Smart Grid; The Next-Generation Smart Network of Power

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***Abstract*— Smart grid comprises of bidirectional power flow and information to produce a broadly distributed automated energy delivery system. Smart Grid is such an intellectual technology of modern era in which the consumers are connected with the utility through a system of networks. 20th century advanced and optimal power grid in principle is Smart Grid. As per demand, Smart Grid is more responsive and much optimal. The importance of Smart Grid is discussed in this paper. The main discussion that has been undertaken in this article is about surveying the literature on enabling technologies for the smart grid. Also various problems which are faced by the current grid system are also discussed. The solutions to these problems are given by implementing Smart Grid technology. This research paper also discusses the Smart Grid significant component such as Advance Metering Infrastructure, Personal Energy Management and Distribution Automation. Furthermore the environmental benefits of smart grid are also discussed.**

Keywords—Smart Grid; Advance Metering Infrastructure (AMI); Two-way Communication; Personal Energy Management (PEM); Distribution Automation (DA); Green Grid

I. Introduction

Awareness is being developed to use alternate resources of energy in spite of traditional convention energy resources, and that will fortunately gaining ground for advancement in smarter grid system. Smart Grid system will depend on data network and automation [1].

To escape any main catastrophe from falling out of control it will auto responded due to the interlinking of smart network data to the power grid [2]. It is the future need of the power generation to have an improved and efficient low voltage power grid [3]. This is fictional to use the Smart Grid from the ground up, initially with low voltage substations, street lights and smart meters. With a number of Smart Grid arrangements it can identify leakages, deliver dimming of street lights, attaining load balancing and sustaining smart households. Complete control on these modules in the grid will result to achieve these milestones [4].

To fulfill the power demand in a cost effective way the smart grid system is based on transmission and distribution lines network [5]. Actually smart grid consists on initiators, transmission and distribution lines and also even some times small grids [6]. For smart grid injection it is important to understand the components includes Smart meter reading system, smart sub-structure metering, responsive demand system, automated distribution, energy regulating system and computerized sub-stations [7].

This paper is divided into three main sections. Comparison amongst old traditional grid and smart grid are discussed in the first section, after this Smart Grid components are discussed in the second section while Smart Grid as a green grid is discussed in the third section and the paper is concluded in the last section.

II. Comparison Among Traditional Grid And Smart Grid

Traditional Grid	Smart Grid
One-way communication	Two-way communication
Blackout and Catastrophe	Islanding and Adaptive
Consolidated Generation	Dispersed Generation
Electromechanical	Digital
Limited Sensors	Sensors Monitoring
Inadequate Control	Overall Control
Manual Restoration	Self-Healing
Narrow Consumer choice	Various Consumer Choice
Blackout and Catastrophe	Two-way communication
Consolidated Generation	Islanding and Adaptive

Table 1: Comparison between Traditional and Smart Grid

Comparison amongst both traditional and smart grid is shown in Table I.

III. Smart Grid Components

Smart Grid is scheme for Advanced Metering Infrastructure, Distribution Automation and Personal Energy Management [8]. Submissions for smart grid are allowed today because this system is secured, intellectual, smarter, ascendable and sustained system. To deliver the most effective electric operation among the network, the consumer's data is received by the power utilities in a Smart Grid system [9].

Explanation of Smart Grid is focused in this paper with a brief illustration on Advance Metering Infrastructure and Distribution Automation trailed by the description of Personal Energy Management that is however to be consummate and is the key part for smart grid initiative beside with the solution as in what way Personal Energy Management can be joined with Smart Grid.

A. Advanced Metering Infrastructure (AMI)

Advanced Metering Infrastructure (AMI) is automatically designed two-way communication system. It communicates between the power supplies company smart meter with an IP address and power suppliers head end system [10][11]. Real time power consumption information is delivered to the utility by the AMI system. AMI also allow the consumers to used energy in the off peak hours depends on the rates of the usage time.

As AMI is two-way communication system it changes the traditional Automated Meter Reading (AMR) [12][13]. AMI allows the clients to use their electric utilization smartly i.e. according to the price rate of electricity by alerting the end users. It allows the end users to utilize power when demand is low.

B. Distribution Automation (DA)

Distribution Automation (DA) System provides power network safety tools for the distribution, and also for cost-effective setup [14]. It delivers a series of solutions for the distribution automation system as well as increasing efficiency of working. It also assures impeccable facility management. DA allows control management, power stability, power grid observations, power regulation, and failure management [15]. It is basically headed-end association management software. This system also improved speed of the network.

It is the main task of every organization to have an efficient and reliable distribution network [16]. DA devices centered on automation are power efficient, highly precise in outcomes and more reliable [17]. In real time to understand the prominence of equipment's like capacitor banks, buttons, transformers and voltage regulators needs much faster outcome and creates blunder and unapproachability situation. Moreover, this is very energy proficient capable on a good capacitor and improved in voltage management [18].

The following are the benefits:

- Environmental friendly
- Stronger system capable to carry all challenges
- Active distribution system
- Minute line losses
- Least possible damages
- Constant voltage in feeder
- Decrease capital inputs
- Energy proficient

C. Personal Energy Management (PEM)

Personal Energy Management is an important segment of Smart Grid. It allows users to directly investigate their energy usage [19]. This section control peak load and also support newly generation sources with the tools for the utilities to afford new use of electricity [20]. PEM is the upcoming future of energy proficiency. To ascend using home area network the clients are intricate directly in the energy management procedure is one of the main feature of Smart Grid [21][22][23]. Metering technology innovative of current era allows an ordered way of communication into the house or professional formerly that did not happen.

A smart distribution grid desires the resources to distantly, progressively and mechanically store data and observes performance capable of efficient and reliable power delivery. PEM takes this indication directly to the customer with a variety of applications for declining peak load, identifying alternative generation, management of restoring of plug-in hybrid vehicles and payment of electric facility. Following are the Smart Grid PEM features shoen in Figure 1. [24][25].

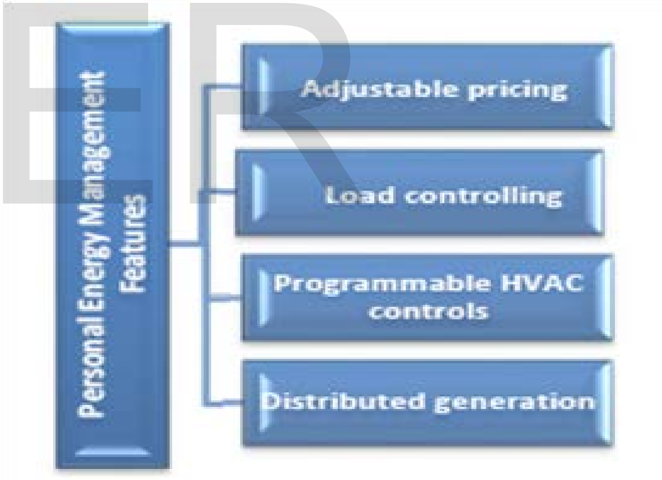

Figure 1: Smart Grid PEM Features

IV. Smart Grid As A Green Grid

Smart Grid uses less consumption of non-renewable resources by using smart meters. It can give assistance to the environment. This consumption from non-renewable energy resources are hazardous for surroundings by release of greenhouse gases and pollution. These gases abolish our environment. Benefits of environment can be scattered in Figure 2,

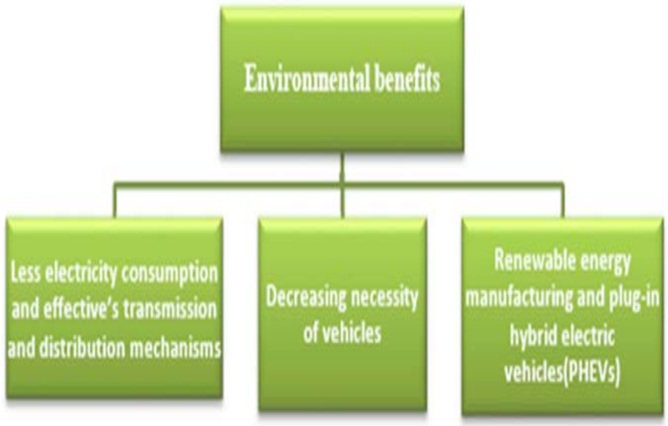

Figure 2: Environmental Benefits

A. *Less electricity consumption and effective transmission and distribution mechanisms*

Smart meters have been familiarized for small utilization of electricity. It allows proficient transmission and distribution mechanism. On daily basis smart meters have proficient capacity of monitoring energy usage; also many clients can't use heavy voltage devices that consume more energy. In spite of those heavy load devices they use low voltage devices for effective lightning. Beside these they can use other techniques to save energy [26] [27]. If end user starts to conserve energy, it is obvious that less energy will be demanded.

B. *Decreasing necessity of vehicles*

Smart meters will also decrease the use of vehicles that were utilized by the officials for meter readings, and several problems related to connections. Problems like that can be easily handled by using smart meters. Due to the use of smart meters a lot of resources can be saved. Smart meters can avoid the global warming problems by decreasing the release of greenhouse gases [28].

C. *Renewable energy manufacturing and plug-in hybrid electric vehicles (PHEVs)*

Smart Grid technology will increase the use of distributed generation (DG) and produce a ground for the ability of conservation of wind and solar generation [9]. For plug-in hybrid electric vehicles (PHEVS) it will be more favorable [1]. Moreover by doing away with the new fossils fuel generation DG will be significantly favorable and useful for environment [29] [30]. Smart Grid technology is fortified with such techniques which allow the use of plug in hybrid electric vehicles (PHEVS) fruitful and thus reducing the consumers dependence

V. CONCLUSION

Energy demand is increasing day by day and the scope of supplier facility organization in the glob has been restricted in the power transmission and distribution. Though, eagerness to proliferate the facility excellence of the power distribution machine has run to amalgamation of new structures in the system. Aim of Smart Grid is to purify contribution of consumer in the power supply scheme. US Energy Information Administration (EIA) reports that global power production will rise up to 77 % from 2006 to 2030. Thus the requirement of improvements of grid rises.

Individual States are in front of errands in approximating and modeling service providers Smart Grid recommendations, later it indicates a tough practical challenge. Shortage of economics resources and lack of trained people in this area needed to assign external experts. Individual states without attaining additional assistance track a significant risk of only responding to service providers an AMI plans and preceding any chance to move onward with their own Smart Grid plans that could perhaps produce additional realistic and strong market drive and considerably improved customer assistances.

Furthermore, due to rising environmental uncertainties, this is suggested that grids necessitates to advance as comparing these days, and alter their self towards non-conventional energy means and use several energy effectiveness skills. Current grids in Pakistan are not that much adequate in mean of proficiency, security, reliability and environmental influences to power supply, according to the necessity of consumer so for that it is necessary to move towards the development solutions like Smart Grid concept to fulfill the consumer's needs.

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