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Autonomous Integration of Distributed Energy Sources and Home Appliances Coordination Scheme in Future Smart Grid Networks

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Abstract

Currently world is trying to sweep over new challenges in energy market, such as climate change, demand response, energy conservation, etc. These issues cannot be overcome with the conventional power system. It needs to promote the existing power system to improve the efficiency, sustainability at lower cost. The next era of power system, known as Smart Grid(SG) is a combination of Information, Technology and Computer (ITC) with the conventional power system. New ideas and emerging technologies are already being used such as IED (Intelligent Electronics Device), SCADA (Supervisory Control and Data Acquisition) and AMI(Automatic Metering Infrastructure). But these methods fail to integrate renewable energy sources with grid. In this work Autonomous Integration of Distributed Energy Sources (AIDES) method along with new Home Appliance Coordination Scheme (HACS) for scheduling of domestic appliance is proposed. This method minimizes the load on live grid and increase the participation of renewable energy sources in our daily energy consumption. Appropriate use of this scheme provides the solutions for energy management issues in smart grids as confirmed by simulation results.

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Keywords: Smart Grid(SG), Power supply, Renewable resources, Distributed energy Sources(DES), carbon foot print, integration.

1. Introduction

Our current electric grid was conceived more than 100 years ago when electricity need were humble, power generation was limited to a small area and built around communities because they have small energy demands. Generally the grids were design for utilities to deliver electricity to consumer's home and bill them once a month. This limited one-way interaction makes it difficult for grid to response for ever changing and rise in demand of

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21st century. The SG provides a two way dialogue where electricity and information can be exchange between the utility and its customer. It's developing network of communication, control, computer, automation, new technologies and tools working together to make the grid more efficient, reliable, secure and greener. The SG enable renewable energy resources to be integrate such as wind, solar, geo-thermal etc. The SG will replace the aging infrastructure of today's grid and utilities can have better communication with us, which help to manage and monitor our electricity needs. The smart home communicate with grid and enable consumers to manage their electricity usage by measuring home's electricity consumption more frequently by a smart meter. The utilities can provide their customer with much better information to manage their electricity bill.

We use energy, lots of energy but there is going to be big changes in the way we use energy. The world is running out of oil, coal and natural gas. Therefore, we need to find alternative and eco-friendly energy source. In future we will live in intelligent houses which control our energy consumption easily, conveniently and intelligently without us really knowing. The consumer could simply use an ordinary mobile phone to automatically start and stop the appliances depending on the per unit price of electricity. Human behaviour is contagious, actions are often guided by how people around us and behaving. It has been understood that adjustment to the way we utilize energy as a part of demand side couldn't just save money but also reduce the load proposed by M. Jun Hong B.Eng (2009)[1]. Fuchs, F*et al.*, (2014) [2] describes the difficulties in the field of integration of distributed energy resources and also stress the need of emerging technologies, power electronics and business studies for the implementation of smart grid technology in integration of Distributed Energy Resources (DER). Hoffmann*et al.* [3] provides an important features on which the integration of DER depends. The properties of electrical grid, voltage, frequency, phase and grid impedance changes with time. There are several two way communication technologies available to manage, monitor and control the grid integration. The communication system used in a real renewable energy project such as Bear Mountain wind farm in British Columbia, Canada and Photovoltaic power systems. It also show the challenges and limitation for the integration of Renewable Energy Sources (RES) and also show the possible solutions respectively [4]. World's population and energy demand increases exponentially. Anees. A.S, [5] demonstrate us a broad outline about the RES in India. As on march, 2012 the power generated by renewable sources was 24914MW i.e. approximately 12.1% of total power generation. Furthermore the Government of India is planning to achieve 20000MW power from solar and 38500MW from wind by 2022.

The Power Grid Corporation of India limited initiate a project on large scale development of desert power and it's grid integration by the name of Desert power India-2050 [6].The new strategy of appliances control using a Home Energy Management(HEM) system is demonstrated. The appliances communicate with each other through Energy Management Unit(EMU) to operate appliances at reduced mode of power consumption with minimum inconvenience[7]. Cyber security and consumer's data privacy is most vital requirement of a system. Customers information should be guarded from theft, data loss and hacking. EMU is a basic entity for data collection and energy management at both power generation side and at demand side. Ye Yan et al.,(2011) [8] provide a secure network for data aggregation and dispatch to keep confidentiality for power usage information of smart home device to the smart meter and for the reverse control message distribution procedure. A.Mahamood et. al (2014),[9] demonstrates a home energy management scheme based upon coordination and communication among appliances through a Wireless Sensor Home Area Network(WSHAN). It uses ZigBee protocol for communicate through messages among appliances, smart meter and central controlling unit.

This paper is composed of as follows: Section-2 elaborates the brief introduction of smart grid and Section-3 explains the power system model,Section-4 contains proposed work and algorithm. Finally, simulation results and conclusion of this paper is presented in Section-5.

2. Smart Grid

Electrical grid mainly consists of four major parts: electricity generation, transmission, distribution and utilization. Smart Grid generally refers to a class of technology people are using to bring utility electricity delivery system into the 21st century using computer based remote control and automation. To move forward we need a new kind of electric grid that can automate and manage the increasing complexity and needs of electricity in 21st century. These systems are made possible by two way communication technology and computer processing. For a century, utility companies have had to send workers out to gather much of the data needed to provide electricity. The workers