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HOW SMART GRID WILL ENERGIZE THE WORLD

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***Abstract*—over the past ten years many stakeholders including utilities, system operators, and regulators have been putting their priceless effort to modernize the electric utility delivery system, also known as "the grid". The grid of 21st century is being referred to as the "Smart Grid". Since devices throughout the system have been computerized allowing utilities and operators to monitor and adjust activities from remote locations. Changes to infrastructure vary across geographical areas depending on population size, economics and population needs. Massive amounts of data are being generated from both the grid and consumer side leading to the next phase in the smart grid evolution.**

The purpose of this paper is to explain the importance of Smart Grid Deployment in Asia-Pacific region. The paper throws the light on various problems and challenges related to electricity grids that are faced in Asia-Pacific region and the solution to manage those problems by adopting the vision of a "Smart Grid." The essence of this vision is "a fully-automated power delivery network that can ensure a two-way flow of electricity and information between the power grids and appliances and all points in between".

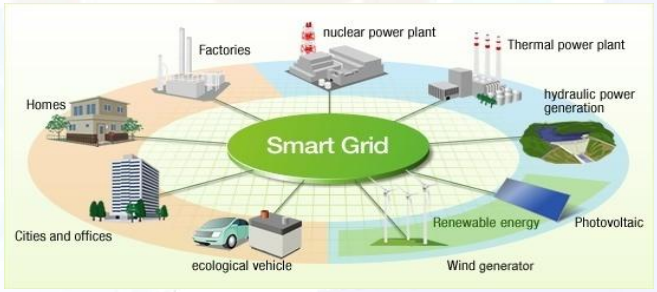
***Index Terms*—Electrical utility, Renewable energy, Smart meters, Home energy management system.**

I. INTRODUCTION

Smart grid is a term referring to the next generation power grid in which electricity distribution and management is updated by incorporating advanced two-way digital technology and communication capabilities for improved control, efficiency, reliability and safety. To ensure the correct functioning of smart grid, it is essential that communications are secured, devices are protected from physical attack, and privacy is respected. Communication requires authentication and confidentiality, devices require protection from physical attacks, and the system as a whole must be robust.

Basically smart grid is an electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviours of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity. Smart grid offers a lot of valuable technology.

Which is regarding the digital technology application and electrical power network, which can be used within the near future or are already in used today smart grid, includes an intelligent monitoring system, electrical network and digital control appliance? All of these can deliver electricity from producer to consumer, control energy flow and make the performance of an electric network more reliable and controllable.



II. FEATURES

A. GREEN

Slowing the advance of global climate change and offering a genuine path toward significant Environmental improvement.

Figure 1 Automation/Real Time Feedback

B. QUALITY FOCUSED

Capable of delivering the power quality necessary – free of sags, spikes, disturbancesand interruptions – to power our increasingly digital economy and the data centers, computers andElectronics necessary to make it run.

C. LOAD ADJUSTMENT

The total load connected to any electric grid changes with the time. Although the total load is the sum of many individual choices of the clients, the overall load is not a stable, slow varying, average power consumption. Imagine the increment of the load if a popular television program starts and millions of televisions will draw current instantly. Traditionally, to respond to a rapid increase in power consumption, faster than the start-up time of a large generator, some spare generators are put on a dissipative standby mode. A smart grid may warn all individual television sets, or another larger customer, to reduce the load temporarily.

D. EFFICIENCY

Numerous contributions to overall improvement of the efficiency of energy infrastructure is anticipated from the deployment of smart grid technology, in particular including demand-side management, for example turning off air conditioners during short-term spikes in electricity price. The overall effect is less redundancy in transmission and distribution lines, and greater utilization of generators, leading to lower power prices.

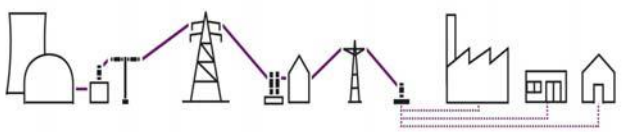
E. RELIABILITY

The smart grid has the ability to improve fault detection and allows self-healing of the network without the intervention by the technicians. This will ensure more reliable supply of electricity, and reduced vulnerability to natural disasters or attack.

III. MOVING BEYOND AMI TO ADOPT A SMART GRID VISION

Metering was all about "Feeding" utilities commercial processes that include metering, meterreading, billing and clearing. Utility networks are "One Way" networks and the last mile is still "BLIND".

Very High **High** **Medium/None** **None/"BLIND"**



This paper focuses on this "last mile" i.e. the growing urgency to make the Electricity Grid "SMART." We are in transition phase today. The major challenges in this region are:

- Quality, security and reliability of supply
- Cross-border power trading and grid services
- Ambitious energy policies and environmental goals
- Electric vehicles
- Real time and variable pricing

Advanced Metering Infrastructure (AMI) is an approach to integrating consumers based upon the development of open standards. It provides consumers with the ability to use electricity more efficiently and provides utilities with the ability to detect problems on their systems and operate them more efficiently. AMI enables consumer-friendly efficiency concepts like "Prices to Devices" to work like this: Assuming that energy is priced on what it costs in near real-time – a Smart Grid imperative – price signals are relayed to "smart" home controllers or end-consumer devices like thermostats, washer/dryers and refrigerators – the home's major energy-users. The devices, in turn, process the information based on consumers' learned wishes and power accordingly. The house or office responds to the occupants, rather than vice-versa.

Smart Grid is a system that enables two-way communications between consumers and electric power companies. The must requirement for Smart Grid is the intelligent meter i.e. the smart meter which is installed on the consumer side. You can have "Smart Metering" without the "Smart Grid"…but the "Smart Grid" is built on "Smart Metering." The basic drivers for Smart Grid are:

- Energy Efficiency
- Demand/Response
- Integrated Multi-Energy
- Revenue Protection
- Operational Efficiency
- Customer Satisfaction

IV. ADVANCED METERING INFRASTRUCTURE

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Distribution Automation System provides tools for the distribution power network's security, economical operation. It guarantees power quality, perfecting facility management as well as increasing working efficiency and providing a series of solutions for the distribution automation system. The system supplies the function of power grid monitoring, control, failure management, and power balance and charge management. It improves reliability with real-time monitoring and intelligent control. This system is basically head-end network management software. It provides network speed enhancements. Improving efficiency and reliability of a distribution network is a critical goal for many utilities. Two-way communications with the protection and control devices on the distribution portion of the smart grid is fundamental to achieving those energy efficiency and reliability goals. Distribution Automation (DA) devices themselves are evolving to be more robust and reliable,

V. INTEGRATED TECHNOLOGY

Basically a smart grid is combination of two infrastructure, namely electrical infrastructure and information infrastructure but the condition is that they must be use securely. Some communications are up to date, but are not uniform because they have been developed in an incremental fashion and not fully integrated. In most cases, data is being collected via modem rather than direct network connection. Integrated communications will allow for real-time control, information and data exchange to optimize system reliability, asset utilization, and security.

INTEGRATION OF TWO INFRASTRUCTURES... SECURELY

ELECTRICAL INFRASTRUCTURE + INFORMATION INFRASTRUCTURE

VI. PERSONAL ENERGY MANAGEMENT

Personal Energy Management (PEM) is a critical component of the smart grid. It opens the door for energy consumers to become directly involved in monitoring and controlling energy use. It provides utilities with the tools to more uniformly control peak load, and ultimately support new sources of generation and new uses of electricity. Personal energy management is the future of energy efficiency. This is one of the aspects of the Smart Grid that has only recently begun to emerge: using Home Area Network to engage the energy consumer more directly in the energy management process. Today's advanced metering technology provides a ready communication gateway into the residence or business that didn't exist before. A smart distribution grid requires the means to remotely, securely and automatically capture information, monitor performance, and execute commands that enable efficient and reliable power delivery. Personal Energy Management takes this concept directly to the consumer with a variety of applications for reducing peak load, monitoring alternative generation, managing recharging of plug-in hybrid vehicles and prepayment of electric service. The Smart Grid solution for home automation utilizes the advanced digital meter with secure ZigBee communications to support a variety of personal energy management features, including:

- VARIABLE PRICING- using an in-home display, consumers are notified of peak pricing and time-of-use rates. In addition, consumers are able to monitor and track kWh (real energy usage) consumption over time. Alerts can warn customers of unexpected or high consumption, leading to better efficiency and reduced costs.
- DISTRIBUTED GENERATION- integrated communications provide opportunities to track net generation and transition customers from site-generated or stored power back to the utility's distribution system during optimal times.

VII. ONGOING PROJECTS IN ASIA REGION

China has embarked on a 10-year project to build a "Smart Grid" that will catapult its power transmission into the digital age, securing electricity supplies and boosting energy conservation. The Government of India has devised a scheme which is called the Restructured Accelerated Power Development and Reforms Program to address the strengthening & upgrading of the Indian transmission and distribution network. The program calls for an investment of US $ 10 billion over a five year span.

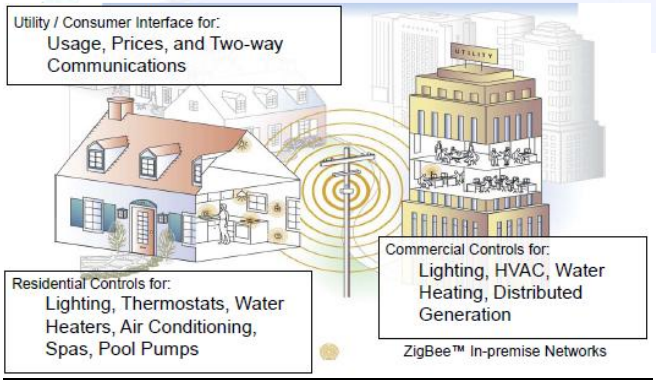

Figure 2.ZigBee Gateways Interface Consumer's Devices to the Utility.

The Japanese trade ministry has estimated the shift to renewable power will require a grid upgrade at a cost of between US$ 51 Billion and US$74 Billion by 2030. Korea aims to create a nationwide Smart Grid by 2030 for an electricity market worth US$ 60 Billion.

- SMART GRID PROJECT IN INDIA

The annual demand of India for electricity is increasing at an annual rate of 8-10%. In 2008 the conference a conference was held the main objective of which was to turn a dumb grid into a smart grid, and it was roughly $100 Billion investments in technologies for generation, distribution, transmission and monitoring.
In July, 2008, in Kolkata (greater Calcutta area) became the first housing project in India where residents have the option of generating power in rooftop solar photovoltaic panels, and selling it to the power grid utility. From now on, their electricity bills will reflect the difference between the energy consumed from the utility and how much they send to the grid.

VIII. WHY DOES A CONSUMER CARE

Most people are well informed about some forms of energy use, and completely blind to others. If you ask a person what kind of mileage their vehicle gets, they can likely provide an answer. Ask them what the price gasoline is, and again they can offer a fairly quick and accurate response. Consumers clearly understand the cost of driving and the impact it has on their wallet and the environment. To help manage this, automakers provide a dashboard that indicates fuel levels and in newer vehicles even consumption data. This information allows the consumer to actively participate in managing their energy usage. If we turn the discussion to the person's home, the responses are very different. How many kilowatt hours do they use in their home? Very few people can respond. What do they pay per kilowatt hour? Again, few can answer. How much money do they save if they raise their thermostat two degrees in the summer? If their entire neighbourhood purchased a plug-in Hybrid Electric Vehicle (PHEV), would their lights dim when everyone returned home from work and plugged them in?

One of the key goals of smart grid is to allow consumer to participate the consumer in the decision regarding their usage, whether the goal is to save money or to save the environment.

IX. FUTURE ASPECTS

Consider an unusually destructive storm has isolated a region. Then the major problem faced by the citizens would be the electricity problem. The citizen would remain in the dark, their food will spoil, security compromise, and their families at risk. Until the future smart grid develops. With the help of this upcoming technology the community will be able to immediately take advantage of distributed resources. It is the ability of distributed generation to continue to generate power even when the power from a utility is absent. Thus combining distributed resources of different types – rooftop (solar), fuel cells. The community can generate sufficient electricity to keep the grocery store, the police department, the traffic lights and health centre.

When it takes a week to restore the line, the generation potential resides in the community. It means the peoples have sufficient power to meet their essential needs.

This is power from people

And it is coming.

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