Smart Grid Structure – India and Germany

C.Sasikumar, S. Jaganthan, R.Prakasam

Abstract - The smart grid is modernization system for traditional electric distribution system, smart grid is a novel solution of future infrastructure. It is used to monitor, protect and auto optimize the electric operations from high voltage network to distributed system. The smart grid is a combination of information and communication technologies, distribution and transmission system. The existing traditional grids are under pressure and faced diversified issues. There are many differences between traditional and smart grids such as two way operations instead of one way operations, self-monitoring capabilities, cyber secure communication, computational intelligence, safe, cost-effective environment. Number of literature discussed the positive features of smart grid for power systems In this paper discussed about the review about structure of Grid through the different perspective like cultures, economics and technologies require individual adoption of existing Smart Grid structures in India and Germany.

Keywords: Smart Grid; Structures; NIST;Smart Grid Architectural Model

I. INTRODUCTION

The detail discussion of smart grid benefits, it is significant to discuss thesmart grid technologies implications in the different countries. The important point is that the basic layout and topologyof smart grid matched with traditional grid systems. To clarifying this point, there is a need to examine some design implications for these technologies. The smart grid system offered digital metering with two-way communications capabilities. These digital meters have remotely operation capabilitiesto control voltage and current with record waveforms, real-time rate structures. Furthermore, these new meters are deployed in same traditional meter places without any design implications. In addition, smart meters have more data for processing and lead to efficient asset management operations. The different review chapters in this article are listed. [1] [2] [3] [4]

II. STARTING POINT FOR EVOLVING THE ANALYSIS AND FINDINGS

The integration of renewable energy sources arises issues in the traditional system and has to integrate the consumer needs

A. Initial Solution

- Transformation of primary traditional grid to smart grid structures.
- Second step ahead of integration of decentralize power generation and its resulting load pattern.
- Climate Legislation (CO2)
- Changing in Generation, Transmission and Distribution and consumer to Prosumer.
- Increase the new market participants.

B. Importance of Consumer

Customers are the center of the transition towards smart grids

- Consumer becomes prosumer.
- Prosumer is the part of value chain.
- Increase the level and size of market power and Net-Social Benefit.

C. Different Structure

The main need for a proper Smart Grid architecture that allows managing the new challenges [2] [3] [8]

Different Drivers for the introduction of Smart Grid

Different issues depending on geographical, economical and social factors

III. COMPARISON RESULT BETWEEN INDIA AND GERMANY

Mainly the country differ in economy due to geographical reasons. Countries are categorized in developed and developing countries based on Economy and GDP discussed in Figure 1. [5] [6]

Criteria to Define the Status of the Country –

Per capital Gross Domestic Product (GDP)

Developed: above $12.000 ($25.000)per capital GDP

USA 2016 : $57.000

Life expectation

Infant mortality

Developed less than 10 infants per 1000 live birth

Source Refernce : UN, 2018; the balance 2018

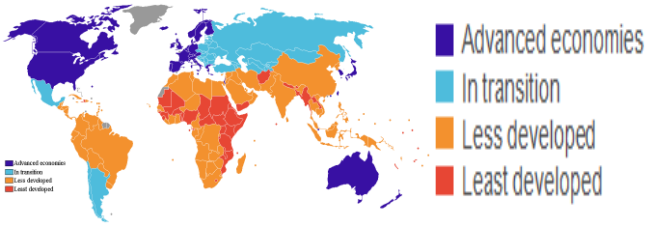

Figure 1. Global Statics of Energy Consumption Source Refernce : Wikipedia and global market 2018

The geological, cultural and technical differences affect the drivers of the smart grid technology in Germany

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Category	Targets and operations
Clean Energy	System efficiency, DER (targets/ EU2020), Electrical Vehicles
Markets	European power markets, European super-grid, Customer participation
Liberalization	Deregulation, Competition, Service innovations (DR)
Operations	Reduce Operation Costs (opex)Energy efficiency/ Reliability

The geological, cultural and technical differences affect the drivers of the smart grid technology in India.

Category	Targets and operations
Reliability	Improve SAIDI, System stability
Operations	Reduce Operation Costs (opex) (losses 25%), Improve asset management
Grid Extension	Electrification of rural areas, Demand Growth/ new Loads, PV power plants (RE targets)
Economics	Revenue collection, Job Creation, Tech innovation

The different drivers derive different technical needs to fulfill the smart grid requirements

India	Germany
Advanced Metering Infrastructure	Condition Based Monitoring
Demand Response	Advanced Metering Infrastructure
DER Integration	Outage Management Systems
Consumer Energy Management	Planning, operation analysis and tools.
Renewable Energy Plant Integration	System Wide Monitoring

The requirements on a smart grid depends on the applying country discussed in figure 2.

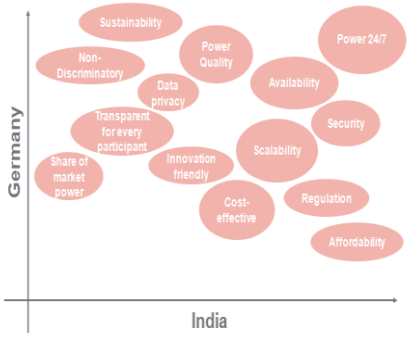

Figure 2 .Requirments and Dependency of Smart Grid

IV. CONSUMER EXPECTATIONS OF A SMART GRID

The major threats of market transition for the consumer is investment and security. Large Initial investments are not cost-effective. Security of long term consistency and policies provided more impact between customers. To involve the customers in power market and remove the market entry barriers and provide the necessary guidance.

V. RECOMMENDATION OF A SMART GRID ARCHITECTURE

The Main Motivation is to reuse as much of the existing work as possible and not re-invent the wheel. The main actors of the Smart Grid and their main interactions. Common Architecture model is used to model and develop the smart grid discussed in figure 4.[9] [12] [13]

Smart grid Conceptual Model:

- National Institute of Standards and Technology (NIST) (NIST) model.
- NIST extended European model (EU).

Reference Architecture:

Smart Grid Architectural Model (SGAM)

SGAM need to combine power system management requirements with expanded interoperability requirements. Aggregating several architectures (e.g. functional, communication, etc.) into a common framework. Helps in providing an appropriate methodology to identify where standardization gaps may exist. Interoperability as the ability of two or more devices from the same vendor, or different vendors, to exchange information and use that information for correct co-operation [IEC61850-2010] discussed in Figure 4 and Figure 5. [16] [17].

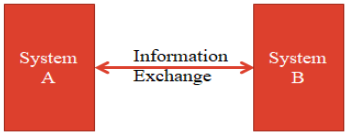

Figure 3. Interoperability

The Country specific recommendations for smart grids are discussed [14]

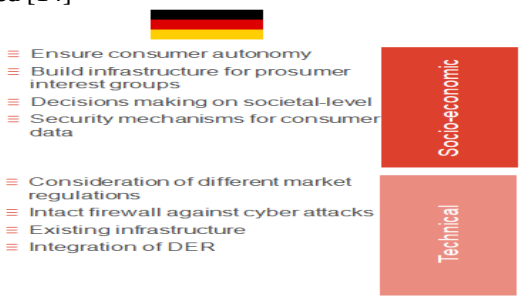

Figure 4. Socio – Economic & Technical Aspects Of Germany

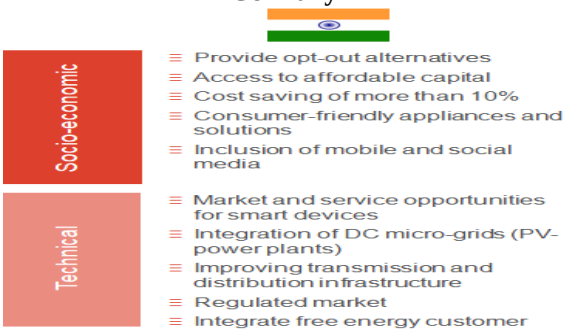

Figure 5. Socio – Economic & Technical Aspects Of India

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VI. CONCLUSION

Divers requirements for the smart grid transition with the constant increase in population growth rates, especially in the developing world, the implementation of improved smart grid are essential in the ever-increasing world population growth. SGAM is a general smart grid architecture and can be adjusted to fulfill the individual needs. Germany and India differ in geographical, technical and political systems. In future research need to development of a individual structure for Germany and India and Focus of the model has to be the consumer and economic analysis.

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