CHALLENGES OF IMPLEMENTING SMART GRIDS IN INDIA

Submitted by: Ravi kaushal Date: 14.01.2011

TABLE OF CONTENT

INTRODUCTION

The Smart Grid is aidea of a better electricity delivery infrastructure. Smart Grid implementations will certainly increase the quantity, quality, and use of information available from advanced sensing, computing, and communications hardware and software. As a result, they help utilities address two of the main issues in today's world:

- Environmental concerns.
- Power delivery limitations and disturbances.

Effective use of Smart Grid technologies helps utilities in:

- Improved grid usage.
- Improves grid efficiency and security.
- Better match of demand with supply of energy and grid congestion.
- Enable distributed generation.
- Allow customers to manage their consumption level and to take benefit of pricing and supply options.
- Cater the environmental issues.

Smart Grid Background

What are Smart Grids?

Smart Grid uses computer hardware and software, sensors, telecommunication equipment and services to:

- Helps the customer to manage consumption and use electricity wisely.
- Enables customer to respond to utility that help minimize the period of surpluses, bottlenecks, and outages.
- Helps utilities in improving their performance and controlling costs by timely availability of information.

Thus Smart Grids associates customer to electricity by an information rich network. And also it provides utilities with valuable operational information that helps them to improve efficiency.In a layman's term Smart Grid is an efficient combination of electrical infrastructure and information technology.

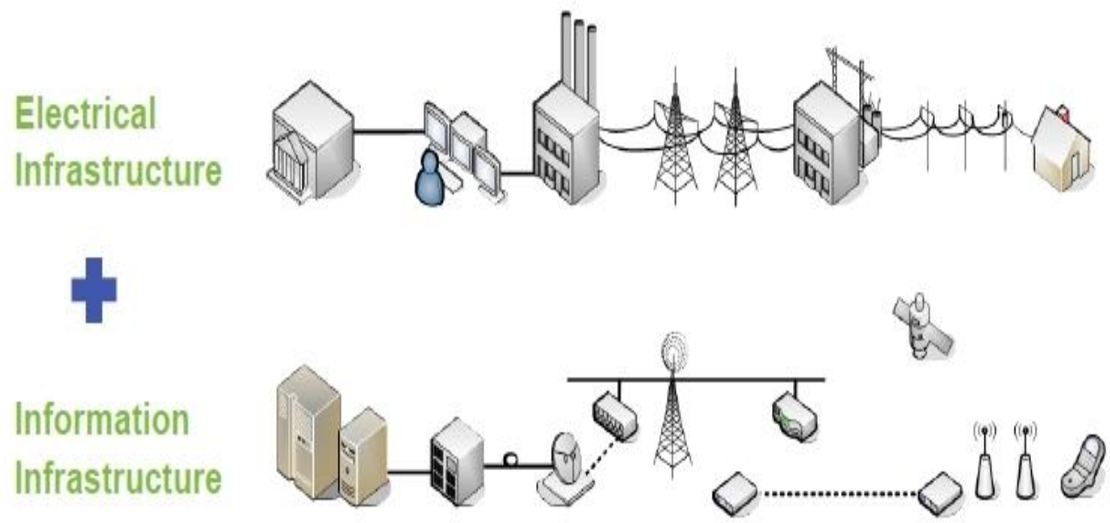

Figure 1: What is Smart Grid?

WHATIS PROMPTING SMART GRID DEVELOPMENT?

Environmental Impact

Smart Grid development is happening at a very fast pace because of the broad interest of policy makers and utilities in decreasing the adverseeffect that energy usage has on the environment. Smart Grids uses technology to drive efficiencies in transmission, distribution, and consumption. As a result, fewer generating plants, fewer transmission and distribution assets are required in order to cater the growing demand of electricity. With the possible expectation of wind farm sprawl, landscape preservation is one of the evidentbenefits. Sincemaximum generation today results in emission of greenhouse gas, Smart Grids reduces air pollution and plays a significant role in combating global climate change issue.

Smart Grids has the capability to accommodate technical difficulties of integrating renewable resources like wind and solar to the grid, providing further reduction in greenhouse gas emissions.

Costs

The ability to bypass the cost of the plant and grid development is a major advantage to both the utilities and customers.And Smart Grids will not reducefunds expansion, of course; therefore huge investments are required in order to setup a link between the customers and the Smart Grid. Further with the aid of Smart Grids less generating units would be required in order to fulfill the energy demand of the growing population and cost of setting up more and more plants can be deferred. At that point of time, more emphasis will be on overall development of T&D efficiency based on demand response, load control, and many other Smart Grid technologies.

Energy efficiency would be the second priority in order to save cost with reference to the customers. With timely and detailed information provided by Smart Grids,customers would be encouraged to limit waste, adopt energy-efficient building standards, and invest more and more in energy efficient appliances.

Utility Operations

Smart Grids can assist the utilities, as the principal focus of the utilities is to improve business processes. Many utilities have anextensive list of projects that they would like to fund in order to improve the customer service or to ease workforce’s burden of repetitive work. Calculating Smart Grid benefits by the cost/benefit analysis it puts emphasis in favor of the change and can also significantly decreasesettlement/payback periods.

Mobile workforcegroup and asset management group work collectively to organize assets and then maintain, renovate, and replace them. Thus results in increased productivity and fuel saving from superior methods.

Similarly, Smart Gridprovides customers with real time information and encourages them to do online payments, thus lowering billing costs. Utilities can include these cost and service improvement in the list of Smart Grid benefits.

Theft Control

This is not an issue in developed countries like US, but in developing countries like India, where people have alittle insight of the grid and higher poverty rate, power theft is quite common. With development of Smart Grid, power theft can be controlled to a greater extent, thereby improving the efficiency of our distribution system. Thus grids will provide higher quality and reliable power supply, and there will be fewer blackouts.

BARRIERS IN IMPLEMENTATION OF SMART GRID

Policy and regulation

The current policy and regulatory frameworks were typically designed to deal with the existing networks and utilities.To some extent the existing model has encouraged competition in generation and supply of power but is unable to promote clean energy supplies. With the move towards smart grids, the prevailing policy andregulatory frameworks must evolve in order to encourage incentives for investment. Thenew frameworks will need to match the interests of the consumers with the utilities and suppliers to ensure that thesocietal goals are achieved at the lowest cost to the consumers.

Generally,governments set policy whereas regulatorsmonitor the implementation in order to protect the consumers andseeks to avoid market exploitation. Over the last two decades,the trend of liberalized market structure in various parts of theworld has focused the attention of policy-makers onempowering competition and consumer choice. The regulatorymodels have evolved to become more and more effectiveto avoid market abuse and to regulatethe rates of return.

Moving forward, the regulatory model will have to adopt the policy which focuses much onlong term carbon reductionand security of supply in thedefined outcomes and they need to rebalance theregulatory incentives to encourage privately financedutilities to invest at rates of return that are commensurateto the risk. This may mean creatingframeworks that allow risk to be shared betweencustomers andshareholders, so that risks and rewards are balanced providing least aggregate cost to the customer.

Business Scenario

Themajority of examples results in negative business cases, undermined by two fundamental challenges:

- **High capital and operating costs** – Capital and operating costs include large fixed costs linked to the chronic communications network. Hardware costs do not cause in significant growths in economies of scaleand software integration possess a significant delivery and integration risks.
- **Benefits are constrained by the regulatoryframework** – When calculating the benefits, organizations tend to be conservative in what theycan gather as cash benefits to the shareholders. Forexample, in many cases, line losses are considered to be put on to the customer and as a result anydrop in losses would have no net impact on theutility shareholder. The smart gridbenefits case may begin on a positive note but, as misalignedpolicy and regulatory incentives are factored in, theinvestment becomes less attractive. Therefore regulators are required to place such policies and regulations in place which could provide benefits both to the utilities and the consumers. Therefore the first factor to be considered is to provide incentives to the utilities in order to remove inefficiencies from the system. They should be aptlyremunerated for the line losses on their networks.

  On the budget side of the calculation, there is no avoiding the fact that smart technologies are expensive to implement, and at the present level it is right to factor inthe risk associated with delivery. But the policy makers and regulators can mitigate that risk by seeking economies of scale and implementing advanced digital technologies.

Technology maturity and delivery risk

Technology is one of the essential constituents of Smart Grid which include a broad range of hardware, software, and communication technologies.Insome cases, the technology is well developed; however,in many areas the technologies are still at a very initial stage of development and are yet to be developedtoa significantlevel. As the technologiesadvances, it will reduce the delivery risk; but till then risk factor have to be included in the business situation.

On the hardware side, speedy evolution of technology is seen from vendors all over the world. Many recently evolved companies have become moreskeptical to the communications solutions and havefocused on operating within a suite of hardware andsoftware solutions. Moreover the policy makers, regulators, and utilities look upon well-established hardware providers for Smart Grid implementation.And this trend is expected to continue with increasingcompetition from Asian manufacturers and, as aconsequence, standards will naturally form andequipment costs will drop as economies of scale arisesand competition increases.

On the software and data management side, the majorchallengeis to overcome the integration of the entire hardware system and to managehigh volume of data. With multiple software providers come multiple data formats and the need for complex data models. In addition, the proliferation of data puts stresses on the data management architecture that are much similar to the telecommunications industry than the utilities industry. Many of these issues are currently being addressed in pilots such as SmartGrid task force and, as a consequence, the delivery risk will reduce as standards will be set up.

Lack of awareness

Consumer's level of understanding about how power is delivered to their homes is often low. So before going forward and implementing Smart Grid concepts, they should be made aware about what Smart Grids are? How Smart Grids can contribute to low carbon economy? What benefits they can drive from Smart Grids? Therefore:

- Consumers should be made aware about their energy consumption pattern at home, offices...etc.
- Policy makers and regulators must be very clear about the future prospects of Smart Grids.
- Utilities need to focus on the overall capabilities of Smart Grids rather than mere implementation of smart meters. They need to consider a more holistic view.

Access to affordable capital

Funds are one of the major roadblocks in implementation of Smart Grid. Policy makers and regulators have to make more conducive rules and regulations in order to attract more and more private players. Furthermore the risk associated with Smart Grid is more; but in long run it is expected that risk-return profile will be closer to the current situation as new policy framework will be in place and risk will be optimally shared across the value chain.

In addition to this, the hardware manufacturers are expected to invest more and more on mass production and R&D activities so that technology obsolescence risk can be minimized and access to the capital required for this transition is at reasonable cost.

Skills and knowledge

As the utilities will move towards Smart Grid, there will be a demand for a new skill sets to bridge the gap and to have to develop new skills in analytics, data management and decision support. To address this issue, a cadre of engineers and managers will need to be trained to manage the transition. This transition will require investment of both time and money from both government and private players to support education programs that will help in building managers and engineers for tomorrow. To bring such a change utilities have to think hard about how they can manage the transition in order to avoid over burdening of staff with change.

Cyber security and data privacy

With the transition from analogous to digital electricity infrastructure comes the challenge of communication security and data management; as digital networks are more prone to malicious attacks from software hackers, security becomes the key issue to be addressed.

In addition to this; concerns on invasion of privacy and security of personal consumption data arises. The data collected from the consumption information could provide a significant insight of consumer's behavior and preferences. This valuable information could be abused if correct protocols and security measures are not adhered to.

If above two issues are not addressed in a transparent manner, it may create a negative impact on customer's perception and will prove to be a barrier for adoption.

SOLUTIONS TO OVERCOME THE BARRIERS IN IMPLEMENTATION

Despite the challenges mentioned above, there are anumber of steps that can be taken tospeed up the implementation of smart grid technologies. Foremost step that is required to be taken is that policy-makers andregulators need to restructure the economic incentives and align riskand reward across the value chain. By building the righteconomic environment for the private sector investment andfocusing more broadly about the way that social valuecases are created and presented implementation would become much easier. By analyzing thesesolutions in bigger environments i.e. in cities, the entireindustry will learn what it takes to implement smart gridssuccessfully and will result in developing an industrythat is set to boomin the comingperiods.

Forming Political and EconomicFrameworks

Policy makers and regulators have to implement a framework which optimally spread the risk over the whole value chain i.e. to guard the investors from risk and to yield the result at lower cost to the customers. They have to form a robust incentive model in order to attract more and more private investment. Also rate of return should be based on the output generated. Rewards and penalty mechanism should be considered in order to monitor the performance of the utilities and to encourage them to deliver the outcomes in the most efficient manner.

Technological and delivery risk associated with Smart Grid are significant. And this can be overcome over a due course of time as more issues arise and are addressed. Risks associated with Smart Grid have to be shared by every member across the value chain. While making the framework regulators must consider how much of that risk a utility can pass on to the contractors, suppliers and consumers. By maintaining the proper balance, there will be an improved alignment of the incentives. And further they have to tackle numerous policy disputes and recommend potential solutions**.**

Moving Towards a Societal Value System

The major challenge for the transition from analogous to digital infrastructure will be to move from utility-centric investment decision to societal-level decisions which determine wider scopes of the Smart Grid. This would help in the accelerated adoption of Smart Grid Technology by the society.

Achieving greater efficiency in energy delivery

Smart Grid Technology should consider building greater efficiency into the energy system which would result in reduction of losses, peak load demand and thereby decreasing generation as well as consumption of energy. New regulatory framework which incentivizes utilities for reducing the technical losses would help utilities to perform more efficiently**.**

Enabling distributed generation and storage

Smart grids will change where, when and how energy is produced. Each household and business will be empowered to become a micro-generator. Onsite photovoltaic panels and small-scale wind turbines are the predominant examples; developing resources consist of geothermal, biomass, hydrogen fuel cells, plug-in hybrid electric vehicles and batteries. As the cost of traditional energy sources continues to rise and the cost of distributed generation technologies falls, the economic situation for this evolution will build.

Increasing Awareness on Smart Grids

There is an imperative need to make the society and the policy makers aware about the capabilities of a Smart Grid. The main step is to form a perfect, universal description onthe common principles of a smart grid.Beyond agreement ona characterization, the matter also needs

to be debated moreholistically as a true enabler to the low-carbon economy,rather than as an investment decision to be taken within the meeting room of distinct utilities.The importance of consumer education is not to be underestimated.The formation of user-friendly andstate-of-the-art products and services will play a significantrole in convincing the societyabout Smart Grids.

Also the utilities are required to scrutinize the major challenges in implementation of Smart Grid and their impact on their business model and operations.

Creating a Fresh Pool of Skills andKnowledge

Successful implementation of the smart grid will require alarge number of highly skilled engineers and managers mainly thosewho are trained to work on transmission and distribution networks.As a result to on-jobtraining and employees development will be vitalacross the industry. Simultaneously, there is a requirement forinvestment in the development of relevant undergraduate,postgraduate and vocational training to make sure theavailability of a suitableworkforcefor the future. The investment in T&D should not be limited and neither in research and knowledge development, which would be essential for the development of this sector.

Addressing Cyber security Risks andData Privacy Issues

Smart Grid success depends on the successful handling of two major IT issues:

- Security
- Integration and data handling

With increase in computers and communication networks comes the increased threat of cyber-attack. The Government should look into this matter because consumer'sconsumption data can be misused by the utilities and the third party. Utilities have to give assurance to the consumers that their valuable information is handled by authorized party in ethical manner. The government has to adopt high standard level in order to withstand cyber-attacks.

ON-GOING SMART GRID ACTIVITIES

- APDRP, R-APDRP initiative for distribution reform (AT&C focus)
- DRUM India – Distribution Reform Upgrade, Management
- Four pilot sites (North Delhi, Bangalore, Gujarat, Maharashtra)
- Smart Grid Vision for India
- Smart Grid Task Force – Headed by Sam Pitroda
- BESCOM project – Bangalore – Integration of renewable and distributed energy resources into the grid
- KEPCO project in Kerala India - $10 Billion initiative for Smart-Grid
- L&T and Telvent project – Maharashtra – Distribution Management System roll-out
- Distributed generation via roof-top solar for 40% in a micro-grid

RECOMMENDATIONS

Regulators

- Create a regulatory framework which aligns incentives of each member in the value chain.
- Allocate risk and reward efficiently.
- Consider both utilities and customer while making policies.
- Adopt output based regulatory system (Reward/Penalties) which stresses on utilities to perform better.

Utilities

- Adopt more holistic approach about Smart Grids, so that they can convey its future benefits to the customers.
- Reduce the risk of technologyobsolescence by R&D activities.
- Undertake large scale pilot projects and analyze the benefits.
- Transformation from utility-centric investment decision to societal-level decisions.

Vendors

- Required to play important role in policy making process
- To help utilities to adopt flexible design and compatibility of Smart Grid fast.
- To convince customers about the acceptance of changing trend by product and service offering.

Customers

- Plays critical role by demanding for more flexible service.
- To encourage more players to enter in this field and in order to make the market competitive
- To help utilities and regulators to set goals and make conducive policies.
- To increase the awareness in society.

CONCLUSION

In this paper an attempt has been made to analyze the key challenges in implementing the Smart Grid concept in India. In most of the advanced countries Utilities have made major achievements in terms of productivity, reliability, and efficiency through the use of Smart Grid technology.Indian utilities are still lagging far behind when compared to other countries. Today their main focus is on providing energy at reasonable price but soon the day will come when the utilities will be focusing on encompassing sustainable use and environmental improvement into their agendas.

And Smart Grids will play a vital role to help utilities in accomplishing this mission. So, theutilities will need to invest heavily in new hardware, software, business process development, and staff training. Further there would be high investment in home area networks and smart appliances by the customers. Achieving the broader view of Smart Grid will require complex task prioritization and right set of policies and regulations to be in place.

Justifying its implementation however requires a full understanding of the long term benefits it would bring tothe customers, utilities, societies in terms of minimizing the cost and improved

customer service. In addition to these benefits it would play important role in addressing global issues like energy security and climate change.

BIBILOGRAPHY

- http://smartgrid-for-india.blogspot.com/
- http://www.smartgridnews.com/artman/publish/article_303.html
- http://www.projectsmonitor.com/ELECTRICITY/india-is-gearing-up-for-smart-grid-technology
- http://gigaom.com/cleantech/5-reasons-why-developing-countries-need-smart-grids-too/
- http://www.metering.com/node/17642
- http://panchabuta.wordpress.com/2010/11/17/first-pilot-project-of-smart-grid-technology-in-electronic-city-bangalore-india/
- http://www.energyandcapital.com/articles/smart-grid-developments/1257
- http://spectrum.ieee.org/tag/smart+grids
- http://www.drumindia.org/smartgrid/agenda.asp
- http://en.wikipedia.org/wiki/Smart_grid