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Status of solar wind renewable energy in India ☆

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ABSTRACT

There are some specific constraints that hinder the development of solar and wind energy system in India. However, India has adequate sunshine and balanced wind speed. Hence there is greater opportunity for extension of solar and wind energy system in the Indian scenario along with enough future scope for these renewable sources through "Grid Parity". The aim of this paper is to present in a coherent and integrated way the major constraints hampering the development of renewable energy in India.

Contents

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1. Introduction

Electricity is the key factor for industrialization, urbanization, economic growth and improvement of quality of life in society. India is the world's fifth prevalent in the electricity sector. India has an installed capacity of 207.85 GW as on September 2012. Captive power plant generates further 31.5 GW. India's foremost transmission producer POWERGRID owns 79,556 circuit km of transmission line and 132 substations that are found in one of India's five transmission areas, that is, Eastern region, Western region, Northern region, North Eastern region, Southern region. Regional load dispatch center (RLDC) is a region house that organizes the use of the transmission system among these regions. State load dispatch center (SLDC) organizes transmission usage within the state and reports this datum to its overseeing RLDC [1]. Distribution amenities provide electricity to 144 million customers in India. These amenities incorporate step down substations and lines to carry the electricity at lower voltages to the electricity consumer. In stipulations of fuel coal fired power plant for 56% of India's installed capacity, hydropower accounts for 19%, natural gas 9% and renewable energy produces 12%. Depletion of conventional resources forces countries to develop effective strategies on energy mix. This requires a novel normative approach in planning for and supporting research on different energy resources. The International Energy Agency (IEA) estimates India needs an asset of at least 135 billion US dollars to give universal access to electricity to its population. According to IEA India will append between 600 GW and 1200 GW of supplementary new power generation capacity before 2050. Over 2010–11 India's industrial demand accounted for 35% of electrical power need, domestic household use 21%, agriculture 21%, commercial 9% and miscellaneous application accounted for the rest according to the 17th electric power survey of India [1,2].

- The electrical energy demand for 2016–17 is anticipated to be at least 1392 TWh, with a peak electric demand of 218 GW.
- The electrical energy demand for 2021–22 is anticipated to be at least 1915 TWh, with a peak electric demand of 298 GW [1,2].

To move to this state of affairs the Indian Government endorses renewable energy sources. These energy sources may deal with restraint about fuel flexibility, efficiency, reliability, economics and emission. The energy mix should revolutionize and start further renewable energy sources (RES) to diminish power generation pollution as well as greater balance in energy supply [6]. India's electricity sector is among the world's most active players in renewable energy utilization. As of December 2011, India produces 22.4 GW electricity based on renewable technology that is beyond the total installed electricity in Austria by all technologies. India was the first country in the world to set up a Ministry of non-conventional energy resources in early 1980 [1,2]. Wind and solar energy are omnipresent, freely available, and environment friendly. The wind energy systems may not be technically viable at all sites because of low wind speeds and being more unpredictable than solar energy. The combined utilization of these renewable energy sources is therefore becoming increasingly attractive and is being widely used as an alternative for oil-produced energy [7]. With these considerations the aim of this paper is to describe in an onslaught and integrated way the major constraint hindering the development of renewable energy in India. Table 1 represents the electricity sector capacity and availability in India.

2. Solar energy in India

2.1. Overview

Sunlight can be converted directly into electricity using photovoltaic (PV). The photovoltaic generation is a technique of converting solar radiation or photon energy into direct current electricity using a semiconductor material that exhibits photovoltaic effect. The International Energy Agency has numerated photovoltaic applications into four categories, namely, off-grid domestic, off-grid nondomestic, grid connected distributed, and grid connected centralized [8]. A typical PV module is made up of around 36 or 72 cells connected in series, encapsulated in a structure made of aluminum, depending on the application and type of cell technology being used [9]. The dominance of photovoltaic (PV) among renewable energy technologies is owed mostly to its noiselessness, non-toxic emission, and relatively simple operation and maintenance [14]. The increasing demand of electricity peak load has activated the utilization of renewable energy for different kinds of applications, such as heating, ventilation, and air-conditioning (HVAC) areas. Researchers also find the potential application of solar energy in cold storage system and utilization of thermal and physicochemical properties of different phase change materials in photovoltaic system [3–5]. These are important and relatively inexpensive sources of electrical energy where grid power is inconvenient, unreasonably expensive to connect, or

Table 1
Electricity sector capacity and availability in India [2].

Item	Value	Date reported
Total installed capacity (GW)	209	October 2012
Available base load supply (MU)	893371	October 2012
Available peak load supply (GW)	125.23	October 2012
Demand base load (MU)	985317	October 2012
Demand peak load (GW)	140.9	October 2012