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A case study of Smart Grid-Need, Implementation & Challenges in India

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Abstract-Electricity over the years has been a major contributor towards improving the standards of not only individuals, but the society, at large. The growth in economy resulted in a surging demand for energy. The electricity consumption per capita by India in 2018-2019 was 2049.337 TW-h. India's electricity sector is dominated by fossil fuels, such as coal. During the 2018-19 year, about three-quarters of the country's electricity was produced by coal itself. Increasing concerns over climate change have limited the liberal usage of available energy options. India faces a rather tough challenge to meet its energy needs and to also provide adequate energy of large quantities in various forms to users, in sustainable manner at reasonable costs. This resulted in installation of renewable sources of energy for electricity. Despite this, millions of households have little to no access to electricity. A large number of people from remote areas suffer from frequent blackouts. This paper studies an implementation of efficient energy technology that is the smart grid and its implementation by the government as well as the commoners.

Keywords:-Smart Grid in India, Distributed Power Generation, National Smart Grid Project

I. INTRODUCTION

The landscape of the entire chain, right from producing to consuming has changed over the last decade. The conventional electric grid was based on the traditional system with one main point generating all the power. This restricted the use of additional alternative sources to reduce the load or to incorporate efficient handing. The traditional grid implemented the one-way communication system. This made it difficult for error hunting and fixing. Due to implementation restrictions, all the distribution had to be monitored manually. This need can increase the amount of time period that outages occur for. The energy is difficult to control, and prone to failures.

Unlike the earlier days, mere availability of energy no longer satisfies the consumers' demand, the consumer today is looking for digital grade power supply which is secure, reliable and at an affordable price. Commensurate with industry requirements and consumer aspirations, it has become necessary that the power engineering community should gear up to meet the challenges faced today.

To counter this problem, a two – way grid was developed that allows for two-way communication between the utility and its customers. The combination of communication and advances in power devices can be used to develop 'Smart Grid' a grid which is smart enough to communicate with its users, or those who are managing it and take appropriate self-healing measures in case of issues. This is done to enable utilization of facilities to the maximum extent possible. Smart Grid consists of controls, sensors, automation, and other software working together, to keep up with our changing electric demand.

The smart grid processes the data points coming from the sensors for available information, which is used to predict and analyze exactly how much of electricity is required and implemented. This avoids overuse/lack of electricity.

The advantages of smart grid over the traditional grid are:

- More efficient transmission of electricity.
- The smart grid can keep a check on itself and allow it to balance power, troubleshoot outrages, and manage distribution without any need for direct intervention from an user or a technician.
- The operations costs are greatly reduced, ultimately lower power costs for consumers
- Reduced peak demand that in turn lower electricity rates.
- Multiple sensors placed on the lines to pinpoint the location of a problem.
- Self -Healing capability
- Improved security

1. Giving Consumers Control/transparency:
The Smart Grid not only gives you the smart technology, it also is about giving you the information, power and tools you need to reflect on and make decisions about your energy use. You can review your daily energy consumption and work on reducing your bills. A person able to control this aspect will try to optimize and minimize consumption, helping lower the level of consumption on a whole.

II. DEVELOPMENT IN INDIA

The government of India has been taking great efforts in implementing renewable sources of energy. The National Electricity Plan by the government of India states that India will not need more non-renewable power plants in this sector until the year 2027, with the commissioning of 50,025 non-renewable power plants and 275,000 renewable power capacity along with it.

An establishedcommittee known as the National Smart Grid Mission for implementing smart grid-related programs and policies. The government has set a target of 35 million smart meters to be installed according the UjwalDiscom Assurance Yojana scheme.

The Indian Government has also launched multiple other schemes parallelly such as the Integrated Power Development Scheme and the DeenDayal Upadhyaya Gram Jyoti Yojana. These schemes are focused on upgradations among jurisdictions, and ensuring the use of automation which can greatly benefit countries such as ours.

Regulations with respect to the uprise of smart grids have also been brought in action, with releasing the Model Smart Grid regulations to be used by the state authorities. This approach has already paved the way to an efficient, transparent and reliable future in terms of smart grid.

III. IMPLEMENTATION

The National Smart Grid Project has by now, allotted 14 pilot projects on the grid technology across India.

The Indian Ministry of Power approved this mission on the 27th of March, 2015.

The electric supply will be through smart grids under the "Smart city Mission"

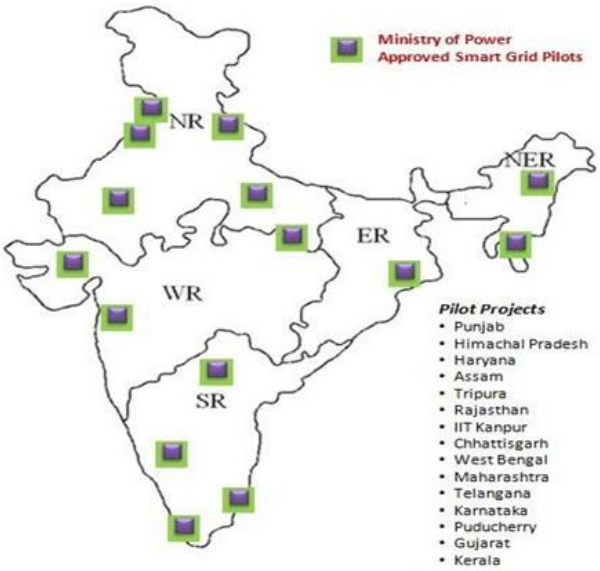

Fig 1. Smart Grid Pilot Projects in India

IV. CHALLENGES

1. Data Privacy and Cyber-Security:
Smart Grid comes with benefits and drawbacks. Use of the web to link data flow between utilities and customers creates a strong and important requirement to deal with cybersecurity. Along with the transition from analogous to digital electricity infrastructure, there comes the challenge of security and management of this infrastructure. With this change, grid networks are more prone to malicious attacks from software hackers.

Security here becomes a key issue. In addition to this, data and privacy leakage can be something that can

undermine and make the success of smart grids impossible. The data collected from the consumption information such as when a person left the house or which part of the house is currently occupied could provide a significant insight into a consumer's behaviour and can be exploited.

This valuable information could be abused or used in unimaginable ways, if correct security measures are not adhered to. The smart grid technology should be designed with security as one of the priorities. Without security, and without general awareness, the public could feel unsafe and monitored in a way leading to negative impacts on the technology.

2. Lack of Awareness:

The amount of information that consumers have about the data and how power is delivered to their homes is often low. So, it is very crucial to inform about the safe usage and security protocols to be used before going forward and implementing smart grid concepts, they should be made aware of what a smart grid is, how it can contribute to a low carbon economy and its benefits to users.

Therefore, consumers must also be made aware of their energy consumption pattern at home, offices, etc., policy makers and regulators must be very clear about the future prospects of smart grids, and the utilities need to focus on the overall capabilities of smart grids along with possible future upgradations rather than mere implementation of smart meters.

3. Data Management:

Database management is a vital issue in Smart grid. The data so collected is really big in volume, for example: from employing the smart and new meter that reads after every 15 minutes instead of once in one whole month has obvious benefits along with the increase in the data that is almost 3000 times. Voluminous data from here is very difficult for collection and storage, it also poses critical problems in retrieval and handling. This continuous high volume of data transfer may slow down data collection, analysis and even report generation.

4. Policy Regulation:

No defined standards exist for the regulation or running of smart grid projects in India. The current policy and regulatory frameworks were typically designed to affect the prevailing networks. With smart grid implementation taking over traditional grid networks, the prevailing policy and frameworks must evolve so as to also encourage incentives for investment.Other challenges faced are high capital investment, work force, power theft, technical challenges, etc

V. CONCLUSION

The implementation of the pilot projects will allow an insight into the real potential of smart grids. The benefits can only then be defined. Although there is no perfect or near- perfect solution found till now, multiple approaches from researches are under trial/implementation through several pilot projects spread across the country.

Socio-economic issues do exist at this point but are being resolved through joint efforts. Governments as well as organizations working in this field are sharing the high capital investment involved in these pilot projects and ensuring support, confidence to all stake holders. Awareness programs are being set across various platforms around the country to bring the fundamental understanding of smart grids among communities and to develop cooperation. Other issues like privacy, policies, even power theft are being identified and resolved.

An assessment framework has been developed to understand the shortcomings and requirements and details are discussed. Appropriate implementation can ensure an optimal solution of India's energy needs.

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