Innovative Non Depleted Solar Energy: A Review

Bhaskar R. S.
Department of Mechanical Engineering College,
IIMT Engineering College, Ganga Nagar,
Meerut, UP, INDIA Pin Code- 250001
02cim04@gmail.com

Abstract **–** Day by day the energy consumption is increasing very rapidly, particularly in the past several decades has raised fears of exhausting the globe's reserves non renewable energy as in near future. But they may be extinct at any time and before facing the situation we have to choose an alternate to avoid the power crisis. One of the best alternatives is choosing the renewable energy resources. This paper describes about the solar energy, one of the non conventional sources and different ways of using it to convert to electric energy.

Keywords: *Energy, Solar Energy, Solar Voltaic System, Solar Tower, Electricity.*

*****

1. Introduction

There are nine major areas of energy resources. They fall into two categories: nonrenewable and renewable. Nonrenewable energy resources, like coal, nuclear, oil, and natural gas, are available in limited supplies. This is usually due to the long time it takes for them to be replenished. Renewable resources are replenished naturally and over relatively short periods of time. The five major renewable energy resources are solar, wind, water (hydro), biomass, and geothermal [1]. We use sun's (also called solar energy) everyday in many different ways. Solar energy has the greatest potential for providing clean, safe and reliable power. The solar energy falling on the earth's continents is more than 200 times the total annual commercial energy currently being used by human [2]. Indirectly the sun or other stars are responsible for all our energy.

2. Solar Energy

Solar energy can be converted into other forms of energy, such as heat and electricity. In the 1830,s the British Astronomer John Herschel used a solar thermal collector box (a device that absorbs sunlight to collect heat) to cook food during an expedition to Africa. Today people use the sun's energy for lots of things [2].

2.1 Solar Thermal Power

Sun emits energy at a rate of $3.8x10^{23}$ KW of which approximate $1.8x10^{4}$ KW is intercepted by the earth. There is a vast scope to utilize available solar energy for thermal applications such as cooking, water heating and crop drying etc.

Solar thermal electricity power system is a device which utilizes the solar radiation for the generation of electricity through the solar conversion: basically collected solar energy is converted to electricity through the sort of heat to electricity conversion device as shown in fig. 1 [3].

The Major component of any solar thermal system is the solar collector. Solar energy collectors are special kind of heat exchangers that transform solar radiation energy to internal energy of the transport medium. A historical introduction into the use of solar energy was attempted followed by a description of the various types of the collectors including flat - plate, compound parabolic, evacuated tube, parabolic trough, fresnel lens, parabolic dish and heliostat field collectors [4]. Electricity production cost through solar energy is quite higher than that of conventional power station. As for as carbon emission is concerned solar based power station released almost zero carbon as presented in table 1[5].

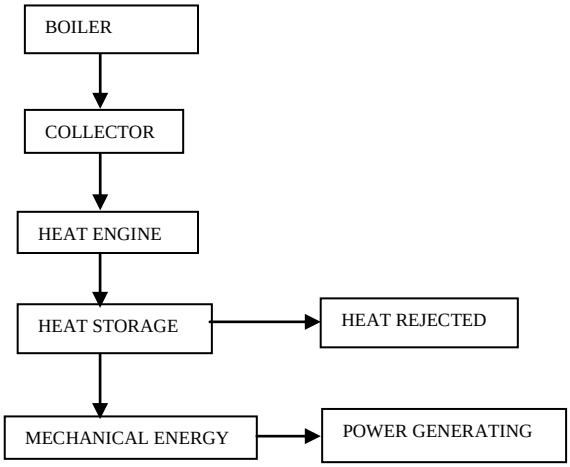


Fig.1 Schematic diagram of a solar thermal conversion system

2.2. Solar Photovoltaic System

Photovoltaic is a direct conversion of light into electricity at the atomic level. Some material exhibit a property known as photoelectric effect that causes them absorbed photons of light and release electrons. When these free electrons are captured, an electric current result that can be used as electricity [2].

Direct solar energy conversion to electricity is conventional done using photovoltaic cells (fig 2), which makes use of the photovoltaic (PV) effect. PV effect depends on interaction of photons, with energy equal to, or more than the band-gap of PV materials. Some of the losses due to band gap limitations are avoided by cascading semiconductor of

 ISSN: 2321-8169
117 – 120

different band gaps [6]. PV modules generate electricity directly from light without emission, noise or vibration. Sunlight is free but power generation cost is exceptionally high, although prices are starting to come down. Solar energy has low energy density: PV module require a large surface area for small amounts of energy generation [7].

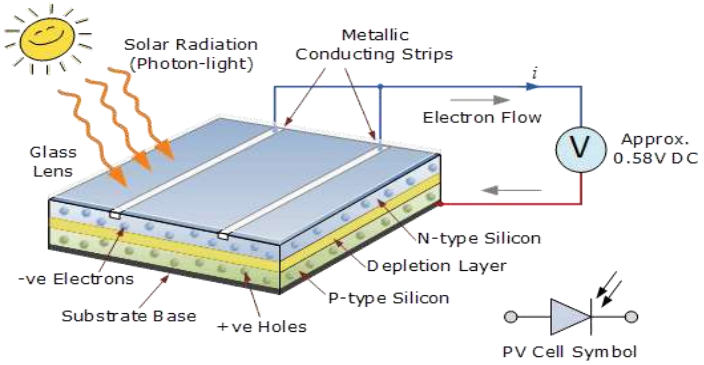


Table 1:

Economics and emissions of conventional technologies compared with solar power generation.

Electricity Generation Technology	Carbon Emissions (gC/kWh)	Generation Cost (US¢/kWh)
Solar thermal and solar PV system	0	9-40

2.3. Solar Tower

This is the other type of conversion of solar to electrical energy with the help of a long tower. The below shown Solar Power Tower which is located in Spain built by Germans with German Technology. The tower reaches up to a height of above 3000 feet.

The base part of the tower is totally insulated with the polythene layer so as to avoid the loss of any radiation during cold and night conditions. The working of the plant as follows.

The upper part of the plant is equipped with high sensitive collectors which collect sunlight directly. The top part of the tower is installed with a storage tank. The collected sunlight is used to heat up the water in the storage tank, which leads to generation of heat energy. This heat energy is transferred to the bottom of the tower without any transformational losses with the help of various heliostats fitted inside the tower. On the other hand the surface under the insulated area gets exposed by the sun and develops heat energy. The steam energy, which is generated by the tower reaches down the tower, it tends to remain in low pressure region. There it along with the heat energy of the bottom starts moving upwards with high velocity which in turn rotates the prime mover of the turbine.

The turbines are installed around the tower and all are rotated due to this velocity. As the turbines are generally coupled with the alternators, electricity generated [2].

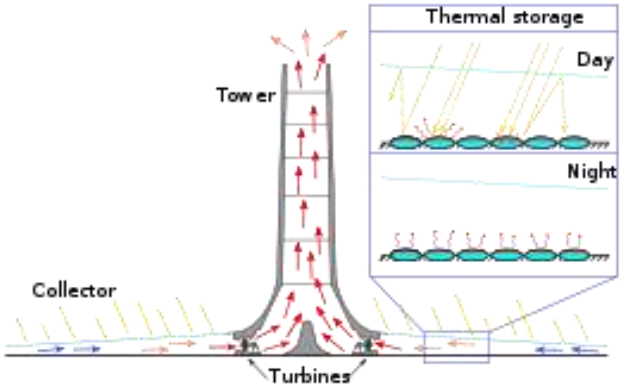


Fig. 2. Solar Power Tower

3.1. Top 5 Largest Solar Power Plants Of The World [8].

1. Tengger Desert Solar Park 1500 MW - Zhongwei , China
2. Datong Solar power Top runner Base -1000 MW – Northern Shanxi Province, China
3. Kurnool Ultra Mega Solar Park-900 MW -Tamil Nadu , India
4. Longyangxia Dam Solar Park-850 MW-Zhejiang, China
5. Kamuthi Solar Power Project- 648 MW- Tamil Nadu, India

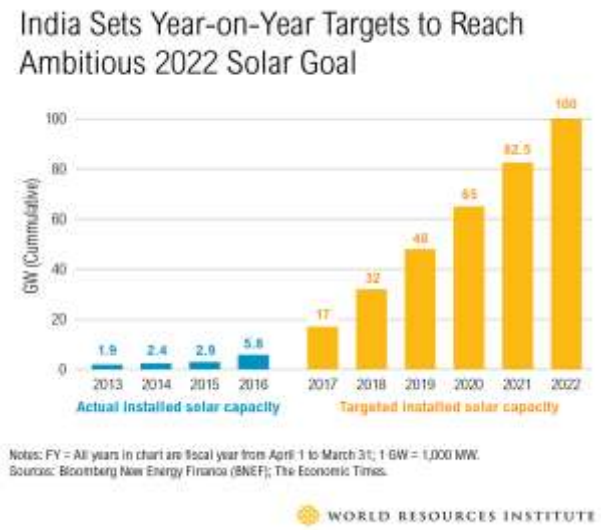
3.2. Top 5 Largest Photovoltaic Power stations of The World [9]. .

1. Solar Star Projects, 579 MW – California, America
2. Desert Sunlight Solar Farm, 550 MW – California, America
3. Topaz Solar Farms, 550 MW - California, America
4. Longyangxia Dam Soalr Park, 530 MW – Qinghai, China
5. Golmud Solar Park 500 MW – Qinghai, China

4. Future Potential of Solar Energy System

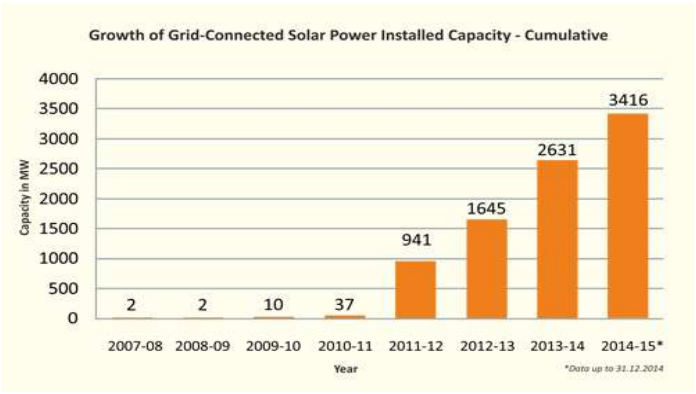
According to the targets, India will add 12 GW f new solar power capacities this fiscal year, and add 15 GW of new solar capacity in FY 2018 and FY 2019, respectively. This will also bring the country closer to the government's commitment of providing 24-hour electricity to all Indians by 2019 [10].

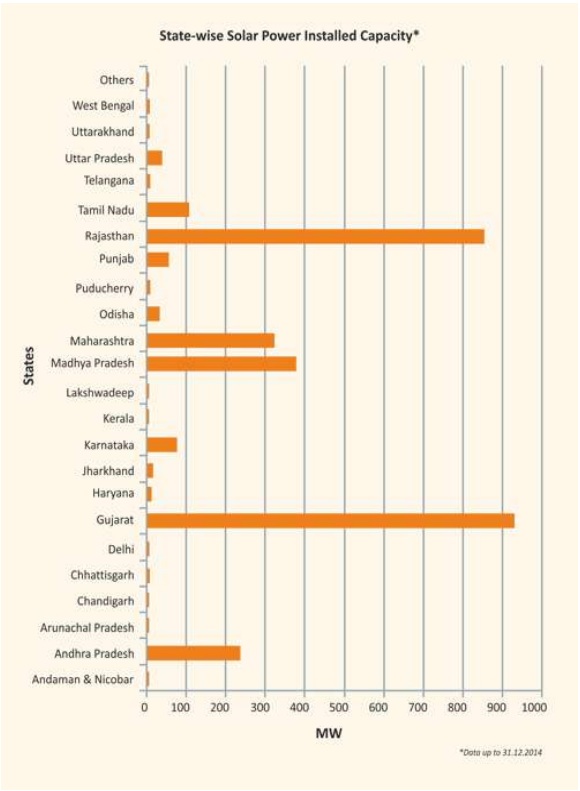
 ISSN: 2321-8169
117 – 120



5. Graph Year by Year Solar Electricity Production Growth in India

In more ways than one, 2014-15 has been a decisive leap forward for renewable energy in India. In his inaugural address to the 1st Renewable Energy Global Investor Meet & Expo (RE-INVEST 2015) organized by the Ministry of New and Renewable Energy (MNRE) during 15-17 February, 2015, Shri Narendra Modi, Prime Minister of India, has articulated the future of renewable as "moving from megawatt to gigawatt". Moving forward from the steady growth patterns of the last two decades, the Renewable Energy sector is now poised to make a quantum jump [11].





6. Limitations of Solar Energy

Solar energy available in most parts of the world but there are some limitations of solar energy [2].

- Low energy density 0.1 to 1 KW/m^2.
- Large area is required to collect the solar energy.
- Direction of rays changes continuously.
- Energy is not uniform during cloudy, weather and not available during night.
- Energy storage is essential.
- High initial cost.
- Low efficiency.
- We could not be 100% powered by the solar panels [12].

7. Advantages

- This system of energy conversion is noiseless and cheap.
- Maintenance cost is low.
- They have long life.
- Pollution free
- Highly Reliable
- Cost-effective User friendly [12].
- Sources are available without the affecting the environment.
- Sun's energy is distributed over a wide geographical area.

8. Applications

- They are best suited for rural areas.
- Pumping of water drinking and irrigation.
- Street lighting.
- Rural telephone exchange operation.
- Battery charging
- Used for pocket calculators, watches, toys, electric fences. etc

9. Conclusions

Most solar panels convert around 15% of the sun's energy into electricity. Most experimental photovoltaic panels can convert 40% incident solar energy into electricity. The use of solar energy for the production of electricity reduces the price/unit as 50 paise. The only problem in this procedure is the high installation charges. So if our engineers work in such a way so as to reduce that cost and in further developments of the equipment, we can definitely meet the power demand in the future and this will be an energy solution.

References:

[1] https://ww2.kqed.org/quest/2014/02/13/nonrenewable-and-renewable-energy-resources-2/
[2] Sai Manoj Rompicherla , "Solar Energy: The Future" IJETT Volume 4 June 2013, pp-2513-2517.
[3] Thirugnanasambandam M, Inian S, Goic R. A Review of Solar Thermal technologies, Renewable and sustainable energy Reviews 2010;14: 12-22.
[4] Kalogirou AS. Solar Thermal Collectors and applications. Progress in Energy and combustion Science 2004; 76:19-31.
[5] N. L. Panwar et. al, "Role of renewable energy sources in environment protection: A review" , Renewable and Sustainable Energy Review 15, pp-1513-1524, 2011.
[6] Goswami DY, Vijayaraghavan S, Lu S, Tamm G. "New and Emerging Development in Solar Energy", Solar Energy 2004; 76:33-43.
[7] Topcu YI, Ulengin F., "Energy for the future: An integrated decision aid for the case of Turkey. Energy 2004; 29: 137-54.
[8] https://www.solarinsure.com/largest-solar-power-plants.
[9] http://www.imeche.org/news/news-article/top-10-solar-photovoltaic-plants-in-the-world.
[10] http://www.wri.org/blog/2016/05/india-charts-roadmap-achieve-ambitious-solar-targets.
[11] http://mnre.gov.in/file-manager/annual-report/2014-2015/EN/Chapter%201/chapter_1.htm.
[12] Nada Kh. M. A. Alrikabi, "Renewable Energy Types" Journal of Clean Energy Technologies, Volume 2, January 2014, pp-61-64.
[13] Ashokverghese, "New and renewable Energy Resources," Proceeding and international Conference on alternate energy resources, Asian Institue of Technology, Thailand, pp. 403-410, 1998.
[14] G D Rai, "Non – Conventional Energy Sources" Khanna Publications.