

Future Prospects and Development of Solar Energy in India

Abstract

We worship the Sun as a God of energy which purify everything. is the only source of energy which drives every thing in our planet Earth Among all the renewable resources available to us solar energy is the most abundant, easily available and economically beneficial. Being a tropical country India receive solar insolation uninterruptedly almost through of the year. With the easy availability, improved technology , better storage facilities and progressive government policy it is fast emerging as a major source of energy in India.

Keywords: Tropic of Cancer, Zero Emission, Equator, Fossil Fuel, Semiconductor, Silicon, Solarphotovoltaic

Introduction

India, with its large population and rapidly growing economy, needs access to clean, affordable and reliable sources of energy. As the tropic of cancer passes from the center of our country , it has a huge potential solar energy production throughout the year. India lies in the high solar insolation region endowed with huge solar energy potential with most of the country having about 300 days sunshine per year with the daily solar radiation incident varying from 4-6 kwh per square meter of surface area depending upon the location and time of the year. The total solar power potential in the country is estimated as approximately 748.95 GW. Solar Power is a clean and renewable resource which has zero emission and having tremendous potential of energy that 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. The current architectural designs make provision for photovoltaic cells and necessary circuitry while making building plans. Because of its location between the Tropic of Cancer and the Equator, India has an average annual temperature that ranges from 25°C - 27.5 °C which means that India has huge solar potential. The sunniest parts are situated in the south/east coast, from Calcutta to Madras.

Objective of Study

The present study focus on how to get the maximum used of solar insolation with improved technology and installation of solar plant in an appropriate places where solar energy is available through out the year.

Solar Energy Development in India

Solar energy in India has a great potential to generate electricity and the country is on course to emerge as a solar energy hub. The techno-commercial potential of photovoltaic in India is enormous. With increase in gross domestic product the energy 'gap' between supply and demand will only widen. Solar PV is a renewable energy resource capable of bridging this 'gap' between supply and demand Most parts of India have 300-330 sunny days in a year, which is equivalent to over 5000 trillion kWh per year capacity which is more than India's total energy consumption per year . The estimated potential envisaged by the Ministry for the solar PV programme, i.e. solar street/home lighting systems, solar lanterns is 20 MW/sq. kilometer.

Solar power is attractive it is abundant and offers a solution to fossil fuel emissions and global climate change. Earth receives solar energy at the rate of approximately 1,73,000 TW. India is both densely populated and has high solar insolation, providing an ideal combination for solar power in India. India is already a leader in wind power generation. In solar energy sector, some large projects have been proposed, and a 35,000 km² area of the Thar Desert has been set aside for solar power projects, sufficient to generate 700 to 2,100 GW per year .Solar energy's potential in India is immense. And with \$10.2 billion investment in clean energy, money is starting to follow the



Ashutosh Agnihotri

Teacher,
Deptt.of Geography,
Seth Anandram Jaipuria,
Kanpur

opportunity. India received \$95 million in venture - capital funding and over \$1.1 billion in large - scale funding for solar projects in 2011, according to a report by Mercom Capital, a clean - energy consulting firm. The biggest funding deal was a \$694 million loan raised by Maharashtra State power Generation Co. for its 150-MW Dhule and 125 -MW Sakri solar projects. Since independence the growth of solar is insufficient what ever be but in India which is atropical Country and having potential of app 14000 G w is currently producing only 8874 Mw (As we know that one Giga watt is equal to 1000 Megawatt and one Mw is equal to 10000 watts). The amount of energy produce and expected energy produce gap is huge. Even the windpower produce is more than solar power in our country.

Difference in Solar Energy Production in Different Stats

Since independence the growth of solar energy is insufficient whatever the reason may be but

in India which is a tropical country and potential of app 14000 Gw , is currently producing only 8874Mw . As we know that 1 Gw = 1000Mw and 1Mw = 10000watts and 1 watt =1.34 horse power , as it is clear that the amount of energy produce and expected energy potential gap is huge . According to an estimate only Thar desert has the potentail to produce 700 to 1200Gw per year where as the whole country is producing just 8874 MW year even the wind power production is more then solar power in our country.

According to studies the total solar energy produce in three states of Rajasthan , Gujarat and Tamilnadu is approximately 50% of total energy produce in our country while rest of the Indian states are having less contribution in it .states like Uttar Pradesh , Madhya Pradesh ,Maharashtra, Punjab Andhra Pradesh Karnataka and Leh region of Jammu and Kashmir are having very high potential of solar energy in India.But producing very less .The state wise production is shown in table no 2

Installed Grid Interactive Renewable Power Capacity in India as of November 30, 2016 (RES MNRE)

Table 1

Source	Total Installed Capacity (MW)	2022 target (MW)
Wind Power	28419.40	60,000.00
Solar Power	8874.87	100,000.00

Source – Ministry of new and renewable energy resource govt of India 2015- 2016

State Wise Distribution of Solar Power in India

State	MW as of 31 Mar 2015	MW as of 31 Mar 2016	MW as of 30 Sep 2016
Rajasthan	942.10	1,269.93	1,294.60
Punjab	185.27	405.06	571.20
Uttar Pradesh	71.26	143.50	143.50
Uttarakhand	5.00	41.15	41.15
Haryana	12.80	15.39	15.39
Delhi	5.47	14.28	23.87
Jammu and Kashmir			1.00
Chadigarh	4.50	6.81	6.81
Himachal Pradesh			0.20
Northern Region			2,097.72
Gujrat	1,000.05	1,119.17	1,136.32
Maharashtra	360.75	385.76	385.76
Chhattisgarh	7.60	93.58	128.46
Madhya Pradesh	558.58	776.37	810.37
Daman & Die	0.00	4.00	4.00
Western Region			2,464.91
Tamil Nadu	142.58	1,061.82	1,555.41
Andhra Pradesh	137.85	572.97	947.05
Telangana	167.05	527.84	961.79
Kerala	0.03	13.05	13.05
Karnataka	77.22	145.46	289.13
Puducherry	0.20	0.20	0.03
			3,766.46
Southern Region			
Biahr	0.00	5.10	90.10
Odisha	31.76	66.92	66.92
Jharkhand	16.00	16.92	16.19

West Bengal	7.21	7.77	11.77
Eastern Region			184.98
Tripura	5.00	5.00	5.00
Arunachal Pradesh	0.03	0.27	0.27
Mizoram			0.10

State	MW as of 31 Mar 2015	MW as of 31 Mar 2016	MW as of 31 Mar 2015
North Eastern Region			5.37
Andamn & Nicobar	5.10	5.10	5.10
Lakshadweep	0.75	0.75	0.75
Others	0.00	58.31	100.92
Islands and others			106.77
Total	3,743.97	6,762.85	8,626.18

Source- ministry of new and renewable energy govt of India 2015-2016

Government plan and growth of Solar Energy in India

To increase the production and technology of solar power in Our Country prime minister, Shri Narendra Modi and French president laid the foundation of International Solar Alliance in Gurgaon. The main purpose of this alliance is to reduce the production and development cost and facilitate increased development of solar technology in the remotest and among poorest. Besides this the govt also launched Jawahar Lal Nehru nation solar mission in 2007 the purpose of this mission can be summed up as under following points-

1. Make India a global leader in solar energy and the mission envisages an installed solar generation capacity of 20,000, 1,00,000 MW by 2030 and of 2,00,000 MW by 2050.
2. The total expected investment required for the 30 year period will run is from Rs. 85,0 crore to Rs. 105,000 crore.
3. Between 2017 and 2020, the target is to achieve tariff parity with conventional grid power and an installed capacity of 20 Gigawatts (GW) by 2020.
4. 4-5 GW of installed solar manufacturing by 2017.

The immediate aim of the National Solar Mission is a Major of the government of India and state Government 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. The objective of the National Solar Mission is to establish India as a global leader in solar energy, by creating the policy condition for its diffusion across the country as quickly as possible.

According to one estimates, the combination of electricity demand growth, fossil fuel availability challenges, and supportive environmental regulations could increase solar power capacity to more than 50GW by 2022. The market will see a significant change after 2017. Lower Solar costs combined with rising prices of grid power will convince off takers (including distribution companies, private firms using open access, and firms putting up their own captive) that solar power is economically viable. This shift will signal the start of the growth phase, during which grid - connected solar capacity will rise rapidly to about 35 GW by 2020 as developers build capacity to meet

requirements and demand from off takers cost efficient alternatives to conventional.

Need to Develop Solar energy in India

India is the second most populous country in the world with the increasing population growing demand and developing industrial sectors the demand of power or electricity keeps on increasing. According to an estimate there is a deficit of 12% annually in the overall country's demand energy for energy. To meet the growing demand solar power is one of the most suitable and eco-friendly way of producing energy. With total of 300 hour of sun light every year which is equivalent of 5000 trillion Kwh, India can easily produce 1900 billion unit of solar power annually. This amount of power generate is enough to fulfill power demand till 2030.

Solar Thermal Process

Solar thermal electricity technologies produce electric power by converting the sun's energy into high- temperature heat using various mirror configurations, which is then channeled to an on-site power plant and used to make electricity through traditional heat-conversion technologies. The plant essentially consists of two parts; one that collects Solar energy and converts it to heat, and another that converts the heat energy to electricity.

Solar Cell

A solar cell is a semiconductor device that transforms sunlight into electricity. Semiconductor material is placed between two electrodes. When sunshine reaches the cell, free negatively charged electrons are discharged from the material, enabling conversion to electricity. This is the so-called photovoltaic effect. In theory, a solar cell made from one semiconductor material only can convert about 30 percent of the solar radiation energy it is exposed to into electricity. Commercial cells today, depending on technology, typically have an efficiency of 5 - 12 percent for thin films and 13-21 percent for crystalline silicon based cells. Efficiencies up to 25 percent have been reached by the use of laboratory processes. By using multiple solar cells, efficiencies above 35 percent have been achieved.

Solar Photovoltaic

Photovoltaic has been derived from the combination of two words. Photo means Light and Voltaic means electricity It is a technology that

converts light directly into electricity Photovoltaic material, most commonly utilizing highly-purified silicon, converts sunlight directly into electricity.

Future Growth Oof Solarin India

The solar industry's structure will rapidly evolve as solar reaches grid parity with conventional power between 2016 and 2018. Solar will be seen more as a viable energy source, not just as an alternative to other renewable sources but also to a significant proportion of conventional grid power. The testing and refinement of off-grid and rooftop solar moods in the seed phase will help lead to the explosive growth of this segment in the growth phase.

Global prices for photovoltaic (PV) modules are dropping, reducing the overall cost of generating solar power. In India, this led to a steep decline in the winning bids for JNNSM projects. With average prices of 15 to 17 per kilowatt hour (kWh), solar costs in India are already among the world's lowest. Given over capacity in the module industry, prices will likely continue falling over the next four years before leveling off. By 2016, the cost of solar power could be as much as 15 percent lower than that of the most expensive grid-connected conventional energy suppliers. The capacity of those suppliers alone, nearly 8 GW in conventional terms, corresponds to solar equivalent generation capacity potential of 25 to 30 GW. Due to implementation challenges, however, it's unlikely that all of this potential will be realized by 2016. Grid parity will be an inflection point, leading to two major shifts in the solar market. First, thanks to favorable project economics, grid-connected capacity will rise at a much faster rate than before, and second, regulations and policy measures will be refined to promote off-grid generation.

According to one estimates, the combination of electricity demand growth, fossil fuel availability challenges, and supportive environmental regulations could increase solar power capacity to more than 50 GW by 2022. The market will see a significant change after 2016. Lower solar costs combined with rising prices of grid power will convince off takers (including distribution companies, private firms using open access, and firms putting up their own captive capacity) that solar power is economically viable. This shift will signal the start of the growth phase, during which grid-connected solar capacity will rise rapidly to about 35 GW by 2020 as developers build capacity to meet requirements and demand from off takers seeking cost efficient alternatives to conventional power.

Challenges-Lands Scarcity

The amount of land required for utility-scale solar power plants — currently approximately 1 km² for every 20-60 megawatts (MW) generated could pose a strain of India's available land resource.

Slow Progress

While the world has progressed substantially in production of basic silicon mono-crystalline photovoltaic cells, India has fallen short to achieve the worldwide momentum. India is now in 7th place worldwide in Solar Photovoltaic (PV) Cell production and 9th place in Solar Thermal Systems with nations like Japan, China, and the US currently ranked far

ahead. Globally, solar is the fastest growing source of energy, though from a very small base, with an annual average growth of 35%, as seen during the past few years.

Latent Potential

Some noted think-tanks recommend that India should adopt a policy of developing solar power as a dominant component of the renewable energy mix, since being a densely populated region in the sunny tropical belt, the subcontinent has the ideal combination of both high solar insolation and a big potential consumer base density. In one of the analyzed scenarios, while reining on its long-term carbon emissions without compromising its economic growth potential, India can make renewable resources like solar the backbone of its economy by 2050.

Government Support

The government of India is promoting the use of solar energy through various strategies. In the budget proposal for 2010-11, the government has announced an allocation of Rs.10 billion towards the Jawaharlal Nehru National Solar Mission and the establishment of a Clean Energy Fund.

Findings

1. Vast population in a country is still not using solar power because of its high cost and less access.
2. Less number of solar electricity generating plant being installed in a country.
3. Roof top solar plant should be mandatory to get more solar power for domestic purpose.
4. More effective technology is needed to harness solar insolation.

Conclusion

With the help of this article it is pivot evident that India has a huge potential of solar energy but due to less improve technology and slow implementation of the government policies it is not widely use among people living in villages as well as in cities. Through easy available and improved technology it can be used widely among masses in future build capacity to meet requirements and demand from off takers seeking cost efficient alternatives to conventional power build capacity to meet requirements and demand from the most abundant and cheap source of energy source ie solar energy.

References

1. TER1(2011): *Towards Energy Security*, 10 January, accessed on 15 Jan 2011 (www.teri.in.org)
2. Singh Manmohan(2010): *To create solar Village*, Jan. *Solar Energy Review*, New Delhi
3. Chatterjee, Pramita(2010): *For Clean Green Energy*, *Economic Times*, October 1st, pp-7
4. *Delhi International Renewable Energy Conference (DIREC-2010)*: accessed on 12 Dec, 2010 (<http://www.direc2010.gov.in/>)
5. *US-India Energy Partnership Summit*, Washington DC(2010); *Solar Energy Review*, New Delhi-India
6. <http://www.energymile.com>
7. <http://www.worldenergyoutlook.org/>
8. www.pcr.org