Solar Thermal Energy In India- A Review

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Abstract- *Energy is accessible in two distinct choices, non inexhaustible (coal, oil, flammable gas) and sustainable (sunlight based, twist, little hydro) sources. As of late solar energy has gotten awesome arrangement of consideration as an effortlessly utilizable wellspring of sustainable power source for giving power. Sustainable power sources like solar is indigenous and can help in lessening the reliance on petroleum derivatives. Solar energy gives a variable and ecological well disposed alternative and national energy security while diminishing worldwide stores of petroleum products undermines the long haul supportability of worldwide economy. The solar energy can be used in two ways one is sun based photovoltaic and other is sunlight based warm. This paper depict the age of power through sun based warm vitality in Indian point of view.*

Keywords- Power scenario, energy potential, solar thermal power generation, Government Support, Opportunities

I. INTRODUCTION

Energy is viewed as a prime specialist in the age of riches and a noteworthy factor in monetary advancement. Restricted fossil assets and ecological issues related with them have stressed the requirement for new manageable energy supply alternatives that utilization sustainable power sources. Solar thermal power generation systems also known as Solar Thermal Electricity (STE) producing frameworks are rising sustainable power source innovations and can be created as suitable choice for power age in future. This paper talks about the innovation alternatives, their present status and openings and difficulties in creating sunlight based warm power plants with regards to India [1]

II. INDIA'S POWER SCENARIO

India's current electricity installed capacity is 135 401.63MW. Currently there is peak power shortage of about 10 % and overall power shortage of 7.5 %.The 11th plan target is to add 100 000 MW by 2012 and MNRE has set up target to add14500 MW by 2012 from new and renewable energy resources out of which 50 MW would be from solar energy. The Integrated Energy Policy of India envisages electricity generation installed capacity of 800 000 MW by 2030 and a substantial contribution would be from renewable energy. This indicates that India's future energy requirements are going to be very high and solar energy can be one of the efficient and eco-friendly ways to meet the same [2]

III. SOLAR ENERGY POTENTIAL

India is situated in the central sun belt of the earth, in this way accepting plentiful brilliant energy from the sun. The India Meteorological Division keeps up an across the country system of radiation stations, which measure solar radiation, and furthermore the day by day term of daylight. In many parts of India, clear bright climate is experienced 250 to 300 days a year. The yearly worldwide radiation shifts from 1600 to 2200 kWh/m2, which is practically identical with radiation got in the tropical and sub-tropical locales. The proportionate energy potential is around 6,000 million GWh of energy for each year. The solar radiation levels are distinctive in different parts of the nation. It can be watched that despite the fact that the most astounding yearly worldwide radiation is gotten in Rajasthan, northern Gujarat and parts of Ladakh locale, the parts of Andhra Pradesh, Maharashtra, and Madhya Pradesh likewise get genuinely huge measure of radiation when contrasted with many parts of the world particularly Japan, Europe and the US where advancement and arrangement of sun powered innovations is greatest [3].

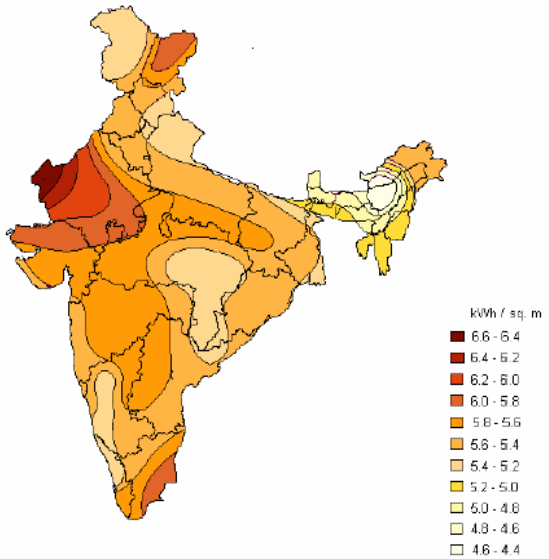


Figure 1 Solar radiation on India
Source: TERI

IV. SOLAR THERMAL POWER GENERATION PROGRAM OF INDIA

In India the first Solar Thermal Power Plant of 50kW limit has been introduced by MNRE following the allegorical trough gatherer innovation (line centering) at Gwalpahari, Gurgaon, which was authorized in 1989 and worked till 1990, after which the plant was closed down because of absence of extras. A Solar Thermal Power Plant of 140MW at Mathania in Rajasthan, has been proposed and endorsed by the Legislature in Rajasthan. The undertaking setup of 140MW Coordinated Solar Thermal Power Plant includes a 35MW sun powered power creating framework and a 105MW traditional power part and the GEF has affirmed an allow of US$ 40 million for the venture. Likewise a business control power plant based on Solar Chimney technology was additionally examined in North-Western piece of Rajasthan. The task was to be executed in five phases. In the first stage the power yield might be 1.75MW, which should be improved to 35MW, 70MW, 126.3MW and 200MW in resulting stages. The stature of the solar chimney, which would at first be 300m, should be expanded bit by bit to 1000m. Cost of power through this plant is required to be Rs. 2.25/kWh. In any case, because of security and different reasons the task was dropped. BHEL restricted, an Indian organization in control types of gear fabricating, had assembled a solar dish based power plant in 1990's as a piece of innovative work program of then the Service of Nonconventional Energy Sources. The undertaking was mostly subsidized by the US Government. Six dishes were utilized as a part of this plant [4].

Opportunities for Solar Thermal Power Generation in India

Solar thermal power generation can play a significant important role in meeting the demand supply gap for electricity. Three types of applications are possible

1. Rural electrification using solar dish collector technology.
2. Typically these dishes care of 10 to 25 kW capacity each and use striling engine for power generation. These can be developed for village level distributed generation by hybridizing them with biomass gasifier for hot air generation.
3. Integration of solar thermal power plants with existing industries such as paper, dairy or sugar industry, which has cogeneration units Many industries have steam turbine sets for cogeneration. These can be coupled with solar thermal power plants. Typically these units are of 5 to 250 MW capacities and can be coupled with solar thermal power plants. This approach will reduce the capital investment on steam turbines and associated power-house infrastructure thus reducing the cost of generation of solar electricity.
4. Integration of solar thermal power generation unit with existing coal thermal power plants. The study shows that savings of up to 24% is possible during periods of high insolation for feed water heating to 241°C [5].

Advantages of Solar Energy

It is an inexhaustible Sustainable power source This innovation is Ubiquitous and it can be caught for transformation every day It is a Non-contaminating innovation, which implies that it doesn't discharge green house gasses It is a Quiet innovation as there are no moving parts engaged with energy age. This innovation requires Low upkeep due to absence of moving parts it can be introduced on measured premise and extended over some undefined time frame most practical option for giving power in remote provincial territories as it can be introduced where the energy request is high and can be developed secluded premise [6].

Limitations of Solar Energy

As the technology is in an evolving stage, the efficiency levels of conversion from light to electricity is in the range of 10 to 17%, depending on the technology used. The initial investment cost of this technology is high. At present the technology is basically surviving because of subsidy schemes available by the government. Solar energy is available only during daytime. Most load profiles indicate peak load in the evening/night time. This necessitates expensive storage devices like battery, which need to be replaced every 3 to 5 years. Generally, the cost of the Battery is 30 to 40% of the system cost. As the efficiency levels are low, the space required is relatively high. For instance, with the existing levels of technologies, the land required for putting up a 1 MW solar PV power plant is between 6 to 9 acres [7].

Barriers

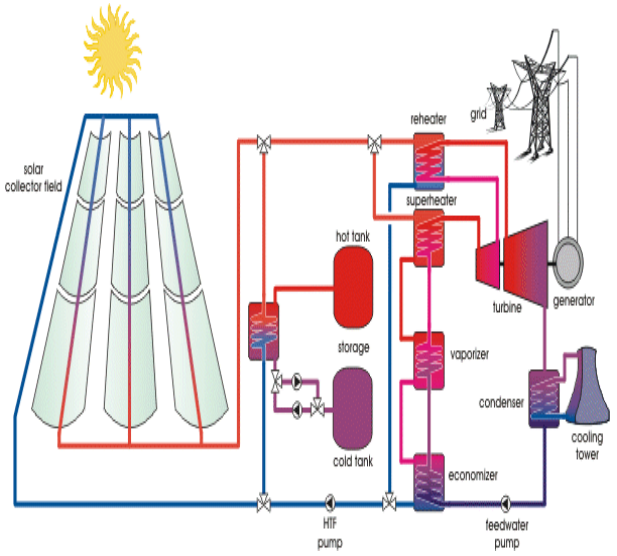
Solar thermal power plants need detailed feasibility study and technology identification along with proper solar radiation resource assessment. The current status of international technology and its availability and financial and commercial feasibility in the context of India is not clear. The delays in finalizing technology for Mathania plant have created a negative impression about the technology [7].

Concentrating Solar Power Technology

Concentrating solar power (CSP) plants produce electricity by converting the infrared part of solar radiation into high temperature heat using various mirror/reflector and receiver configurations. The heat is then channeled through a conventional generator.

The plants consist of two parts: one that collects solar energy and converts it to heat, commonly known as 'solar field' and another that converts heat energy to electricity, known as 'power block'. CSP plants use the high-temperature heat from concentrating solar collectors to drive conventional types of engines turbines. (Ramchandra and Jain, 2011) All CSP are based on four basic essential sub systems namely collector, receiver (absorber), transport/ storage and power conversion. Following four CSP technologies have either reached commercialization stage or are near it:

Parabolic Trough
Power towers
Parabolic Dishes (Dish-Sterling)
Compound Linear Fresnel Reflectors (CLFR)



Working of Solar Thermal Power Plant

Working of Concentrating Solar Thermal System

Solar energy authorities are exceptional sort of heat exchangers that change solar radiation energy to inside energy of the vehicle medium. The significant part of any close planetary system is the solar authority. This is a gadget which retains the approaching solar radiation, changes over into heat, and exchanges this heat to a liquid (typically air, water, or oil) coursing through the gatherer. The solar energy in this way gathered is conveyed from the coursing liquid either straight forwardly to the boiling water or space molding gear or to a heat energy stockpiling tank from which can be drawn for use around evening time as well as overcast days. (Beerbauma and Weinrebe, 2000) There are essentially two sorts of solar authorities:

Non concentrating or stationary and concentrating.

A non-concentrating gatherer has a similar zone for catching and for engrossing solar radiation, though a sun-following concentrating solar authority for the most part has curved reflecting surfaces to capture and center the sun's shaft radiation to a littler getting range, in this manner expanding the radiation motion [8].

Solar cooling

Development of cooling systems in appropriate capacity ranges for space cooling as well as applications in cold storages with active involvement of industry is proposed. For establishing the technology, installation of about 500-ton capacity systems is proposed for monitoring, evaluation, and design optimization studies [8].

Indian Government Incentives and Support

Government acts and policies

Government of India has come out with Acts and Policies to support renewable Energy.

- The Electricity Act 2003 has promotes electricity generation from co-generation and renewable energy sources. This Act accelerated the process of renewable energy development in the country. The guidelines for competitive procurement have been framed under Section 63 of the Electricity Act 2003 it states:
- "The Appropriate Commission shall adopt the tariff if such tariff has been determined through transparent process of bidding in accordance with the guidelines issued by the Central Government".
- The National Electricity Policy 2005 stipulates that the share of electricity from non- conventional resources would need to be increased such purchase by distribution companies shall be through competitive process.
- According to Tariff Policy 2006 states the Appropriate Commission shall decide a minimum percentage for purchase of energy from non- conventional source according the availability of resources in that region and its impact on retail tariffs [9].

Solar mission

Jawaharlal Nehru National Solar Mission (JNNSM) was launched in 11 Jan. 2009 with the target for Grid Connected Solar Projects of 20,000 MW by 2022. The Mission had adopted a three-phase approach. First four year (2009-13) had marked as Phase-I. The remaining 4 years of the twelfth Plan (2013–17) had been marked as Phase-II and the thirteenth Plan (2017–22) will be Phase-III of the project .The aim of this project was to add 1,000 MW of grid solar power by 2013, and another 3,000 MW by 2017. The target for 2017 may be higher based on the availability of international funds and technology transfer.

But in June 2015 The Union Cabinet of India gave approval for stepping up of India's solar power capacity goal under The Jawaharlal Nehru National Solar Mission (JNNSM) by five times, reaching 100 GW by 2022. The target will comprise of 40 GW rooftop and 57 GW through large and medium scale grid connected solar power plants. By this step of government India will become one of the greatest countries of the world in solar energy power generation. That new solar target of 100 GW is expected to abate over 170 million tones of CO2 over its life cycle. The total investment will be around Rs.6,00,000 cr. (@ Rs.6 cr. per MW at present rate) for 100 GW power generation. Table 4 shows the targets of power generation in different years.

The Ministry has chalked out year wise target to achieve 100000 MW by 2022 which is as under :

Year	Rooftop	Ground Mounted Solar Power Projects	Total (in MW)
2015-16	200	1,800	2,000
2016-17	4,800	7,200	12,000
2017-18	5,000	10,000	15,000
2018-19	6,000	10,000	16,000
2019-20	7,000	10,000	17000
2020-21	8,000	9,500	17,500
2021-22	9,000	8,500	17,500
Total	40,000	57,000	97,000 *

*3,743 MW commissioned upto 31.03.2015

Government Support

The Government of India is providing Rs. 15,050 cr. subsidy to promote solar capacity addition in the country. This capital subsidy will be provided for solar projects in many cities and towns. Solar power projects with investment of about Rs. 90,000 cr. would be developed using bundling method with thermal power[13]. Further, investment will come from large Public Sector Undertakings (PSU) and Independent Power Producers (IPPs). Many states Government have also come out with state solar policies to promote solar energy technology [9].

V. CONCLUSION

Solar power is an immense source of directly useable energy and ultimately creates other energy resources: biomass, wind, hydropower and wave energy. Concentrating solar thermal is considered as one of the main options for renewable bulk electricity production. It is expected for the next years a concentrating solar thermal development similar in potential and magnitude to the wind power take-off recently experienced. Direct use of solar energy is the only renewable means capable of ultimately supplanting current global energy supply from non-renewable sources, but at the expense of a land area of at least half a million km^2.

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