

## CHALLENGES IN CEMENTING ENERGY EFFICIENCY THROUGH SMARTGRID IN INDIA

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### Abstract

Whether electricity is a chattel or a premium non-core service? The more beatifically this'll justify, will restructure the way of transportation and the use of electricity, resultantly foster the gaining momentum concept called SMARTGRID. The Indian electric grid is suffering from the lack of communication and other analytical capabilities. Modernization efforts are underway to make the grid more "smarter" and "efficient". This paper will highlight the challenges of the technology in strengthening energy efficiency movement of the country.

*Keywords: energy, smart grid, efficiency, challenges*

### 1. Introduction:

The challenges standing against climate change and the continued growth of electricity demand are putting increasing stress across the global electricity network infrastructure. Renewable energy is rising high day by day, the user-scale renewable such as overhead photovoltaic are also expected to take a flight, which drives much of the recent thrust on larger-scale renewable systems, and owing to their volatility and sporadicity, require increased grid flexibility. On a broader stretch, these energy sources require "smarter" grids to meet safety, reliability, and control requirements. As noted from the Electric Power Research Institute, a smart grid ought to ideally a cluster of micro-grids that occurs in a symbiotic relationship with the conventional large-scale grid. These micro-grids having a basis of small-scale renewable energy sources, which consists of sensors and an electronic control system that would channelize the exchange of information and control capability for the smart micro-grid that also would enable it to interact with the master grid. A circumstantial applied tactics and investment is needed to remake the major part of power networks. To reduce demand-Supply gap by the concept of energy efficiency, which cannot be done otherwise a grid, smart enough to transfer power in the most efficient way which can be achieved by the fantastic notion of 'Smart Grid'. It is neither a single concept and nor a single technology. It is an intellectual and practically established grid that uses digital technology and

communicating networking to atomize and augments the authority and monitoring of the electrical distribution system that will renovate the century's grid more reliable, secure and efficient. The bipartition ship of the bi-grid network would work to achieve maximum extent of reliability and serve almost unheard of needs of different customers at minimum cost. This smart grid will act as a catalyst to reform the existing energy management services and emerge with the new tariff structures with a suite of new business models henceforth, to strengthen the infrastructure of energy sector for the vision of low carbon economy and a greener odyssey.

### 2. Smart Grid –Brief Description and Importance:

Smart Grid is an evolution of the existing electricity grid which will facilitate and support the clean energy growth and innovation in the 21st century, with improved monitoring, analysis, control and communication capability along with escalated cost savings to maximize the efficiency of the electricity system. The "Smart" feature of the grid will empower the consumer with the choice and flexibility to make efficient and economic use of electricity. According to definition given by the European Technology Platform for Smart Grids, it is an electricity networks that can intelligently integrate the behaviour and actions of all users connected to it -

generators, consumers and those of that do both – to deliver sustainable, economic and secure electricity supplies more efficiently. In accordance to a report provided in table 1 by Central Electricity Authority has clearly illustrated the position of power in India. It is a belief that the successful implementation of the smart grid will definitely have a significant share in resolving key issues emerging in present portrait of power picture to turn the dream of “Power to All” into reality.

Table 1: Position of power in India

Source: Central Electricity Authority

Smart Grid supports better and optimal energy management, reducing power fluctuation, low cost transportations (by transporting only required power) and also involving the maximum use of renewable energy. Moreover making meter

Energy ( April, 2010 - March, 2011)

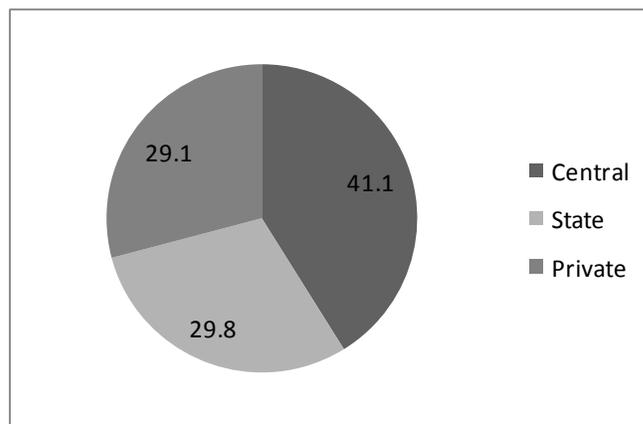
Region	Requirement (MU)	Availability(MU)	Surplus/ Deficit (-)	
			(MU)	(%)
NR	258,780	237,985	-20,795	-8.0
WR	268,488	232,871	-35,617	-13.3
SR	229,904	217,981	-11,923	-5.2
ER	94,558	90,526	-4,032	-4.3
NER	9,861	8,992	-869	-8.8
All India	861,591	788,355	-73,236	-8.5

reading nearly instantaneous, smart metering can synergize with gas and water meter readings, creating additional cost savings and more importantly, the greater convenience for customers. With electricity burden on individual pocket escalating every now and then, the smart grid will facilitate the end user with choices that could minimize the figures in their bills. It can offer time-of-use, as opposed to the price set by flat rate retail tariffs, rising day by day most consumers now pay. When consumers respond to such tariffs through a smart grid, the load at the peak hours would reduce hence, it will improve asset utilization and that therefore occur with a great impact in lowering down per-unit generation costs. To put in a simplified manner, a smart grid is the collective alliance of

integration of information and summation of communications technology into electric transmission and distribution networks which delivers electricity using double-lane digital technology to enable the more efficient use of the grid for monitoring, assurance of demand –supply balances and detection of faults in a “self-healing” process. The interventions use modern innovative services together with advance technology for enriching efficiency and promote end user to optimum utilization [1, 2, 3, 4, 5].

### 3. An Indian context of Smart Grid at a glance

India’s power sector with a total installed capacity of 2,11,772 MW with Inter Regional power transfer capacity of 27,750 MW and its large and looming demand- supply gap with extensive electricity losses – have supported the interest of the Government and other stakeholders in the smart grid.



Source: Central Electricity Authority

Fig 1: Electricity generation in India

Electricity is a synchronic sector in the 7<sup>th</sup> Schedule of the Constitution of India. Hence, it falls under the domain of the states and the Centre. Fig. 1 is describing the generation layout under the purview of the State and Central Govt. of India. According to the Prime Minister Manmohan Singh view of the rising population, demand could rise to 800,000 MW to as much as 950,000 MW by 2030 although generating capacity has added manifold from 1,362 MW to 211,772 MW from 1947 to 2012. Energy demand is increasing due to rising incomes, accelerated industrialization, urbanization and population growth. A closer look to energy use in future is more specifically presented in Table no 2.

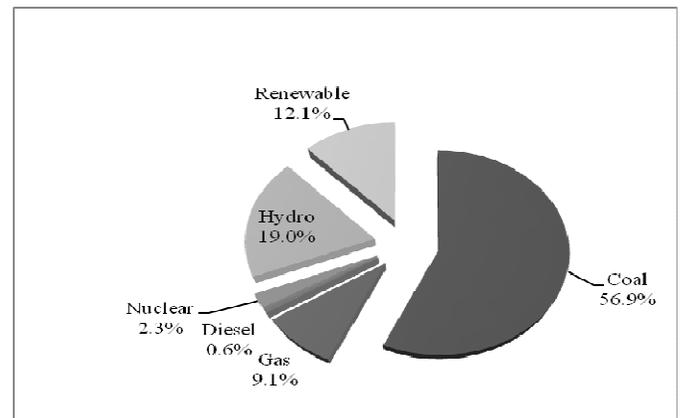
Table 2: Projected Energy Demand Scenario

Year	Energy Demand in Million Tonnes of Oil Eq	
2003-04	572	Mtoe
2016-17	842-916	Mtoe
2026-27	1406-1561	Mtoe
2031-32	1850-2200	Mtoe

Source: World Energy Outlook 2010

With the help of the pie-chart given in Fig 1, one can have an estimation of the major push from Government of India in any smart grid development since it owns the bulk of the power in the country. The Ministry of Power, Central Electricity authority, Power Grid Corporation of India Ltd, Power Finance Corporation of India limited are the major regulatory bodies and stakeholders toward this initiative. In coordination with the Central Electricity Authority, the Bureau of Indian Standards is the agency best able to look at undertakings of the initiative to formulate or adopt international standards with modifications to suit Indian conditions. The Smart Grid is a “transactive” agent, which can make the present day grid a fully automated system providing environmental and resilience benefits, increasing the overall efficiency by enabling the financial information, as well as "electrical transactions among consumers, grid assets, and other authorized users. This whole transformation between the current electric power delivery system and smart grid requires some changes and improvements across the grid value chain that constitute the smart grid capabilities or “key features ” and equip smart grid to redefine the future of power distribution. Intervention of the technology is more inclined to be tailored fit rather than one common size with respect to geographic variances found and taking consideration of the strategy and tactics involved at the execution line to meet the “to-be” vision for a smarter grid. The active demand management feature of smart grid will enable active participation through real time communication hence leads to environment friendly and cost-optimized power consumption. It will also facilitate decentralized generation which allows individual loads to tailor generation and providing independency from grid power failures. Di - centralization of smart grid will allow bi-directional movement and measurement of power and will also manage intermittency of renewable generation. Smart grid will allow different pricing schemes for Electric Vehicle fuelling and will also reduce personal energy consumption and exhaust emissions. It uses an advance technology like SCADA, Phase Management Unit (P.M.U) etc. which gives the information of changes in phase angle, current, power, voltage thus giving it the ability of self

assessments, so that it can detect and mitigate all the issues and can self heal itself by restoring its corrupted components or network sections. The self healing feature of smart grid makes the grid safer and reliable. The Asset optimization characteristic of Smart Grid optimizes the capital assets by increasing the load factors and decreasing the system losses. It is intelligent enough to monitor the whole system, and provide the planners all the required knowledge which can help them to extend the life of assets by repairing the equipment before it fails unexpectedly, and reduce the energy losses. Optimizing the flow of power will reduce waste and will help to decrease the capital cost of the system by maximize use of lowest-cost generation resources. Following Fig. 2 depicts the power generation through different resources in India. The major share of coal based power plant followed by the contributions of hydro, renewable, Gas, nuclear and diesel respectively.



Source: www.Powermin.nic.in

Fig 2. Fuel- wise Indian Power sector

All these factors will in turn increase the consumer saving. Supply shortfalls, load distribution, substantial contribution towards loss reduction, and minimization of human element in curbstone readings or even deliberate errors which are thought to be the significant factors for losses are supposed to be the specific reasons which are driving the adoption of the smart grid in India. The most important RAPDRP i.e. Restructured Accelerated Power Development and Reforms Programme which will fund projects to upgrade distribution and transmission networks with a set target of reducing 15 percent of the sectors technical and commercial losses. [2, 4, 7, 8,10,11]

#### **4. Barriers: Challenges for implementation**

There are several factors that put a brake on the growth of smart grid developments, a quick glance to the most prominent challenges that are holding back the investments in the smart grid which may affect the results of cost benefit analysis and what the potential measures could be taken in order to accelerate the adoption of the technologies will be examined in the following

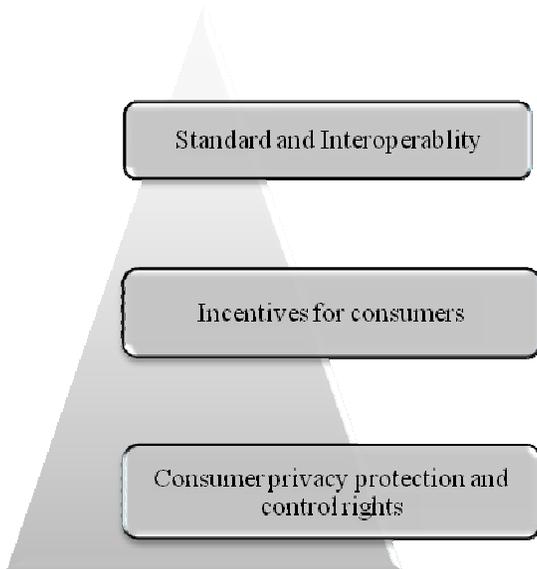


Fig 3. The Smart grid Vision for Power Sector in India

section. Some areas have been identified and taken as the major hurdles and need to be addressed for a broader adoption of the novel technology. An industry may not have enough reserve to finance a new technology without financial aid provided by government viz. incentives on investment and subsidy. Equipment compatibility is another major issue to look into, vintage technologies and their respective second crop equipments are not compatible hence may place problems before utilities and regulators to keep retired equipment with depreciated lives with minimized capital cost. The lack of policy and regulation also accounts for the challenges because there is no such defined guidelines and standards exist for the regulation of smart grid. In longer aspect, a shortfall in critical skills prerequisite to the architect and build of smart grid. Most of the DISCOM has limited experience; as a result they have weak internal skills. The lack of automation, information, communication technology and dependence on outsiders for Know-how will work as a penalty for the smart grid vision in India. Moreover, consumer education will also play a

significant role. Customer reaction is directly proportional to the benefits of market penetration of the technology. The absence of empirical evidence in context to the performance outcomes, and economics on a system-wide basis over time is always a source of uncertainty. In addition to these concerns over the vulnerability of various areas there are unfanatical concerns over invasion of privacy and security of personal consumption data. The basic conceptual structure of the working plan of policy makers and regulatory bodies is designed concurrent to the conventional grid operations, to look forward to the move headed to Smart grids will demand for the up gradation of the standard network to a new framework that will in line with the interest of consumers towards low cost and encourage the incentives for investment. [3, 5, 6]

### 5. Conclusion

Despite of all the thorny practical problems, the implementation of the technology including some who says these ideas are not yet implementable on the basis of cost incurred and benefit analysis. The analysis present in this paper would advances the understanding in defining the vision of the worthy challenge to revolutionize the current development in Indian power sector and will enable widespread smart grid adoption. Here the question comes can the India's smartgrid vision will enable to reshape the electricity sector into a different and better environment? The Indian smart grid is a by product of the need to descend high electric losses and industrial struggles, which provides quality service, reliability, and stability of electrification. Real global deployment and hence enormous energy saving with superlative connectivity would then become feasible which will open new horizon for energy conservation and climate change. The concept of adoption of smart grid in the Indian context synergise the potential of electricity supply and offers a broad band of ideas to meet the government of India electricity targets sooner and workable. Though the beneficiaries to this initiative would be the people of the economy, but, it will also add a significant portion to a high growth, sustainable and low carbon economy, within the picture of climate change and carbon crisis therein. The corresponding reduction in emission by the designing sustainable smart grid will definitely act as a blueprint for the nations, developed and developing alike. Smart Grid Solutions is a stepping stone towards the smart era, where every end-user will gain monitoring over their energy costs through an interactively connected electric system. Smart grid will be an evolution towards an optimized and sustainable energy system

which will prove itself as a more intelligent, efficient and reliable milestone and moreover it will have a positive influence on the climate change.

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