4th International Conference on
Energy, Environment and Sustainable Development 2016 (EESD 2016)

# 142. Review Study on Smart Grid

Iqra panhwar , Saba Rao , Abdul Razaque Sahito

*Institute of Environmenental Engineering & Management , Mehran University of Engineering and Technology, Jamshoro, Pakistan.*

## Abstract

In principle, smart grid is an advanced version of 20th century power grid and it is much optimal, advanced as well as more responsive as per demand. The purpose of this paper is to explain the importance's of smart gird. This paper will throw light on the various problem which are faced by the electricity grid and the solution of these problems by implementing the vision of a smart grid. Smart grid is the intellectual electricity distribution system in which energy providers and the customers are interconnected with each other through a network. This paper will also provide the outline on the key components of smart grid system which includes Advanced Metering Infrastructure, Personal Energy Management and Distribution Automation and will also throw light on the Environmental Benefits of Smart Grid.

© 2016. Iqra panhwar, Saba Rao , Abdul Razaque Sahito . Selection and/or peer-review under responsibility of Energy and Environmental Engineering Research Group (EEERG), Mehran University of Engineering and Technology, Jamshoro, Pakistan.

***Keywords:*** *smart Grid ; Energy ; Two-way Commiuncation ; Management ; Environment.*

## 1. INTRODUCTION

The concept and an awareness is developing of alternate energy resources instead of conventional resources is gaining ground that will eventually result in smarter and advanced grid system. This system will based on automation and smart data network [1].

This combination of smart data network linked to the power grid will be auto responder which will help to avoid any major failure from falling out of control [2]. An improved and efficient low voltage power grid is the need of the future power generation [3]. It is supposed to appliance the Smart Grid from the ground up, preliminary with LV substations, smart meters and streetlights. It can identify the leakages, deliver streetlight dimming, maintain smart households and achieve load balancing with a number of smart Grid structures. It will only happen when there is full control on these components in the Grid [4].

A smart grid system based on network of transmission and distribution lines works efficiently from generation to consumption and fulfil the power demands in a cost effective way [5]. In fact a smart grid is based on initiators, transmission lines, distribution lines and sometimes small grids even [6]. For installation of smart grids we have to understand the components which are;

Computerized sub-station, smart meter reading system, smart metering sub-structure, demand responsive system, mechanized distribution and energy regulating system [7].

*E-mail address:* iqra.panhwar02@gmail.com

## 2. COMPARSION AMONG EXISTING GRID AND SMART GRID

| EXISTING GRID | SMART GRID |
|---|---|
| Electromechanical | Digital |
| One-way Communication | Two-way Communication |
| Centralized Generation | Distributed Generation |
| Few Sensors | Sensor Monitoring |
| Manual Restoration | Self – Healing |
| Failures & Blackout | Adaptive & Islanding |
| Limited Control | General Control |
| Limited Consumer Choice | Several Consumer Choice |

## 3. COMPONENT OF SMART GRID

Smart Grid is System for Advanced Metering Infrastructure, Distribution Automation and Personal Energy Management [8]. It is a protected, ascendable, intelligent and supported system with the path to future, allowing submissions for Smart Grid today. In a Smart Grid system, customer's data is received by the electric power company in order to deliver the most effective electric network operations [9]. This paper focuses on the explanation of smart grid with the short depiction on Advanced Metering Infrastructure and Distribution Automation followed by the explanation of Personal Energy Management which is yet to be accomplished and is the major part for smart grid enterprise along with the solution as to how Personal Energy Management can be combined with smart grid.

### 3.1 ADVANCED METERING INFRASTRUCTURE (AMI)

(AMI) is designed for automatic, is a two-way communication between a utility's smart meter with an IP address and a utility's head end systems [10]. The objective of an AMI is to deliver utility firms with real-time information about power consumption and allow clients to make up-to-date selections about energy usage based on the rate at the time of use [11]. AMI changes from old-style Automated Meter Reading (AMR) in that it allows two-way communications with the meter [12]. It includes the smart use of Demand/Response system where the end consumers are alerted of the pricing rates of electricity when the demand is high or low and the customs can use their electric utilizations accordingly [13].

### 3.2 DISTRIBUTION AUTOMATION (DA)

Distribution Automation (DA) System delivers tools for the distribution power network's safety, cost-effective operation [14]. It assurances perfecting facility management as well as increasing working efficiency and providing a chain of solutions for the distribution automation system. The system delivers the purpose of power grid observing, regulator, failure management, and power stability and control management and advances dependability [15]. This system is fundamentally headed-end linkage management software. It delivers network speed improvements. For every organization an efficient and reliable distribution network is one of the main objectives [16]. (DA) distribution devices based on automation are much more reliable, more accurate in results and energy as well as power efficient. [17]. Understanding the status of devices like: buttons, capacitor banks, voltage regulators and transformers in real

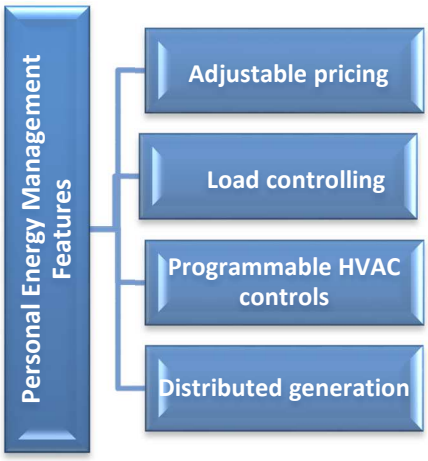
time allows much faster outage finding and develops an error situation and inaccessibility. Furthermore, it is much energy efficient based on a good capacitor and better in voltage management [18].

Benefits usually include:

- Effective distribution system
- Minimum line losses/damages
- A stable voltage in feeder
- An strong system ready to meet all challenges
- Reduce capital inputs
- Energy efficient
- Environmental /Eco –friendly

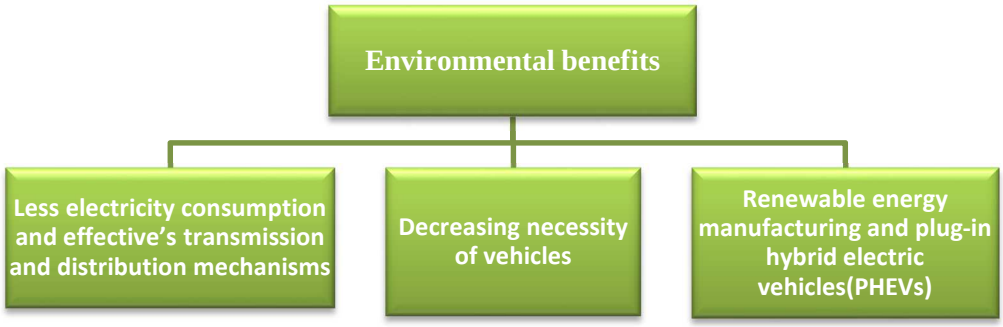
### 3.3 PERSONAL ENERGY MANAGEMENT (PEM)

PEM is a serious section of the smart grid. It opens the door for energy customers to become directly involved in observing energy use [19]. It affords utilities with the tools to more evenly control peak load, and support new sources of generation and new uses of electricity [20]. Personal energy management is the future of energy efficiency. This is one of the features of the Smart Grid that has only newly started to arise using Home Area Network to involve the energy customer more straight in the energy management procedure [21]. Today's innovative metering technology offers an organized communication way into the house or professional that didn't exist before. A smart distribution grid needs the means to remotely, steadily and mechanically capture information and monitor performance that allow efficient and reliable power delivery [22]. Personal Energy Management takes this idea directly to the customer with a range of applications for decreasing peak load, observing alternative generation, management of recharging of plug-in hybrid vehicles and payment of electric service [23]. The Smart Grid personal energy management features, including [24].




## 4 SMART GRID AS A GREEN GRID

Smart meters can give benefits to the environment or surrounding by less consumption of non-renewable resources which are hazardous or which impact our environment by emission of greenhouse gases and air pollutants which destroy our surrounding. Environmental benefits can be distributed as:




### 1. Less electricity consumption and effective's transmission and distribution mechanisms:

For less consumption of electricity and efficient transmission and distribution mechanism , smart meters have been introduced which have an efficient capacity of monitoring energy usage on daily basis apart from this, many customers can stop using unwanted or heavy voltage devices which consume more energy and electricity. Instead, they may use less voltage appliances for effective lightning. Furthermore, they also can make other energy – saving changes by which energy usage can be reduced [25]. It is an obvious fact that if customers start to conserve energy, less power or energy will be manufactured or required.

### 2. Decreasing necessity of vehicles:

Smart meters will also reduce the necessity of vehicles which are used by meter reading electricity official for different purposes such as meter reading, connection and disconnection problem [27]. These sorts of problems can effectively be handled through smart meters without sending any vehicle/team. In this way, we can also save our resources and avoid global problems such as potentially global warming climate change by reducing emission of greenhouse gases [28].

### 3. Renewable energy manufacturing and plug-in hybrid electric vehicles (PHEVs)

The smart grid will produce a ground for new and modern technologies to increase the distributed generation and energy conservation ability of wind and solar generation [9]. It will also be helpful for plug-in hybrid electric vehicles (PHEVS) [1]. In addition to this, distributed generation will be greatly beneficial and helpful for environment by doing away with the new fossil fuel production [29] [30]. The smart grid is also equipped with such technologies that make the usage of plug – in hybrid electric vehicles (PHEVS) successful and thus decreasing the customers over reliance on gasoline and diesel-fueled vehicles [31].

## 5 CONCLUSION

The scope of facility suppliers has been limited in the power transmission and distribution organizations through the globe. However, the enthusiasm to increase the facility quality of the power distribution machine has ran to unification of new features in the system. The smart grid goals at refining the participation of customer in the power supply device. According to the report of US (EIA) Energy Information Administration, the world's electricity generation will increase up to 77 % from 2006 to 2030. Thus the necessity for grid developments is growing. Individual States are facing tasks in estimating and modeling utility Smart Grid suggestions, later it signifies a difficult practical challenge. Instruction staffs, for the most part, do not have people trained in this area and shortage of economics resources wanted to appoint outside specialists. Without obtaining extra help, individual states track an important risk of simply reacting to utility AMI plans and foregoing any chance to move onward with their own Smart Grid plans which could possibly create more reasonable and healthy market movement and significantly better client benefits.

Additionally, because of growing environmental worries, it is recommended that grids need to develop as compare these days, and convert their self towards renewable energy resources and use servals energy effectiveness skills. However, if we talk about Pakistan current grids are not that much sufficient in mean of efficiency, safety, capability, reliability and environmental impacts to supply the energy or electrical power, according to the need of societies so for that it is important we should move towards the advance solutions like Smart Grid concept to fulfil the needs societies.

**Acknowledgements**

This review paper is made possible through the help and support from everyone, including: parents, friends and especially all teachers of the Institute of Environmental Engineering and Management (MUET) Jamshoro , for their support and encouragement .

## 6 REFERENCE:

[1] Steps to Smart Grid Realization RECENT ADVANCES in COMPUTER ENGINEERING and APPLICATIONS by shahram javadi & shahriar.

[2] Haase P. Intelli grid: a smart network of power. EPRI J 2005:17–25.

[3] NETL, "A COMPENDIUM OF MODERNGRID TECHNOLOGIES", National Energy Technology

Laboratory for the U.S. Department of Energy, June 2007.

[4] NETL, "A VISION FORTHE MODERN GRID ", National Energy Technology Laboratory for the U.S. Department of Energy, March 2007.

[5] Cisco Smart Grid, "Solutions for the Next-Generation Energy Network", 2009

[6] James G. Cupp, Mike E. Beehler, "Implementing Smart Grid Communications",2008 Burns & McDonnell Marketing, Communications

[7] Ali Ipakchi, Kema Inc, 2007, "Implementing the Smart Grid: Enterprise Information Integration", Grid-Interop Forum 2007, Paper 121-122.

[8] Andreas Umbach, "Advanced Metering-The foundation of Smart Grid," Presentation, 18 Mar, 2009

[9] Zhou S, Wu Z, Li J, Zhang X. Real-time energy control approach for smart home energy management system. Electr Power Compon Syst 2014;42:315–26

[10] Kahrobaee S, Rajabzadeh RA, Kiat SL, Asgarpoor S. A multiagent modeling and investigation of smart homes with power generation, storage, and trading features. IEEE Trans Smart Grid 2013;4(2):659–68.

[11] Christine Hertzog, Liz Ude, and Douglas Stuart, "Smart Grid Dictionary" 2nd Edition, 16 June, 2010

[12] Global Smart Energy, "The Electricity Economy: New Opportunities from the Transformation of the Electric Power Sector", August 2008.

[13] ISO New England, "Overview of the Smart grid – Policies, Initiatives and Needs", February 17, 2009

[14] Jai Belagur, P.E., "Implementing Low-Cost Distribution-Automation Programs," 12 Jan, 2010.

[15] Mike Burns, Matt Spaur, "Enabling Cost-Effective Distribution Automation through Open-Standards AMI Communications" 2009 Published

[16] Flynn, Byron, "Case studies regarding the integration of monitoring & diagnostic equipment on aging transformers with communications for SCADA and maintenance", DistribuTECH 2008, Conference and Exhibition, Tampa Convention Center, Tampa, FL, January 22-24, 2008

[17] Tropos Network, "A Wireless Distribution Area Network for Smart Grids, "June 2009, Published Automation," January 2006.

[18] ROA Group, "Introduction to Smart Grid: Latest Developments in the U.S., Europe and South Korea," June 10, 2010, Published

[19] Tsui KM, Chan SC. Demand response optimization for smart home scheduling under real-time pricing. IEEE Trans Smart Grid 2012;3:4.

[20] Han J, Choi CS, Park WK, Lee I. Green home energy management system through comparison of energy usage between the same kinds of home appliances. In: Proceedings of the 15h IEEE international symposium on consumer electronics (ISCE); 2011: p. 1–4.

[21] Son YS and Moon KD. Home energy management system based on power line communication. In: Proceedings of the 28th international conference on consumer electronics (ICCE) 2010.

[22] Han J, Choi CS, and Lee I. More efficient home energy management system based on ZigBee communication and infrared remote controls. In: Proceedings of the 29th international conference on consumer electronics (ICCE); 2011.

[23] Zhang Y, Zeng P, Zang C. Review of home energy management system in smart grid. Power Syst Protect Control 2014;42(18):144–54 [in Chinese.

[24] Zheng J, Gao DW, Lin L. Smart meters in smart grid: an overview. In: Proceedings of the green technologies conference; 2013: p. 57–64.

[25] Zheng J, Gao DW, Lin L. Smart meters in smart grid: an overview. In: Proceedings of the green technologies conference; 2013: p. 57–64.

[26] Ma Y, Houghton T, Cruden A, Infield D. Modeling the benefits of vehicleto-grid technology to a power system. IEEE Trans Power Syst 2012;27

(2):1012–20.

[27] Ma Y, Houghton T, Cruden A, Infield D. Modeling the benefits of vehicleto-grid technology to a power system. IEEE Trans Power Syst 2012;27

(2):1012–20.

[28] Kantarci ME, Mouftah HT. Wireless multimedia sensor and actor networks for the next-generation power grid. AdHoc Netw 2011;9(4):542–51.

[29] Ali ARA, Hag AE, Bahadiri M, Harbaji M, Yousef AEH. Smart home renewable energy management system. Energy Proced 2011;12:120–6.

[30] Mesarića P, Krajcarb S. Home demand side management integrated with electric vehicles and renewable energy sources. Energy Build 2015;108 (1):1–9.