Sustainable Cities and Society 12 (2014) 69–75

Contents lists available at ScienceDirect

Sustainable Cities and Society

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

Harnessing clean WATTS from the SUN: India's contribution, a techno economic analysis and empowering the future of energy sector

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ARTICLE INFO

Keywords:
Photovoltaic
Power grid
Solar energy

ABSTRACT

India has the most developed renewable energy markets and has the highest energy intensities in Asia. Very little investment and priority are being given to increase of the efficiency. On the other hand, the India has a high potential for developing energy production from renewable energy sources (RES) like solar, water, wind and biomass. However, these potentials are not studied and exploited enough and the present situation for their utilization is not so good. Although energy is a critical foundation for economic growth and social progress of any country, there are many constraints for RES development in all of them (political, technological, financial, legislative, educational, etc.). Obviously, defining development strategies and new support measures are necessary since renewable energy sources can make an important contribution to the regional energy supply and security. The main purpose of this paper is to explore the solar energy harvesting and opportunities in India. In this paper, efforts have been made for cost analysis, payback period calculations, current potential status, promotion policies, targets, major milestones and future of solar energy potential contribution and plans in India.

1. Introduction

1.1. Indian renewable energy market

Ministry of New and Renewable Energy (MNRE) Government of India are currently implementing Jawaharlal Nehru National Solar Mission (JNNSM) as part of Government of India's ambitious plan to provide viable and sustainable source of alternative energy in the country.

The Jawaharlal Nehru National Solar Mission was launched on the 11th January, 2010 by the Prime Minister. The Mission has set the ambitious target of deploying 20,000 MW of grid connected solar power by 2022. Mission will create an enabling policy framework to achieve this objective and make India a global leader in solar energy. The National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenge. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change (MNRE, 2014).

India is the most developed renewable energy market in South Asia, with annual revenues of about USD 185 billion. It is the third most attractive country to invest in renewable energy; according to Ernst & Young. The overall demand–supply gap in the energy sector is expanding due to an increase in the population's standard of living. The demand–supply gap in power is currently at 10.3% and is one of the key drivers of renewable energy. The utilization of renewable energy sources is still relatively low in India, thus presenting excellent business potential. The Indian Government expects the sector to grow to USD 19 billion, between 2008 and 2012, with renewable energy making up 20% of the 70,000 MW of total additional energy planned from 2008 to 2012. India has been attracting over USD 3 billion investment every year in renewable sector. The country is emerging as one of the largest potential sources of Certified Emission Reduction (CER) and Renewable Energy Certificates (REC) (Fig. 1).

1.2. Solar energy in India

India has a vast potential for renewable energy sources, especially in areas such as solar power, biomass and wind power. The current installed capacity of renewable energy is around 92,204 MW, constituting about 7.3% of India's total installed generation capacity. India is already the fourth largest in the world in terms of wind energy installations and we are seeing significant investment activity in this area.

Technological breakthroughs for cost-effective photovoltaic technology could generate a quantum leap in the renewable energy

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http://dx.doi.org/10.1016/j.scs.2014.01.005

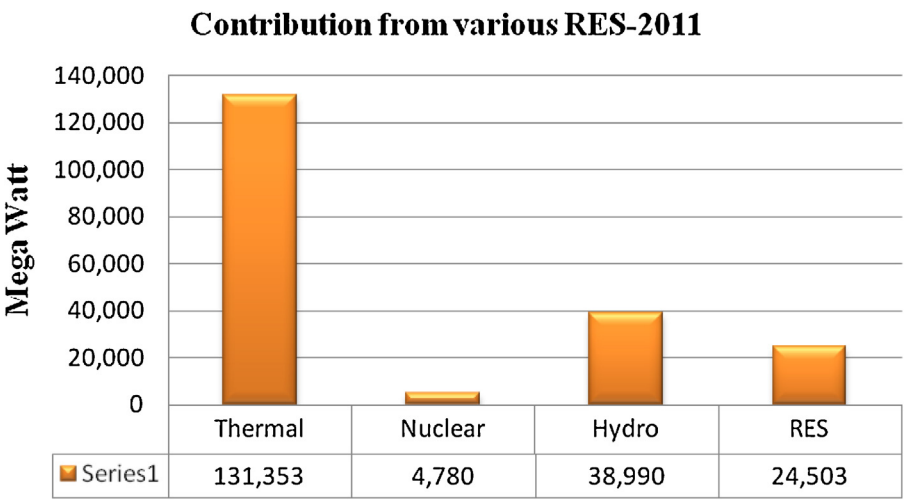

Fig. 1. Contribution from various RES-2011.

sector since India is well endowed with solar isolation (average of 6 kWh/m^2/day).

India just had 2.12 MW of grid-connected solar generation capacity. As part of the National Solar Mission, the Ministry aims to bolster the annual photovoltaic production to at least 1000 MW a year by 2017. With an installed capacity of 123 GW, the country currently faces energy shortage of 8% and a peak demand shortage of 11.6%. In order to sustain a growth rate of 8%, it is estimated 36 that the power generation capacity in India would have to increase to 306 GW in the next 10 years which is 2.5 times current levels (Fig. 2).

During most of 2012, and also at the start of 2013, many in the PV industry were hoping that final PV demand figures for 2012 would exceed the 30 GW level.

Estimates during 2012 often exceeded 35 GW as PV companies looked for positive signs that the supply/demand imbalance was being corrected and profit levels would be restored quickly. Ultimately, PV demand during 2012 fell well short of the 30 GW marks (NPD SolarbuzzMarketbuzz Report, 2014) (Figs. 3 and 4).

India is facing a power deficit of 9% and this is likely to continue over the next few years. In many states, industries are facing up to 50% power cuts (CEA, 2012). The gap between the power purchase costs and the power tariffs has severely constrained the finances of state power utilities with net losses estimated at around INR 88,170 crores (Thirteenth Finance Commission Report, 2014) in 2012–13. On the other hand, solar power costs have reduced rapidly in the last few years. Globally, the solar photovoltaic (PV) market has grown from around 9.5 GW in 2007 to 69 GW of cumulative installations by 2011 (BP Statistical Review, 2014). Accordingly, the solar PV industry has grown from USA 17 Bn in 2007 to USA 93 Bn in revenue by 2011 (Solarbuzz, 2014).

1.3. *Off-grid PV power plant and solar power plant features and benefits*

Off-grid or Standalone solar PV system is used to generate electrical energy where mains electricity is not available, like remote household, portable display, satellite. Off-grid system consists of PV array, charge controller, battery bank and inverter. The output of the system can be DC or AC or both for supply to DC or AC loads. The system needs to be designed for 24 × 7 operation over a long period of time with minimal maintenance (Fig. 5 and Table 1).

Tubular Gel Batteries are more efficient as a storage device due to the below features:

(i) Completely maintenance free.
(ii) Tubular positive plates.
(iii) Thixotropic gelled electrolyte.
(iv) Works on gas recombination principle.
(v) Sealed using pressure regulated valve.
(vi) Spill and leak proof.

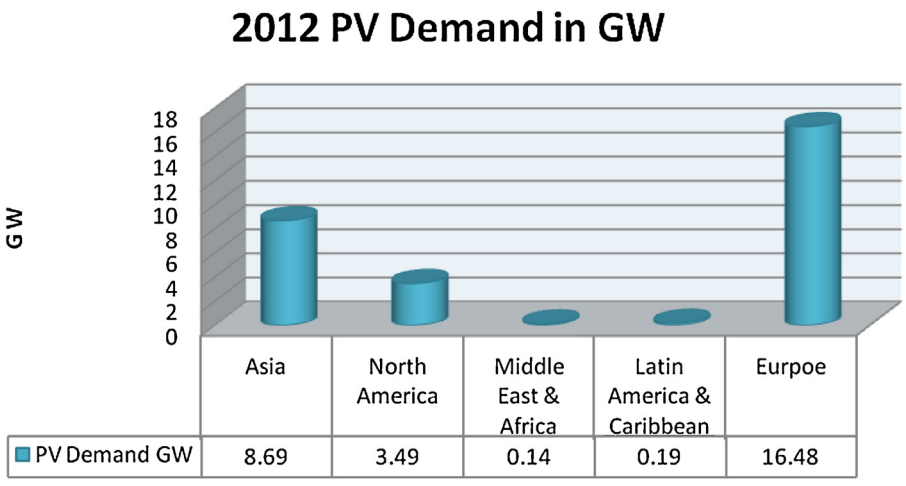

Fig. 2. 2012 PV Demand by Region. Credit: NPD Solarbuzz Marketbuzz report.