

Solar Energy and its Status in India

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Abstract - Conventional energy are only the forms of energy which was used worldwide But after the oil disaster in 1973, the global has to consider regarding some substitute regarding resources of energy other than conventional energy resources (coal, gas and petroleum etc.). Renewable energy resources are the alternate which will afford resolutions to the extensive standing energy difficulties being faced by the developing nations. To conquer the energy scarcity in India renewable sources like solar energy, wind energy, geothermal energy, ocean energy, biomass energy and fuel cell equipment can be used. Sun is the basis of each energy. Heat and light are the major kind of solar energy. It is the main vital choice of the world has a large potential of green energy. India has a huge potential for generating green electricity from the renewable energy sources. Many plans are started by the Indian government to encourage renewable energy, On 11/01/2010, under the National Action Plan on Climate Change, (NAPCC-2008) to support the green energy. India opened Jawahar Lal Nehru Solar Mission (JNNSM). In this paper attempts have made to review the accessibility, current status, promotion policies and future potential of Solar energy. Universal energy requirement and environmental concerns are the key factors to use the sustainable and clean energy resources.

Index Terms - Renewable energy; solar energy; India; PV cell; JNNSM; power generation

1. INTRODUCTION

Energy is the main fundamental component in human growth and in addition an essential aspects which persuades to maintain the development of any nation.[1]. The conventional resources of energy have most important coercion to our survive and future universal safety environmental standards, health and society. Thus there is vital demand of support renewable energy in present Indian power sector in maintainable and eco friendly way.[2] Renewable energy is energy which facilitates sources which are constantly reloaded such as sunlight, wind, rain, tides, waves and geothermal heat. Renewable power is only a hygienic source of energy as selected with slightest carbon emissions or pollution. Due to this energy, one can get less dependency on coal and other fossil fuels. By using this type of energy, India will be able to get better air quality, it downs global warming emissions which makes an opportunity of making new industries and jobs and it also move forward towards a cleaner, safer and affordable energy in the world.[3]

The organization of paper is as follows: Introduction was shown in section 1. Status of renewable energy is given in section 2, and basics of solar energy are given in section 3. Section 4 consists of Current scenario of solar energy in India. Potential of solar

energy is presented in section 5. Similarly, section 6 & 7 comprises of reduction in environmental pollutions and Research and development assets in solar power respectively. At last conclusion is given.

2. RENEWABLE ENERGY STATUS IN INDIA

For the expansion of any nation, energy is the foremost effort. The worldwide manufacturing of electricity is over 20,000TWh (terawatt-hour) [4]. Globally fossil fuels are anticipated to carry on delivering a lot of the energy used. Demand for Renewable Energy Sources reported for 19% of global energy demand, with conventional biomass accounting for the immensity of that need. [5]. In the world, India is the only nation who placed a ministry of non conventional energy resources in early 1980s. [6] Renewable energy in India approaches under the apprehending of the Ministry of New and Renewable Energy (MNRE). Upto the 30.03.2012, The total expected impending for renewable energy production in the India is estimated at 89774 MW. [7] as shown in fig 1.

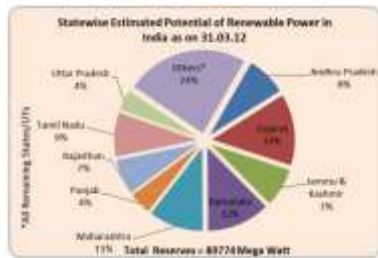


Fig. 1 Estimated potential of Renewable sources in India- 2012 [7]

Now a days, beyond of PV cell and storm energy there are another renewable energy sector which showing noteworthy evolution like small hydro and biomass power. Some of the significant elements that show slight movement now like wave, tidal and geothermal, have the chances of noteworthy expansion in future [8]

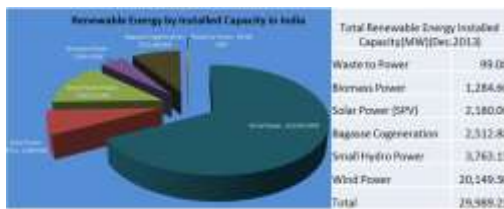


Fig.2 Renewable sources established capacity in India Dec 2013 [8]

The main factors for the extension of the renewable power in India are as follow:

- High increasing rate in overall energy requirement
- Increasing reliance on imports for fossil fuels
- Necessitate for a feasible resolution for rural electrification
- Power peak stipulated-supply
- Pressure on industry and polity to subside Greenhouse gas emissions.

2.1 Advantages & Dis advantages

Renewable energy technologies (RETS) have numerous benefits compared with conservative largely fossil fuels-based, energy systems.

- RETs provides energy security and much more stability with observe of the market price volatility,
- Renewable models are so portable and can be installed in modular designs (as small as in few kilowatts)

Conversely, various RETS too contain drawbacks.

- First, some RETs are changes continuously and also not calculated as earlier, so they are to be mixed with other system which are under human control (e.g., solar and wind) .
- Some renewable power types, like biofuels, contend for agriculture land and irrigation water with food crops. If it is not employed with great concerned, they may have bad social and economic results. [9]

3. SOLAR ENERGY

This section talks about the solar energy as renewable energy obtainable in the India. Aspects on prospective and position are presented for the solar energy [10]

Earth surface get an amount of 10,000 times of solar power as evaluated with world energy demand. In India, solar energy is deemed as most plentiful source of all renewable resources.

The entire hypothetical latent for solar energy in conditions of through typical irradiance is extremely huge. India has a immense possible for solar energy generation, since India obtains solar energy corresponding to over 5000 trillion KWh annually, which is extreme than total power consumption in the country [11].The availability of land for solar program is limited, because India is thickly populated country with residential, agriculture and industries priorities.

Solar technique is mainly divided into two groups,

- Photovoltaic: Converts sunlight directly into electricity, based on photovoltaic effects.
- Thermal: Converts the heat of the sun mainly for heating and drying.

a. Solar Photovoltaic (PV)

The technique of translation of solar energy into electricity is called Solar photovoltaic (PV). The utilized potential is less than 150 MW, and of that only about 20 MW is grid-connected. In India the apparition try to reach the mounted capacity of 1~2 GW by 2013, 4~10 GW by 2017 and 20GW by 2022[12]

b. Concentrating Solar Power (CSP)

For the generatio of electricity through CSP, a conventional thermodynamic scale is used in which CSP uses mirrors for concentration of sunrays, produce heat and then steam it to get electricity. Utilization of this CSP is very low or negligible.The National Solar Mission has previously designed 500

MW to Indian corporate and these CSP plants are presently being charged. [13]

c. Solar Thermal for Heating Purposes

Solar thermal energy for heating and drying has very important role in India. Studies have shown that energy from solar thermal used for industrial heating and drying can save up to 4.5 million tons of furnace oil or diesel per year. Industries like food, beverages, transport, textiles and chemicals are the some specific industries which find application of solar heating and drying.. [13]

d. Solar Water Heating

The overall capacity is about 140 million sq.meters for solar water heating in India. In this, the total set up capacity is 3.5 million sq.meters

The overall probability in India for solar irrigate warmth is about 140 million sq. meters. Of this, the total set uped capacity is regarding 3.5 million sq. meters. Every year, over 20,000 solar water heaters are installed across India, according to some estimates. The Jawaharlal Nehru National Solar Mission targets to install 20 million square meters of solar water heating systems by 2022. [14]

4. SOLAR ENERGY POTENTIAL IN INDIA

India stretch outs in the sunny belt of the world. India is situated in the northern hemisphere, lying between latitudes $8^{\circ}4'N$ and $37^{\circ}6'N$ and longitudes $68^{\circ}7'E$ and $97^{\circ}25'E$; the country is divided into almost two equal halves by the Tropic of Cancer ($23^{\circ}30'N$). The southern half which coincides with peninsular India lies in the tropical zone, while the northern half belongs to the subtropical zone. The annual global radiation varies from 1600 to 2200 kWh/m², which is typical of the tropical and subtropical regions.[15]. Therefore the scope for generating power and thermal applications using solar energy is huge.[16]

For solar power consumption, India is a best place as most of its parts get 300 days of sunshine a year.[16]. Depending upon the location, daily average incident of solar energy varies from 4 to 7 kWh/m² with the daylight hours ranging between 2300 to 3200 per year.[17]. Assuming 10% adaptation competence for PV modules, India receives adequate solar power to produce more than 500,000 TWh per year of electricity.

It is three orders of amount more than the likely electricity demand for India by the year 2015 [18]. Fig. 3 shows map of India with solar emission stages in various states of the nation. It can be monitored that even though the maximum yearly global

radiation is established in Rajasthan, northern Gujarat and parts of Ladakh province, the divisions of Andhra Pradesh, Maharashtra, Madhya Pradesh too get reasonably bulky quantity of radiation as compared to several parts of the world especially Japan, Europe and the US where development and utilization of solar technologies is utmost [19].

India's electricity requires can be get together on a total land area of 3000 km² which is equivalent to 0.1% of total land in the country [20, 21, 22].

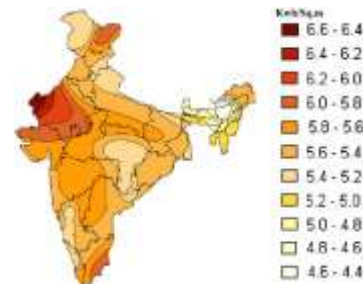


Fig. 3. Solar radiation on India [19].

5. CURRENT SOLAR PV ENERGY SCENARIO IN INDIA

The Indian government is accounted to have settled the sketch for the National Solar Mission, outlining determined long-term plans to achieve an installed solar power production capacity of 20,000MW by the year 2020, which would be enlarged to 100,000MW by the year 2030 and advance to 200,000MW by the year 2050. To spread out in three phases, it aspires to realize parity with coal-based thermal power generation by 2030. In the primary stage of execution (2009–2012), a sum of Rs. 10,130 crore would be involved. The financial condition would be Rs. 22,515 crore and Rs. 11,921 crore in the second (2012–2017) and third (2017–2020) phases of achievement respectively. The Mission predicts an investment of Rs. 91,684 crore over the next 30 years. This will comprise an interest financial assistance to the tune of Rs. 7300 crore. The plan moreover aspires to decrease the rate of solar power generation by 2017–2020 with the intention of make solar power competitive among power generated from fossil fuels [31].

In all the renewable energy sources, Solar PV has the highest capital costs but having lowest operational cost due to its very low maintenance & mend it. To make solar energy as a widely used energy it is very essential to reduce its cost. Since 30th June, 2010, 12.28MW solar PV power generation with grid connected has been already installed.[24]. The

estimated capital cost of a solar PV plant per MW is Rs. 17 crores. This comprises the cost of panels, the balance of systems, the cost of ground and additional supportive infrastructures. (Table1).

Table 1: Break-up for the capital expenses [25].

Component	Amount (Rs.in Crores)	% of Total
Solar panel arrays	7.7	45
Inverter	2.5	15
Balance of system	3.4	12
Installation	1.7	10
Others (Infrastructure)	3.0	18

Solar PV changes the industries very fast as well as giving the speed to change the technologies & policy. As we know India get 300 sunny days in a year, there will be in ideal marketplace for solar power companies. According to an Indian Semiconductor Association study, India has 9 companies built-up solar cells and 19 companies developed photovoltaic modules or panels. India has approximately 60 corporations accumulating and providing solar photovoltaic system. Due to augmented requirement for clean power, an energy starved industry, companies are coming significantly with quantity of household missions. Indian government is also giving subsidies to support such type of projects through state electricity boards.[26] The Central Indian Govt. has currently supported 12 tenders under the Special Incentives Package Scheme (SIPS). Simultaneously, these offers could bring in about Rs. 76,573 crore of assets to the household solar power sector. Under SIPS, the government supplies an incentive of 20 per cent of the capital spending during the first 10 years to an entity situated in a special economic zone (SEZ). Systems supported outside acquire a 25% inducement. Incentives could be in the structure of capital grant or equity contribution. [24] As surveyed, the four largest energy consumers in the world are United States, China, Russia and India. Currently the R&D team of every country is focusing on the renewable energy sources. There are above 24 countries approximately in the world with a growing PV capacity of more than 1GW. Austria, Chile, and South Africa, all crossed the 1 GW in 2016. The power utilization is extremely high as the resources are in bound. Solar in India is developing very fast as people are getting aware. The R&D team of India is

continuously working on the development of the renewable energy. The progress and policy is observed by India's Ministry of New Renewable Energy (MNRE), Energy development societies in different situations and Indian Renewable Energy Agency Limited (IREDA). Various application of solar thermal are extended which contain water heating, drying etc. People are also adopting Solar energy as the uses are very progressive.

6. REDUCTION IN ENVIRONMENTAL POLLUTIONS BY SOLAR POWER GENERATION

Renewable energy is very essential, as it changes climate in India and also efforts are making to improve the emission of pollutants like carbon-dioxide, sulphur dioxide and nitrogen oxide by installation of CPV systems. Air pollution and exclusion of noise are also the advantages of solar energy. Government of India has currently begins the striving Jawaharlal Nehru National Solar Mission (JNNSM) which goals to support the expansion and employ of solar energy for power generation and other utilizes in the country [24]. By the year 2022, the JNNSM targeted the installation of 20 GW of grid connected solar power using both CSP and CPV).

As Indian surveyed shows that its per capita discharge will be approximately 2–2.5 tonnes of carbon-dioxide corresponding by 2020 and approximately 3–3.5 tonnes of carbon-dioxide equal by 2030, evaluated to about 1–1.2 tonnes presently [27].

Generally, every 1 GW of extra renewable energy capacity decreases CO₂ discharges via 3.3 million tonnes a year. So there is a huge requirement to support the CSP in Indian power sector to assemble potential energy requirement and eliminate GHG emission for surroundings protection [28]. The NAPCC suggested to the extent that 15% of India's energy might be approach from renewable energies by 2020. Overall numbers of 106 projects reporting solar generations of 40.648 MW have been approved during 2010–2011 under off grid STP application of JNNSM [28]. The MNRE prepared to decrease carbon productions (generated by burning the diesel of generators associated to cell phone towers) by using solar power.[29]

7. RESEARCH AND DEVELOPMENT ASSETS IN SOLAR POWER

A number of major government and industry R&D efforts aim to make STE and CPV a main stream power source within the next decade. India is following an forceful solar energy enlargement policy, making a main industry and setting up determined mid-term objectives for the household promote in the multi-GW scale. The CPV machinery is currently affecting from pilot facilities to commercial-scale relevance's. By Eleventh Five-Year Plan (2007–2012) GOI recommended a solar R&D funding of amount Rs. 400 crore. The functioning cluster on R&D for the energy division offered an extra Rs. 5300 crore in Research, manifestation and expansion for the eleventh five-year Plan, with the two major topics being: research on silicon production for PV manufacturing and research on Light emitted diodes [30,31]. India formulate a universal head in solar energy and the task predicts an installed solar generation ability of 20,000 MW by 2020, 100,000 MW by 2030 and of 200,000 MW by 2050. The overall anticipated funding since the government for the 30-year period will run to Rs. 85,000 crore to 105,000 crore [31]

8. CONCLUSION

Country like India has very much unbalanced in electricity production. Production is less and consumption is very much. Solar power is very good option in India to increase power production. This is also very good for our environment protection and economic development. Solar power is boundless source of energy and our country also provide suitable climate for this energy but we need some better idea to increase efficiency and decrease production cost. Our government launches some schemes for production of solar power and achieves some successes but we need education and publicity in society for these schemes so that people take some initiative for use renewable energy as much as at a place of conventional energy sources. Currently we are generating 4.59% of solar energy of total produced renewable energy installed capacity in India. It is very low in comparison of total installed capacity of renewable energy and scope is very much for this solar PV.

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