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Solar Power India's Future Energy

Abstract

The demand for energy is growing day by day in the whole world. The Conventional energy sources like coal and petroleum are limited. Renewable energy resources will play an important role in the future. India is a tropical Country, where sunshine is available for longer hours per day and in great intensity. Solar Energy, therefore, has great potential as future energy source. Solar energy is a clean renewable resource with zero emission has got tremendous potential of energy which can be harnessed using a variety of devices. With recent developments, solar energy systems are easily available for industrial and domestic use with the added advantage of minimum maintenance. Most of the developed countries are switching over to solar energy as one of the prime renewable energy source. In India JawaharlalNehruNational 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. Government of India had launched JNNSM in 2010. The target was to start Grid connected Solar Projects of 20 GW by 2022. In 2015 government increased the target to 100 GW by 2022. This article provides an overview on solar energy in India. It reviews the current status of solar energy in terms of existing capacity. The article also focuses on the importance and relevance of solar energy.

Keywords:

Zero Emission, Solar energy, Solar Mission, solar power projects, Energy Production, Photovoltaic.

Introduction

India, a rapidly growing economy with more than 1 billion people, is facing a huge energy demand. The electricity production has expanded over the years but we cannot deny the fact that the population of the country is also expanding. The power produced in the country is mostly from coal and it is predicted that country's coal reserves won't last beyond 2040-50. More than 68% population is living in villages and half of the villages remain without electricity. It's high time that our country should concentrate more on energy efficiency, conservation and renewable energy. To meet this surging demand, solar energy is the best form of energy to fulfil the energy needs of Indian sub-continent.

The geographical location of the country stands to its benefit for generating solar energy. The reason being India is a tropical country and it receives solar radiation almost throughout the year, which amounts to 3,000 hours of sunshine. This is equal to more than 5,000 trillion kWh. Almost all parts of India receive 4-7 kWh of solar radiation per sq. metres. This is equivalent to 2,300–3,200 sunshine hours per year. States like Rajasthan, Gujarat, Madhya Pradesh, Haryana, Punjab, Andhra Pradesh, Bihar, Maharashtra, Orissa, and West Bengal have great potential for tapping solar energy due to their location.

TheRadiation Climatology of India:

1. About 3300 to 3700 hours of bright sunshine are available in a year in the northwest and West Centralregions of the country and 2900 hours over Central peninsula except Assam, Kerala and Kashmir where it is appreciably lower.

2. About 7.5 Kwh/m²/day of solar energy is received over the country as a whole, for the major portion of the year, of which the maximum about 210 Kwh/m²/month is received during cloud free winter months and premonsoon months and the minimum 140 Kwh/m²/month is received during monsoon seasons.

3. During winter, the lowest radiation is received in North India and the highest in the South India. During summer, a reversal occurs with high values in North and low in South.

4. Diffused solar radiation is a minimum 740 KWh/m² over Rajasthan increasing eastwards to 840 KWh/m² in Assam and to 920 KWh/m² in extreme south of the peninsula.

5. The total solar energy received by the country is over 60 x 10¹³ MWh. There are between 250 to 300 Days of usual sunshine per year in most parts of the country.

Solar potential in India

The solar energy potential in India is immense due to its convenient location near the equator. The National Institute of Solar Energy in India has determined the country's solar power potential at about 750 GW, a recently released document by the Ministry of New & Renewable Energy (MNRE) shows. The solar power potential has been estimated using the wasteland availability data in every state and jurisdiction of India. The estimate is based on the assumption that only 3% of the total wasteland available in a state is used for development of solar power projects.

According to the estimates, Rajasthan and Jammu & Kashmir have the highest solar power potential. Rajasthan, with its healthy resource of solar radiation and availability of vast tracts of wasteland in the form of the Thar Desert, has a potential of about 142 GW. Jammu & Kashmir receives the highest amount of solar radiation in India, and has a significantly large area of wasteland in Ladakh.

Agricultural states like Punjab and Haryana expectedly rank low in terms of estimated solar power potential. Punjab would find it difficult to make available land for large solar power projects and has thus decided to concentrate efforts to set up solar power projects over rooftops and canals.

India's current solar power installed capacity is around 3 GW, or less than 0.5% of the estimated potential. Naturally there exists a massive opportunity to tap this potential. As a result, the Indian government has increased its solar power capacity addition target five-fold. Instead of the initial target to installed 22 GW solar power capacity by 2022, the government now plans to add 100 GW capacities. This includes 20 GW of ultra mega solar power projects, with installed capacity of 500 MW or more, across 12 states.

State wise Estimated Solar Power Potential	
Total Solar Power in GWp:	748.98 GWp
State	Solar Potential (GWp)
Andhra Pradesh	38.44
Arunachal Pradesh	8.65
Assam	13.76
Bihar	11.20
Chhattisgarh	18.27
Delhi	2.05
Goa	0.88
Gujarat	35.77
Haryana	4.56
Himachal Pradesh	33.84

Rooftop solar	200	4800	5000	6000	7000	8000	9000	40,000
Ground Mounted Solar projects	1800	7200	10000	10000	10000	9500	8500	57000
Total	2000	12000	15000	16000	17000	17500	17500	97000

(Table No.2 Year-wise Targets (in MW))

Growth of utilities installed solar capacity

The growth of the utilities installed solar capacity in India for every year of the JNNSM. All capacities are as on 31 March of the listed year.

Year	Installed capacity	Annual growth (MW)	Annual growth (%)
2011	461 MW	300 MW	186.34 %
2012	1,205 MW	744 MW	161.39 %
2013	2,319 MW	1,114 MW	92.45 %
2014	2,632 MW	313 MW	13.50 %
2015	3,744 MW	1,112 MW	42.25 %
2016	6,762.85 MW	3,018.85 MW	80.63%
2017	12,288.83 MW	5,525.98 MW	81.71%

(Table No.3Growth of utilities installed solar capacity)

Importance and Relevance of Solar Energy in India

India is endowed with abundant solar energy, which is capable of producing 5,000 trillion kilowatts of clean energy. Country is blessed with around 300 sunny days in a year and solar insolation of 4-7 kWh per Sq. m per day. If this energy is harnessed efficiently, it can easily reduce our energy deficit scenario and that to with no carbon emission. Many States in India have already recognised and identified solar energy potential and other are lined up to meet their growing energy needs with clean and everlasting solar energy. In near future Solar energy will have a huge role to play in meeting India's energy demand.

To elaborate more on importance and relevance of solar energy in India some of the key parameters are discussed:

1. Cost: Solar power is still high on absolute costs compared to other conventional sources of power such as coal. The objective of the Solar Mission is to create conditions, through rapid scale-up of capacity and technological innovation to drive down costs towards grid parity. In the last three years the cost of generation from solar has drastically come down and MNRE anticipates solar power achieving grid parity by 2017-18 and parity with coal-based thermal power by 2025, but this recognizes that cost trajectory will depend upon the scale of global deployment and technology development and transfer. The Mission also recognizes that there are a number of off-grid solar applications particularly for meeting rural energy needs, which are already cost-effective and provides for their rapid expansion.

2. Scalability: India is endowed with vast solar energy potential. About 5,000 trillion kWh per year energy is incident over India's land area with most parts receiving 4-7 kWh per sq. m per day. Hence both technology routes for conversion of solar radiation into heat and electricity, namely, solar thermal and solar photovoltaic, can effectively be harnessed providing huge scalability for solar in India. Solar also provides the ability to generate power on a distributed basis and enables rapid capacity addition with short lead times. Off-grid decentralized and low-temperature applications will be advantageous from a rural electrification perspective and meeting other energy needs for power and heating and cooling in both rural and urban areas. The constraint on scalability will be the availability of space, since in all current applications, solar power is space intensive. In addition, without effective storage, solar power is characterized by a high degree of variability. In India, this would be particularly true in the monsoon season.

3. Environmental impact: Solar energy is environmentally friendly as it has zero emissions while generating electricity or heat.

4. Security of source: From energy security perspective, solar is the most secure of all sources, since it is abundantly available. Theoretically, a small fraction of the total incident solar energy (if captured effectively) can meet the entire country's power requirements. It is also clear that given the large proportion of poor and energy un-served population in the country, every effort needs to be made to exploit the relatively abundant sources of energy available to the country. While, today, domestic coal based power generation is the cheapest electricity source, future scenarios suggest that this could well change. Already, faced with crippling electricity shortages, price of electricity traded internally, touched Rs-17.46 per unit during peak periods in the month of July 2012. The situation will also change, as the country moves towards imported coal to meet its energy demand. The price of power will have to factor in the availability of coal in international markets and the cost of developing import infrastructure. It is also evident that as the cost of environmental degradation is factored into the mining of coal, as it must, the price of this raw material will increase. In the situation of energy shortages, the country is increasing the use of diesel-based electricity, which is both expensive – costs as high as Rs-15 per unit - and polluting. It is in this situation the solar imperative is both urgent and feasible to enable the country to meet long-term energy needs.

Advantages of Solar Energy in India

1. This is an inexhaustible source of energy and the best replacement to other non-renewable energies in India.
2. Solar energy is environment friendly. When in use, it does not release CO₂ and other gases which pollute the air. Hence, it is very suitable for India, India being one of the most polluted countries of the world.
3. Solar energy can be used for variety of purposes like as heating, drying, cooking or electricity, which is suitable for the rural areas in India. It can also be used in cars, planes, large power boats, satellites, calculators and many more such items, just apt for the urban population.

4. Solar power is inexhaustible. In energy deficient country like India, where Power generation is costly, solar energy is the best alternate means of power generation.
5. We don't need a power or gas grid to get solar energy. A solar energy system can be installed anywhere. Solar panels can be easily placed in houses.

Disadvantages of Solar Energy in India

1. We cannot generate energy during the night time with solar energy. And, also during day time, the weather may be cloudy or rainy, with little or no sun radiation. Hence, this makes solar energy panels less reliable as a solution.
2. Only those areas that receive good amount of sunlight are suitable for producing solar energy.
3. Solar panels also require inverters and storage batteries to convert direct electricity to alternating electricity so as to generate electricity. While installing a solar panel is quite cheap, installing other equipment's becomes expensive.
4. The land space required to install a solar plant with solar panel is quite large and that land space remains occupied for many years altogether and cannot be used for other purposes.
5. Energy production is quite low compared to other forms of energy.
6. Solar panels require considerable maintenance as they are fragile and can be easily damaged. So extra expenses are incurred as additional insurance.

Conclusions

In this article, we have discussed about the current status of solar energy in India. The Ministry of non- convection energy resources, government of India is trying to increases the power capacity and achieve the target of 100 GW by 2022. This discussion shows that the status of solar energy is satisfactory in India but some extra effort is required for betterment of solar source. In spite of reduction of the cost of solar power, it is expensive source of power compared with conventional sources. It is very important to support and subsidize the solar power till it can compete with the conventional sources. The step of Indian government to increases the target is a very good to become India as one of the most solar powered countries in the world. Solar energy development in India can also be an important tool for spurring regional economic development, particularly for many underdeveloped states, which have the greatest potential for developing solar power systems which is unlimited and clean source of energy. It can provide secure electricity supply to foster domestic industrial development. So it can be concluded that photovoltaic power systems will have an important share in the electricity of the future not only in India, but all over world.

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