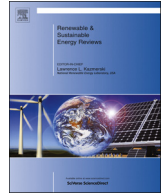




Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Role of smart grid in renewable energy: An overview



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ARTICLE INFO

Article history:

Received 28 August 2014

Received in revised form

31 May 2015

Accepted 18 September 2015

Available online 27 February 2016

Keywords:

Renewable energy

Smart grid system

Renewable power

Energy

ABSTRACT

Smart grid engineering is the key for a beneficial use of widespread energy resources, it is a modernized electrical grid that uses analog or digital information and communications technology. Renewable energy itself a thrust area of research due to its availability, applicability and environmental friendly nature and the application of smart grid in renewable energy makes it vast and more promising. This fusion enables the efficient use of renewable energies which is a key challenge for now. The present review paper attempts to investigate the role of smart grid in the renewable energy. The introductory section sets the role of renewable energy and distributed power in a smart grid system. Subsections cover the concept and availability of renewable energies, renewable energy power calculation formulae, smart grid concepts and its feasibility, case studied as performed by different researchers around the World, discussion and future recommendations and finally the conclusions from the study. To achieve this, articles from different sources such as internet, reports, conferences and journals of Elsevier, Springer, Taylor and Francis, Wiley and many more have been collected and reviewed. This paper concludes that renewable energies can be used efficiently and in a smart way by using the smart grids. However, the smart grid technology is not mature enough and needs more research on the same.

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1. Introduction

Energy is able to do the work. In science, energy can be neither created nor be destroyed, just transformed into another form. Energy and its conversion are vital for all life in the world and the basic part of the energy conversion includes into useable energy production. During this process, the energy can be transformed into several different forms. The different form of energy can get from nonrenewable and renewable energy sources. The most uses energy sources are form nonrenewable fossil fuels, oil, natural gas and coal. Another nonrenewable source is element uranium whose can be created hug heat and ultimately electricity. Fossil fuels and nuclear energy are the leading energy sources and can be stored in many countries. The uses of fossil fuels have almost been double from 630,000 to 121,000 TW h and the uses of coal and natural gas has also increased in the year 1973–2010. However, the uses of nuclear energy are much lower than the fossil fuels, about 84000 TW h in 2010 [1].

The use of renewable energy increased greatly just after the first big oil crisis in the late seventies. Although in most power generating systems, the main source of energy (the fuel) can manipulate, this is not true for solar, water and wind energies [2]. The solar energy is the main source for renewable energy which can be used directly as Bioenergy and other related renewable sources. Where a small part of the solar energy that reaches the surface of the earth is used in photosynthesis. The irradiation solar energy to energy stored in the biomass is only 4.6–6%. According to International Energy Agency, about 15,000 TW h was used for energy purposes in 2010. Where wind energy utilization was 574 TW h in 2012 and the hydropower was 3438 TW h in 2010. However, the utilization of solar energy is very low, about 100 TW h [1].

The main problems with these renewable energy sources are cost and availability; wind, hydro and solar power are not always available where and when needed. Unlike conventional sources of electric power, these renewable sources are not “dispatch able” the power output cannot control. Daily and seasonal effects and limited predictability result in intermittent generation. Smart grids promise to facilitate the integration of renewable energy and will provide other benefits as well [2]. A smart grid is an electrical grid that uses information and communication technology. The information about the behaviors of suppliers and consumers, which is automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity [3]. Most smart grids are located aside from closely populated areas, near a fuel source and at a dam site, to take advantage from the renewable energy sources. They are usually quite large to take benefits of the economies of scale. The electric power, which

generate, stepped up to a higher voltage at which it connects to the transmission network. The transmission network will move the long distance, sometime across international boundaries, until it reaches its wholesale customer (usually the company that owns the local distribution network) [4]. On arrival at a substation, the power will stepped down from a transmission level voltage. As it exits the substation, it enters the distribution wiring. Finally, upon arrival at the service location, the power is stepped down again from the distribution voltage to the required service voltage [5].

In this paper attempt has been made to present the overview of smart grid technology and its role in renewable energy. Section 1 represents the introductory part, Section 2 represent the basic concept of renewable energy technologies, their sizes and capacities and worldwide availability. Section 3 presents the basic renewable energy formulae with examples, Section 4 presents an overview of the smart grid technology, Section 5 presents the case studies as presented by the different researchers around the world and finally the conclusions, current trends and future recommendation from the study has been presented in the last i.e. Section 6.

2. Renewable energy: basic concepts and availability

There are many renewable energy sources available in the world. The basic part of these kind of energy sources are free and available. Here will be described all the renewable energy technologies and worldwide their production capacity.

2.1. Hydro energy

The hydropower main source is water, which is sinuous and then converted into electricity. The power of water is called hydroelectric or hydropower. In hydro power plant, the water is reserved or storing from river by using a dam that water will through a turbine. When turbine spanning, the generator producing electricity [6].

There is another type of hydroelectric plant which is called pumped storage and that can be able to storage power. This system will work in the turbine by pumping the water from the river or from lower to upper reservoir and the generator spin the turbine backward. This process will be running continuously and produces more power which will be ready to use. Electricity generated from the generators because that spins the turbines forward. The power production from the big, minor or micro-hydroelectric plants which will be enough electricity for a farm, ranch and house.

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