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Green solar energy: Future prospects in Haryana as well in India

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Abstract
Renewable energy is developed from renewable resources, such as sunlight, wind, rain, tides, waves, and geothermal heat occurring naturally. Renewable energy based on REN21's 2016 report, contributed 19.2% to global energy consumption and 23.7% to their generation of electricity in 2014 and 2015, respectively. This energy consumption is divided as 8.9% coming from traditional biomass, 4.2% as heat energy (modern biomass, geothermal and solar heat), 3.9% hydro electricity and 2.2% is electricity from wind, solar, geothermal, and biomass. Countries like China and the United States are heavily investing in wind, hydro, solar and biofuels. Globally, there are millions jobs associated with the renewable energy industries, with solar photovoltaics being the largest renewable employer. Renewable energy resources exist over wide geographical areas compared to other energy sources, which are limited to some regions. Rapid usage of renewable energy and energy efficiency can help in significant energy security, climate change mitigation, and economic benefits. It can provide powerful incentives for deployment of renewable energy technologies. Present day scenario demands for promoting renewable sources such as solar power and wind power. Presently, about 30 nations around the world already have renewable energy contributing more than 20 percent of energy supply. At national level, renewable energy markets are projected to continue to grow strongly in the coming decade and beyond. Countries like, Iceland and Norway already generate all their electricity using renewable energy. Many other countries have set a goal to reach 100% renewable energy in the future. Denmark government has decided to switch the total energy supply (electricity, mobility and heating/cooling) to 100% renewable energy by 2050. India has a vast supply of renewable energy resources. Indeed, it is the only country to have an exclusive ministry for renewable energy development, the Ministry of Non-Conventional Energy Sources (MNES). Since its formation, the Ministry has launched one of the world's largest and most ambitious programs on renewable energy. Significant progress is being made in power generation from renewable energy sources. MNES has been renamed as the Ministry of New and Renewable Energy. India has an expanding solar energy sector: 9 solar cell manufactures, 22 PV module manufactures, and 50 PV systems manufacturers. Therefore, technology resources exist in country and a growing market would lead to job growth in country. Now India has set a target for renewable energy generation of 175 gigawatts by 2022 and it has got off to a good start with nearly 12 GW likely to be installed by 2016, more than three times the current capacity. In the present study, an attempt has been made to discuss about the applications of solar energy and its status in India. The paper would also include the policies, implementations, incentives, and initiatives taken by Haryana State Government.

Keywords: renewable energy, sunlight, wind, rain, tides, waves, etc.

Introduction

There are different sources of energy such as, coal, petroleum, natural gas which are conventional and exhaustible. Present era emphasizes on renewable energy. The renewable energy forms are solar, wind power, hydroelectricity, biomass, geothermal etc. Most of these renewable energies depend in one way or another on sunlight. Wind and hydroelectric power are the direct result of differential heating of the Earth's surface which leads to air moving about (wind) and precipitation forming as the air is lifted. Solar energy is the direct conversion of sunlight using panels or collectors. Biomass energy is stored sunlight contained in plants. Other renewable energies that do not depend on sunlight are geothermal energy, which is a result of radioactive decay in the crust combined with the original heat of accreting the Earth, and tidal energy, which is a conversion of gravitational energy.

Basic principles of Solar Energy and its Applications

Solar energy is created by light and heat which is emitted by the sun, in the form of electromagnetic radiation. With the help of today's advanced technology, we are able to capture this radiant energy and turn it into usable forms of solar energy - such as heating or electricity. http://www.articlesbase.com/technology-articles/solar-energy-basic-principles-649460.html) Solar energy is the sun's nuclear fusion (of Hydrogen nuclei into Helium) reactions within the continuous energy generated. On earth's orbit, the average solar radiation intensity is 1367kw/m2 while the circumference of the Earth's equator is 40000km. Thus, we can calculate the energy the earth which is up to 173,000 TW. At sea level on the standard peak its "intensity is 1kw/m2, a point on the earth's surface 24h of the annual average radiation intensity is 0.20kw/m2, or roughly 102,000 TW of energy" (C. Sharma, S.K. Bohidar and P. K. Sen, April 2015, p. 1). Humans rely on solar energy to

survive which all other forms of renewable energy (except for geothermal resources). Although the total amount of solar energy resources is ten thousand times of the energy used by humans, but the density of solar energy is low, which is influenced by location and season (a major problem of development and utilization of solar energy). The applications of solar energy are as follows:

Solar Water Heating
Solar energy can be used to heat water for bathing, dishwashing, and washing clothes. It is the second largest home energy cost. By installing a solar water heater one can reduce its water heating bill up to 50 percent.

Solar Electricity
Solar energy can also be used to produce electricity. There are two ways to generate electricity from solar energy; photo voltaic and solar thermal systems. Photovoltaic Electricity comes from the words photo (meaning light), and volt (a measurement of electricity). Sometimes photovoltaic cells are known PV cells or solar cells for short. Solar-powered toys, calculators, and roadside telephone call boxes all use solar cells to convert sunlight into electricity. Solar cells are made up of silicon (the second most common substance on Earth), the same substance that makes up sand.

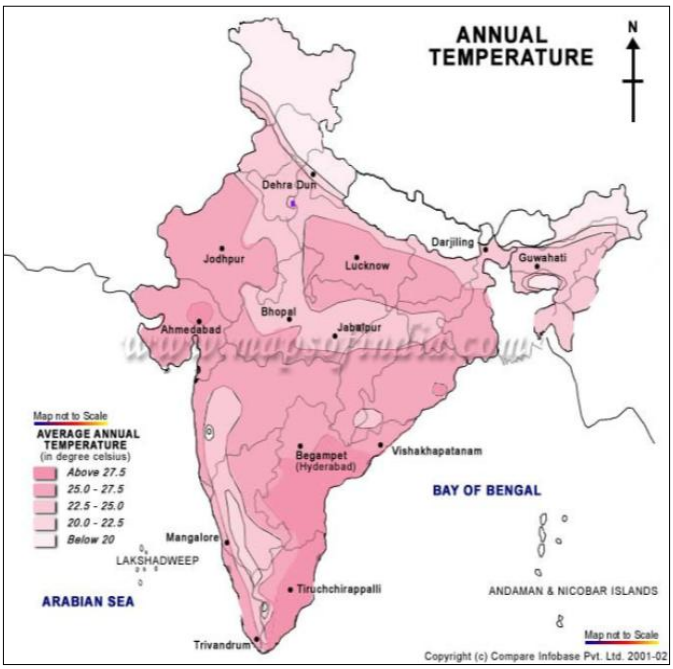
Solar Thermal Electricity
Like solar cells, solar thermal systems, also known as concentrated solar power (CSP), use solar energy to produce electricity in a different way. Most of the solar thermal system use a solar collector with a mirrored surface to focus sunlight onto a receiver that heats a liquid used to make steam to produce electricity in the same way as coal plants do.

Solar Space Heating
This type of systems are used for heating the space inside a building. Today, many houses use it for space heating. A passive solar home is designed to let in as much sunlight as possible just like a big solar collector. Sunlight passes through the windows and get trapped inside to heat the walls and floor inside the house.

Solar Distillation
Saline water can be distilled with the help of solar energy. These water treatment systems depend on solar flux. The sun's energy per unit area is called solar flux, and is generally measured in W/m2. While the extraterrestrial solar flux (flux at the outer edge of our atmosphere) is 1,353 W/m2, this can never be reached on the Earth's surface. If the solar flux were that high on the Earth's surface we would be in much greater danger from the sun, so we are quite thankful that the atmosphere absorbs much of the solar flux.

Solar Cooking
Up till now, you have used a certain type of fuel to ignite a flame so as to cook the food in cookers. But there is a problem with these cookers as, often they would cook the food unevenly, or would burn the food. Cooking food using the sun's rays makes cooking easier. In this fuel is not required to ignite a flame. Instead, the sun's rays are converted to heat so as to cook the food that is placed on a rack or grill.

India Scenario
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 (Figure 1). The sunniest parts are situated in the south/east coast, from Calcutta to Madras. Solar energy has several applications: photovoltaic (PV) cells are placed on the roof top of houses or commercial buildings, and collectors such as mirrors or parabolic dishes that can move and track the sun throughout the day are also used. This mechanism is being used for concentrated lighting in buildings.



Source: http://www.mapsofindia.com/maps/india

Fig 1: Showing the Average Annual Temperature Zones

The national institute of solar energy in India has determined the country's solar power potential at about 750 GW. 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 has an estimated potential of 111 GW. Madhya Pradesh and Maharashtra both have more than 60 GW of solar power potential. Gujarat, the leading Indian state in terms of installed solar power, has an estimated potential of 36 GW. The state has large tracts of land covered with marshes but these lands also support a wide variety of wildlife. Gujarat already has an installed capacity of close to 900 MW of solar power and has already started developing utility-scale solar power projects over water canals. Major solar power plants are: i) Kamuthi solar power project (world's largest solar power plant) in Tamil Nadu (648 MW), ii) Charanka Solar Park - Charanka village, Patan district, Gujarat (221 MW), iii) Welspun Solar MP project 151 MW Neemuch Solar Plant - Neemuch, Madhya Pradesh (151 MW),

iv) Sakri solar plant- Maharashtra (121 MW).

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. Instead of the initial target to installed 22 GW solar power capacity by 2022, the government now plans to add 100 GW capacity. This includes 20 GWof ultra mega solar power projects, with installed capacity of 500 MW or more, across 12 states.

The Department of Renewable Energy is responsible for formulating policies and programmes necessary for popularizing the applications of various non -conventional and renewable sources of energy in the State. It is implementing various schemes concerning utilization of solar energy, biogas, micro hydel, biomas Energy etc. The Department is also acting as a State Designated Agency for the implementation of the Energy Conservation Act, 2001 in the State of Haryana for taking full advantage of fiscal and financial incentives made available by the Ministry of New & Renewable Energy (MNRE), Govt of India and Indian Renewable Energy Development Agency (IREDA) and to give impetus to the process of implementation, State Govt. has set up a new agency called Haryana Renewable Energy Development Agency (HAREDA) in May, 1997. This agency is acting as a nodal agency to implement the various centrally and state sponsored schemes/ projects in the area of renewable energy in the State. The National Bank for Agriculture and Rural Development (NABARD) has sanctioned a loan of Rs 204.67 crore for Haryana under Rural Infrastructure Development Fund for projects including a 10 mw solar plant at Panipat thermal power station.

Haryana - the Competitive Advantage

The state of Haryana is located in the northern part of India, populated by about 25.35 million people and covers an area of about 44212 sq kilometres. In terms of food production, per capita income, industrial growth, excellent transport and communication facilities the state easily qualifies as one of the most advanced states of the country.

In an environment where the demand for energy and power is growing rapidly the state seeks to build on renewable energy and be a part of the drive that is taking a firm shape in the entire country. The state is blessed with high solar radiation levels with more than 300 days of clear sunlight and seeks to harness the untapped and inexhaustible solar energy potential in the state. Therefore the state government formulated its policy as, **Haryana Solar Power Policy, 2016** to promote generation of green and clean power. The govt. seeks to attain its target of Soar Renewable Purchase Obligation (Solar RPO) which is just 0.25% at present and would be scaled up to at least 8% by 2021-22.

Implementation and objectives of Policy

The policy would be operational with effect from the date of its notification and will remain in force till a new Policy is notified. The State Government can remove any inconsistency with Electricity Act, Rules & Regulation made thereof or any Government of India policy/State Electricity Regulatory Commission's order.

To promote generation of green and clean power in the State of Haryana using solar energy by creating conditions conducive to the participation of private and public sector in the promotion and setting up of Solar Energy based power projects. There should be productive use of wastelands / non – agricultural lands by leading to socioeconomic transformation and a reduction in regional disparities in development. Employment should be generation as well as skill up gradation of the youth. An appropriate investment climate should be provided so that it would leverage the benefits of Clean Development Mechanism (CDM) and result in lower Green House Gas (GHG) emissions. Solar Centres of Excellence and pools of technical professionals are to be created. Government has to Spread environmental consciousness among all citizens of the State especially the youth and school going children. Decentralization and diversification of the energy portfolio also has to be done.

The Ministry of New & Renewable Energy, Govt. of India has planned to scale up the ambitious target to add 1, 00,000 MW of solar power by 2022. Haryana State has planned to enhance its capacity of 3200 MW solar power by the year 2021-22.

The government of Haryana has formulated some Initiatives to meet its goals, such as

(a) To install ground mounted MW scale solar power plants.
(b) Installation of solar power plants by the Haryana Power Generation Corporations on its land.
(c) To develop solar parks through Saur Urja Nigam Haryana Ltd. (SUN Haryana).
(d) Installation of solar power plants under schemes of Ministry of New & Renewable Energy like VGF scheme, unemployed youth/farmers scheme and purchase of power under bundling scheme of National Vidyut Vyapar Nigam Ltd. (NVVNL)/NTPC.
(e) Installation of solar power plants on canal banks.
(f) Rooftop grid connected solar power plants through net metering.
(g) Rooftop grid connected solar power plants on cluster of Govt. /PSU buildings.

To bring significant investment from project developers, as well as to meet the Solar Renewable Purchase Obligation (RPO) mandate and to achieve the targets fixed by the Government while to boost the economy Solar Parks will have to be set up in the State. A Joint Venture company has been formed by HSIIDC and HPGCL named "Saur Urja Nigam Haryana Limited" (SUN Haryana) to meet all this. The company will aggregate lands in various parts of the State for setting up Solar Parks/Solar Power Plants through Private Power Producers.

Perquisites

The state government has offered the following incentives/benefits to be provided to the Solar Power Projects on 'Must Run Status and Operational Projects:

i) All expenses for power evacuation, Transmission, distribution line and synchronizing equipment required for installation will be as per the orders of the Haryana Electricity Regulatory Commission for Electricity on Renewable energy Tariff & other issues, as modified from time to time.
ii) All new projects of MW scale generating solar energy

will be treated as "Industry" in terms of Industrial Policy of the State.

iii) Price preference will be given to IPPs who set up the Solar Power Plants in the State.

iv) The banking facility shall be allowed for a period of one year by the Licensee/ Utilities and IPP will pay the difference of Unscheduled Interchange charges (UI charges) at the time of injection and at the time of withdrawal.

v) A generating company engaged in generation of electricity from Solar Power Plant shall be eligible to avail the Renewable Energy Certificates as per regulations of the Central Electricity Regulatory Commission.

vi) Exemption from Land use approval, External Development Charges, scrutiny fee and infrastructure development charges.

vii) These projects shall not require any clearance from the Haryana Pollution Control Board and Forest department.

viii) 100% Exemption in Stamp Duty for lease of land for projects.

ix) The project developer may be individual/company/firm/ group of companies or a Joint venture/Consortium of maximum 4 partners having minimum 51% share holding of leading partner.

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