07
Solar	1211.08	739.08	7002.71	3930.3

Biomass	349.28	302	2421.72	2010.34
Biogas	410.14	522.31	3211.44	4620.03
Small Hydro	687.92	747.37	5904.56	5902.73
Others	20.96	20.14	148.32	159.74
Total	6287.06	4354.04	53906.32	42025.21

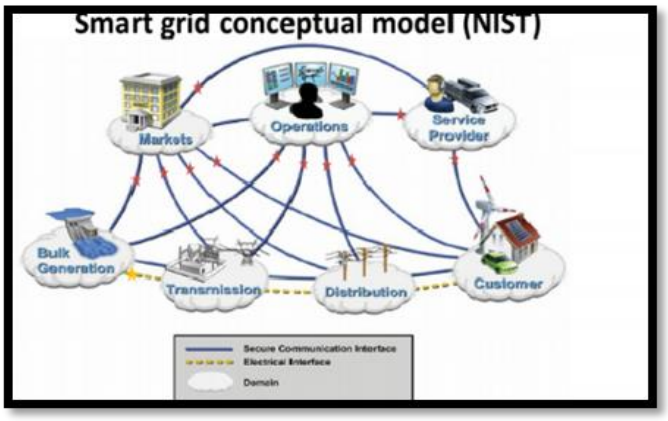

Fig. 2

A smart Grid employs innovative products and services together with intelligent monitoring, control, communication and self-healing technologies to

- Better facilitate the connection and operation of generators of all sizes and technologies.
- Allow electricity consumers to play a part in optimizing the operation of the system
- Provide consumers with greater information and choice of supply
- Significantly reduce the environmental impact of the total electricity supply system and
- Deliver enhanced levels of reliability and security of supply

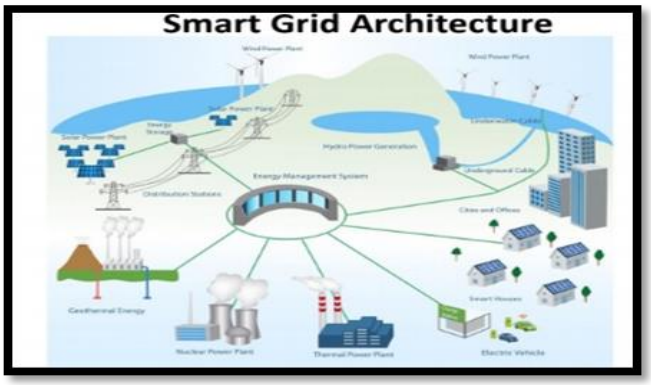

Fig. 3 Smart Grids components of Smart

- Smart Infrastructure (Smart energy system & Smart information system)
- Smart Communication
- Smart Management
- Smart Communications

III. LAYOUT OF SMART GRID

Our Smart grid structure is 4 main parts and each having different operation and control.

a. Customer Domain: Is most important structure of smart grid. It is speared from generation to distribution and control by software (PMU, SCADA, VSAT). This is two ways communication system

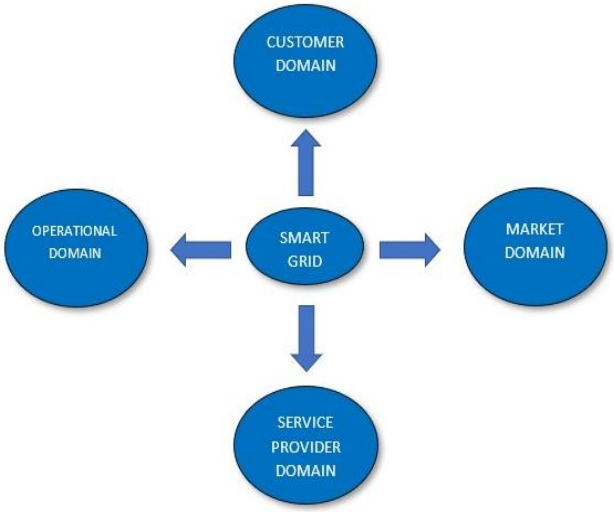

Fig. 4

Customer domain participation and their functions are as below. So Micro and mini generation is much more important on smart grid.

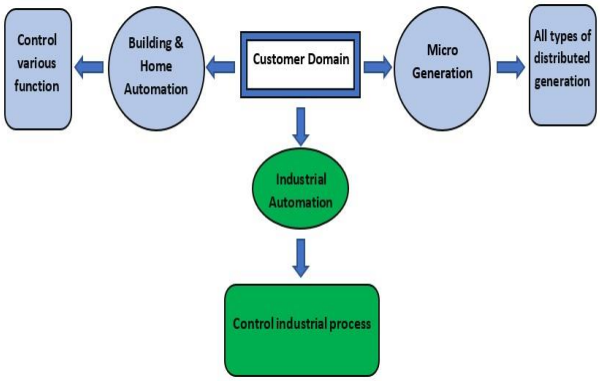

Fig. 5

b. Market Domain: Smart grid does not depend upon only customer control; it is depending on every hook and nook corner. Market domain management is also important in smart grid.

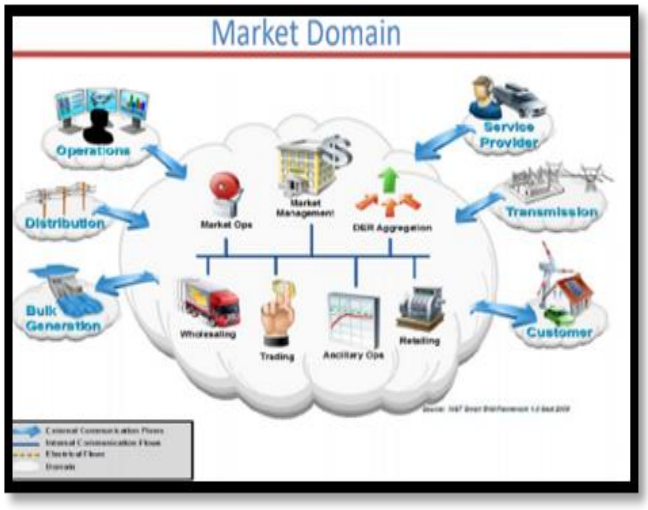

Fig. 6

The working processes are as below

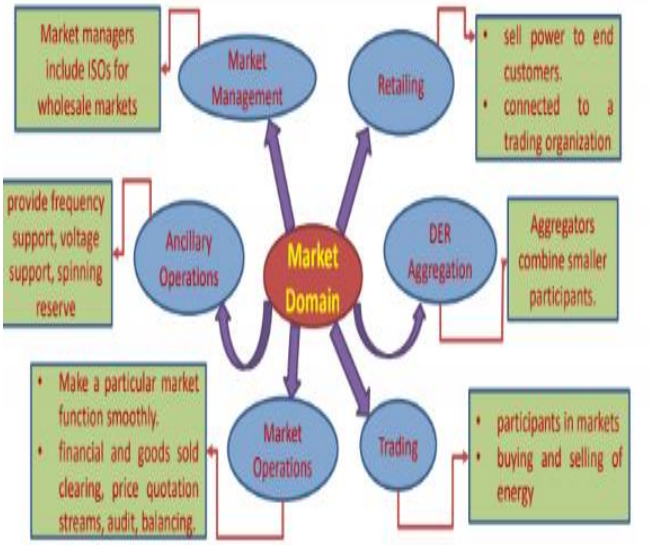

Fig. 7

c. Service provider Domain: Perform services to support the business process of power system producers, distributors and customers. These business processes range from traditional utility services, such as management of energy use and home energy generation. The challenges are to develop the key interfaces and standards that will enable a dynamic market driven ecosystem while protecting the critical power infrastructure. Service provider will follow this infrastructure process.

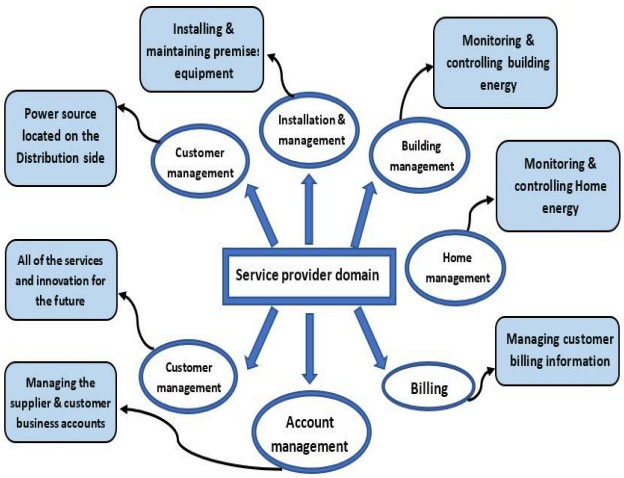

Fig. 8

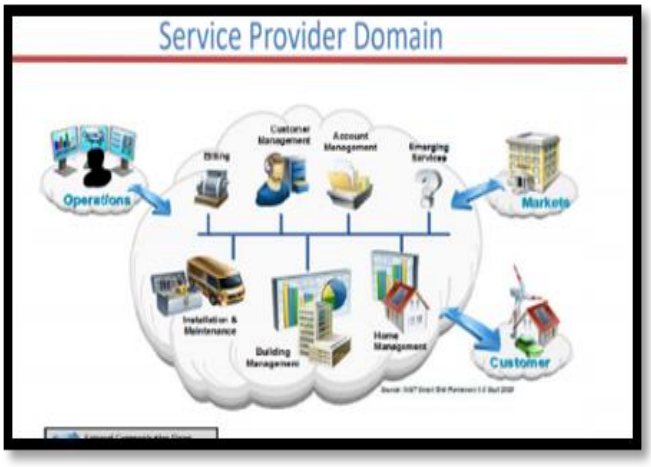

Fig. 9

d. Operational Domain: Our conventional grid will be smart when operational structure will be change as follows.

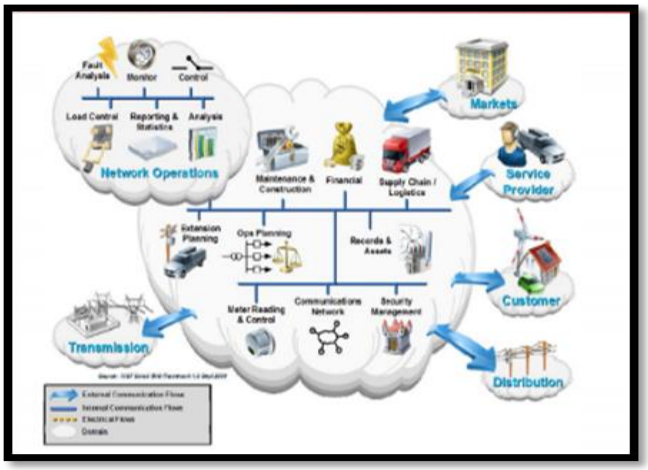

Fig. 10

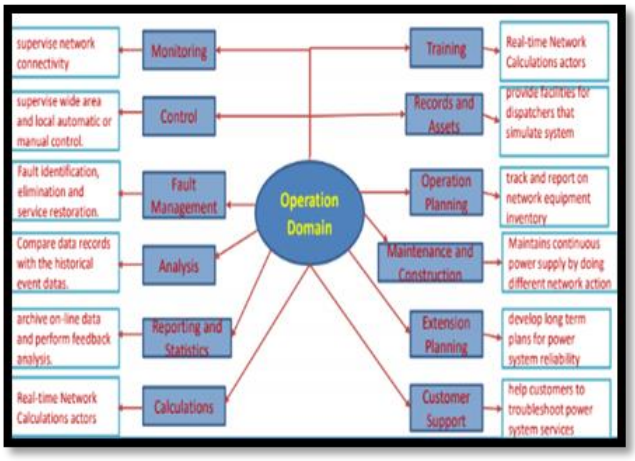

Fig. 11

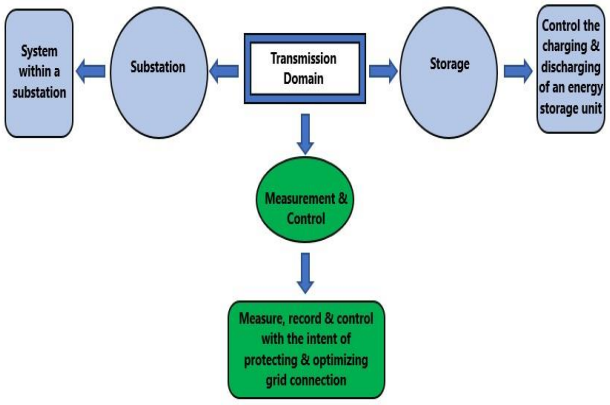

Fig. 13

By researching above mention structure will be follow by conventional grid to making system smart and efficient.
Now smart grid structure also depends on,

e. Transmission domain: Transmission is the bulk transfer of Electrical power from generation sources to distribution through multiple substations. A transmission network is typically operated by Regional Transmission operator or Independent System Operator (RTO/ISO) whose primary responsibility is to maintain grid stability on the electric grid by balancing generation (supply) with load (demand) across the transmission network. Energy and supporting ancillary services are procured through the markets domain, scheduled and operated from operations domain and finally delivered through the transmission domain to the distribution system.

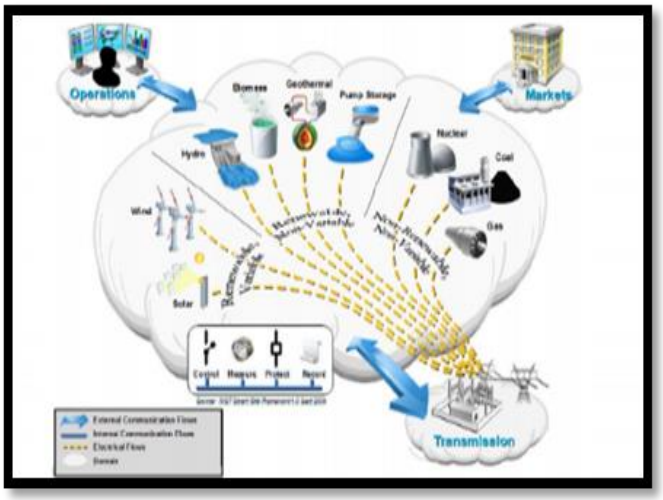

Fig. 12

The transmission domain participators and their functions are considered as given below

f. Distribution Domain: The Distribution domain is the electrical interconnection between the Transmission domain, the customer domain and the metering point for consumption, distribution storage and distribution generation.

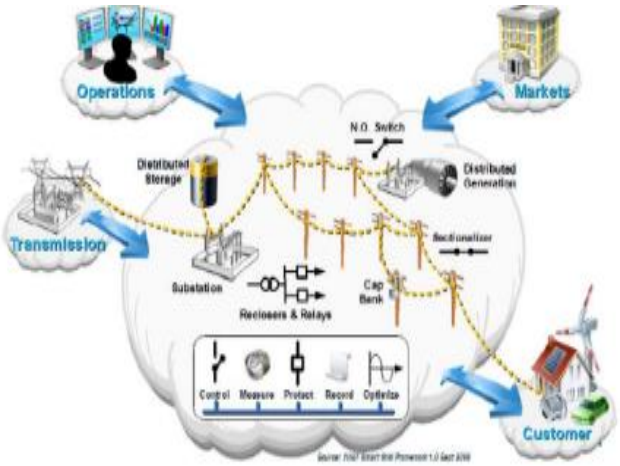

Fig. 14

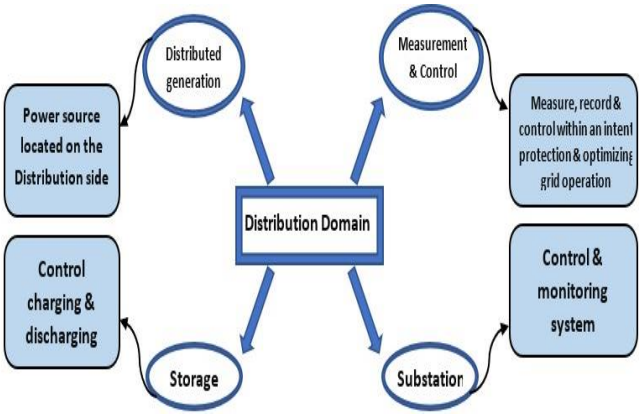

Fig. 15

Making system more secure and reliable overall system structure should be changed to solve power crisis.

IV. MODERN EMERGING TECHNOLOGY IN SMART GRID

As the electricity requirements of India have grown tremendously and demand has been running ahead of supply. Electricity generation and transmission processes in India are very inefficient in comparison with those developing countries like Japan, USA, and China. As per CEA (Central Electrical Authority) survey to increase load factor not only depends on restructuring environment it also depends proper adoption and monitoring of immerging technologies of Big data Analytic which shown below.

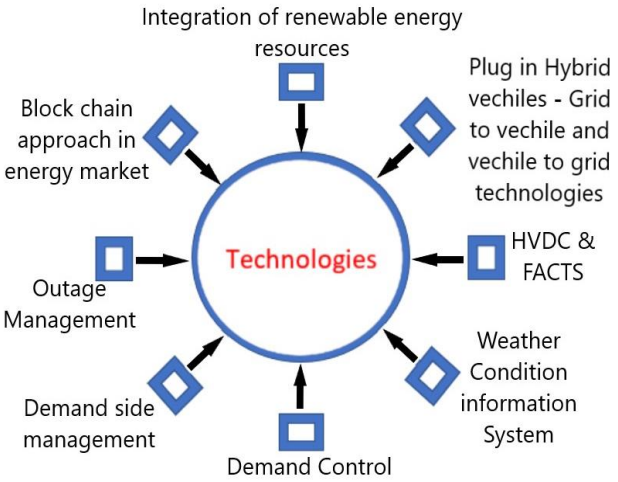

Fig. 16

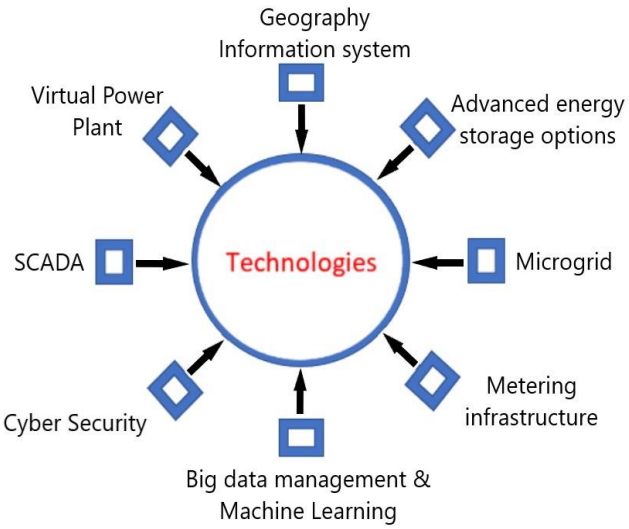

Fig. 17

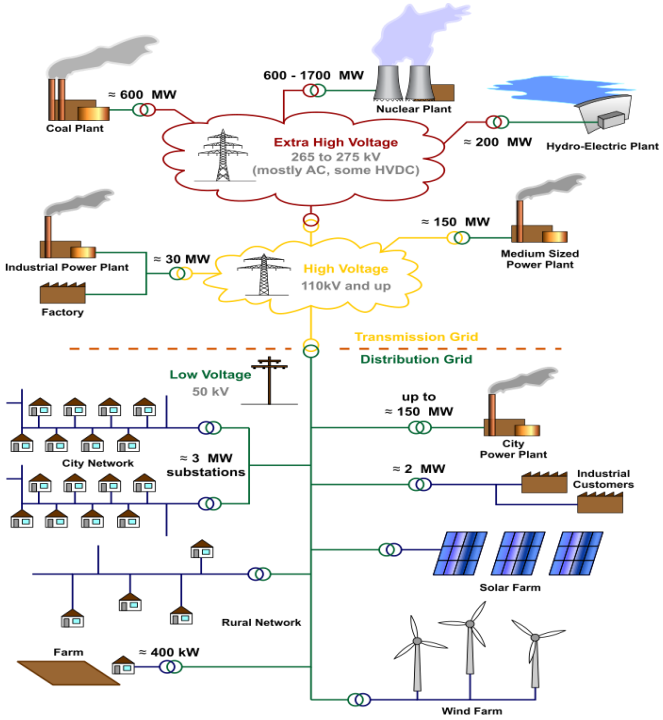

Fig. 18

Generating stations and distribution systems are connected through transmission lines. The transmission system of a particular area (e.g., state) is known as a grid. Different grids are interconnected through tie lines to form a regional grid (Also called power pools). Different grids are further connected to form a national grid. Interconnected operations are always economical and reliable. Generating stations must be interconnected so that they feed into the general system but not into particular load. Economic advantages of interconnection are to reduce the reserve generation capacity in each area. If there is sudden increase of load or loss of generation in one area, it is possible to borrow power from adjoining interconnected areas. So modern structure is based on interconnected network for better efficiency.

V. REASONS OF DISTRIBUTION NETWORK

For distributed generation of power to complete successfully with central generation in a competitive environment, network when it operated in large scale. The conventional arrangement of a modern large power system has a number of advantages. Large generating units can be made efficient and operated only a relatively small staff only when it operated in distributed network. The interconnected high voltage transmission network allows the most efficient generating plant to be dispatched at any time, bulk power to be transported large distances with limited electrical losses and generation reserve to be minimized. The distribution networks can be designed simply for unidirectional flows of power and sized to accommodate customer loads only. But

now a day's response of climate change, many governments has set ambitious targets to increase the use of renewable energy and to reduce greenhouse gas emissions from electricity generations.

VI. POWER CRISIS IN INDIA

The Electricity requirements in India have grown tremendously and demand has been running ahead of supply. So, we produced our power bulk from Thermal power plant mainly. Our transmission and distribution system not so much well and good to maintained balanced power supply all loads and also our transmission line losses are also so much high compare than other developing country (23.68%).To reduced transmission losses and maintained balanced supply we will restructure our power system network by incorporation of renewable energy generation in our same grid network by distributed generation and make our system smart. The below picture shown that.

VII. SMART GRID

Throughout the world, energy policy is developing rapidly with the aims of providing electrical energy supplies that are

1. Low or Zero –carbon to reduce the production of greenhouse gases and mitigate climate change.
2. Secure and not dependent on imported fossil fuel.
3. Economic and affordable by industry, commerce and all sections of society.

The objectives of energy policy converge in the use of distributed generation, renewable and cogeneration (Combined heat and power, CHP).Recently the name Smart grids has become common to describe the future power network that will make extensive use of modern information and communication technologies to support a flexible ,secure and cost –effective de-carbonized electrical power system. Smart Grids are intelligently controlled active networks that facilitate the integration of distributed generation into the power system. The European Technology Platform for Smart Grids has published a definition of a Smart Grid" A Smart Grid is an electricity network that can intelligently integrate the actions of all users connected to it-generators, Consumers and those that do both-in order to efficiently deliver sustainable, economic and secure electricity supplies.

A Smart Grid employs innovative products and services together with intelligent monitoring, control, communication and self-healing technologies to

- Better facilitate the connection and operation of generators of all sizes and technologies.
- Allow electricity consumers to play a part in optimizing the operation of the system
- Provide consumers with greater information and choice of supply;
- Significantly reduce the environmental impact of the total electricity supply system
- Deliver enhanced levels of reliability and security of supply.

VIII. THE FUTURE DEVELOPMENT OF DISTRIBUTED GENERATION

At present, distributed generation is seen primarily as a means of producing electrical energy and making a limited contribution to the other ancillary services that are required in any power system. In our present distribution networks has different problems that can be overcome only when we will be incorporated renewable energy resources in our conventional systems and adopting new technologies like deep learning, AI, Virtual Machine learning technologies for making our conventional systems by smart systems.

IX. POWER SECTORS REFORMS IN INDIA

To meet up with large gap between demand and supply, various steps are required to be taken up. For this, instead of planning and building power plants in isolation, studies must be made to optimal generating capacity expansion. .Now is the high time to get reformed and more modern techniques should be applied to the electricity production and transmission. Every attempt should be made to improve system load factors by flattening the load curve by giving proper tariff incentives and taking other administrative measures.

The government target of 20000MW of nuclear capacities by year 2025 needs accelerated efforts to get achieved.
The renewable and combined power plants with help of modern technologies should get supported both public and private sectors.

X. CONCLUSIONS

The electricity supply undertakings need to analyse the system, spot the weakness and take corrective measures to improve reliabilities and conditions responsible for power crisis. There is also need to improve the utilization of generating equipment and take care of the environmental aspects of energy generations. So, India's power slogan is `One nation, One grid `which is possible only in modern structure of power system network.

REFERENCES

[1] A course in Power Systems-J.B. Gupta, Kataria Publications.
[2] Distributed Generation-N. Jenkins, J.B. Ekanayake and G. Strbac
[3] Commission of the European, Union Smart Grids Technology Platform. European Technology Platform for the Electricity Networks of the Future. Available from URL://www.smartgrids.eu/[Accessed February 2010]
[4] Principles of Power System – V.K. Meheta. S. Chand.

[5] Electrical Power Systems-D.Das New Age International Publishers
[6] Blune S.W .Electric Power System Basics for Nonelectrical Professional,IEEE,press;2007
[7] IEEE 1547.IEEE Standard for interconnecting Distributed Resources With Electrica Power Systems:2003
[8] Electricity Network Associations Engineering Recommendation G59/1.Recommendations for the connection of Embedded Generation Plant to the Public Electrical Suppliers Distribution Systems: [1991].
[9] Modern Power System Analysis-Nagrath Kothari,TMH

Authors Profile

Mr. Anirban Sen Pursued Bachelor of Technology from JIS College of Engineering in year 2018. He is currently pursuing Master of Technology in Electrical Devices and Power System from JIS College of Engineering

Mrs. Suparna pal currently work as a Asst. Prof of EE department of JIS College of Engineering. Her Interested area are Power system, Renewable Energy, smart grid, Switch Gear, Emerging technology etc.

Miss Riya Paul pursued Diploma in Electrical Engineering from APC Polytechnic, Bachelor of Technology in Electrical Engineering from JIS College of Engineering. She is currently pursuing Master of Technology in Electrical Devices and Power System from JIS College of Engineering.

