

A Review on Growth & Future Plans of Solar Power Generation in India

Dheerendra Kumar Singh¹, Nagendra Kumar Swarnkar², Dr. Mahendra Lalwani³

¹M.Tech. scholar, Power Systems, Apex Institute of Engineering & Technology, Jaipur

²Associate Professor, Department of Electrical Engineering, Apex Institute of Engineering & Technology, Jaipur

³Associate Professor, Department of Electrical Engineering, University College of Engineering (RTU), Kota

Abstract—Although energy is a prime agent in the generation of wealth but energy crisis is one of the biggest issues due to limited availability of fuel or raw material for conventional sources. In addition, the increasing prices of oil, gas, coal and uranium (for nuclear power) also indicate the demand of some other sources to generate the power which do not affect the environment and fulfill the power demand of rural and urban areas effectively & efficiently. Therefore alternate sources must be targeted to meet the reliable & quality power continuously. Renewable energy sources have the enormous potential and can fulfill the present energy demand. Major types of renewable energy sources include solar, wind, hydro and biomass, all of which have great potential of energy. Solar energy is clean, pollution-free, reliable and most promising & more predictable than other renewable sources and less sensitive to changes in seasonal weather. This paper presents a review of growth, advantages and applications of solar energy in India.

Keywords- Conventional sources, Energy crisis, Quality power, Renewable energy, Solar energy.

I. INTRODUCTION

Since the energy is a significant factor in economic development, it is considered as a prime agent in the generation of wealth. Limited fossil resources and environmental problems associated with them have emphasized the need for new sustainable energy supply options that use renewable energies. Renewable energy (RE) sources have enormous potential and can meet much higher times the present world energy demand. They can improve diversity in energy supply markets, secure long-term sustainable energy supplies, and reduce the atmospheric emissions locally & globally [1]. They can also provide commercially attractive options to meet exact needs for energy services particularly in developing countries and rural areas, create new business & new job opportunities,

and offer possibilities for local manufacturing of apparatus. In this paper, a review and study on growth of solar energy & future plans to meet energy demand in Indian scenario is presented. Major types of renewable energy sources include solar, wind, hydro and biomass, all of which have great potential to meet future energy challenges. Solar power is one of the most promising & more predictable than other renewable sources and less sensitive to changes in seasonal weather. Whereas, generation of power from other renewable sources is limited to sites where these resources exist in sufficient quantities and can be harnessed, solar energy can produce power at the point of demand in both rural and urban areas [2].

II. COMPARISON OF SOLAR ENERGY & OIL RESOURCES

Table 1.1 shows the comparison of solar energy & oil resources which shows why the solar energy is future of country in power sector [3].

TABLE 1.1: COMPARISON BETWEEN SOLAR ENERGY & OIL RESOURCES [3]

S. No.	Particulars	Solar Energy	Oil Resources
1.	Availability	They are abundant in	They are abundant in
2.	Regeneration	Can be Regenerated; Inexhaustible resource	Ore is drained, can't be regenerated
3.	Emission	Zero emission	Releases greenhouse gases
4.	Environmental effect of use	Pollution free & environment friendly	Harmful to the environment
5.	Transportation	Used where it is available or transported where needed	Has to be transported from its source site for further processing, exposing the environment to pollution from accidents

6.	Distribution	Evenly distributed in the world	Uneven distribution which leads to flow gap and price fluctuations
7.	Development	Leads to more sustainable development. i.e. more jobs opportunities	Lesser sustainable development
8.	Storage	Need storage between production and consumption.	Portable form of energy. Easy to store
9.	Climate change	Depends on alteration of climate	Do not depend on weather modifications
10.	Area	Large amount of land is required	Not large geographical area is required
11.	Geo-political implications	Reduces our reliance on oil, Safe guarding national security. Allows for self-sufficiency	Over-reliance on oil as a resource can undermine a country's energy security.
12.	Cost	High Capital and Maintenance cost	Cost of producing is low since they are naturally available. Furthermore they are cheap to transform from one form of energy to another.
13.	Energy Supply	Once generated, they produce high amount of energy	Limited supply only

III. ACHIEVEMENTS & FUTURE PLANS

The Ministry of New & Renewable Energy (MNRE) provides lot of fiscal & non-fiscal incentives for the promotion of RE such that concessional excise & custom duties, generation based incentives, Viability Gap Funding (VGF), enforcing the Renewable Purchase Obligations (RPO) and other. At G20 Summit 2014, the Prime minister of India stressed the need to improve generation of clean & green energy in competition of conventional energy.

According to National Action Plan on Climate Change (NAPCC), a minimum share of RE in national grid was only 5 percent in 2009-10 and it should have to be increased by 1 percent every year so as to reach 15 percent by 2020. In actual practice, the share of RE has been increased from 7.8 percent to 12.3 percent in last five years i.e. from 2008 to 2013. India is world's 6th largest energy consumer, accounting for 3.4% of global energy consumption. Due to India's economic rise, the demand for energy has grown at

an average of 3.6% per annum over the past 30 years [2].

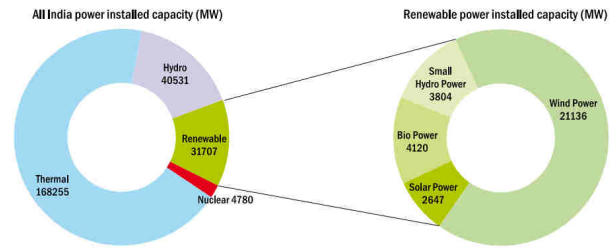


Fig. 1: RE at a glance (as on June 2014) [4]

In September 2010, the installed power generation capacity of India stood at 164,835.8 MW, while the per capita energy consumption stood at 612 kWh whereas in June 2014, the installed power generation capacity of India stood at 2,45,273 MW, in which 31,707 MW was shared by RE. Fig. 1 shows the division of total installed capacity and RE installed capacity of India [4].

MNRE set a target to install 29,800 MW in addition from various RE sources during the five year plan period (i.e. upto March 2017) which includes small hydro, wind, bio and solar power are expected to 2100 MW, 15,000 MW, 2700 MW and 10,000 MW, respectively. Fig. 2 shows the year wise growth of RE till FY 2014.

Renewable energy installed capacity

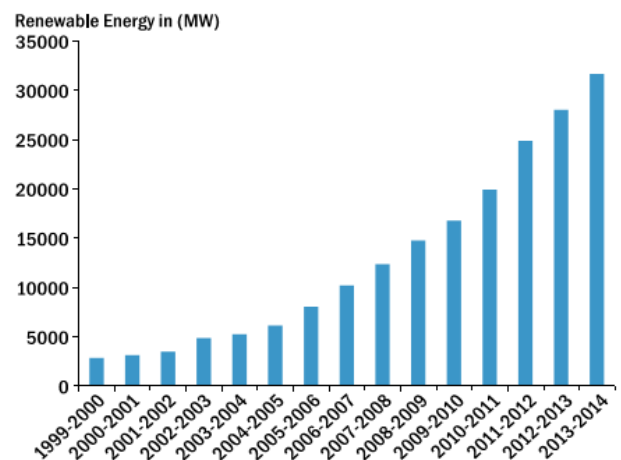


Fig. 2 Year wise growth of installed capacity of RE in India (as on June 2014) [4]

Fig. 3 shows how the cumulative capacity is continuously increasing globally and what will be it up to 2030 [5].

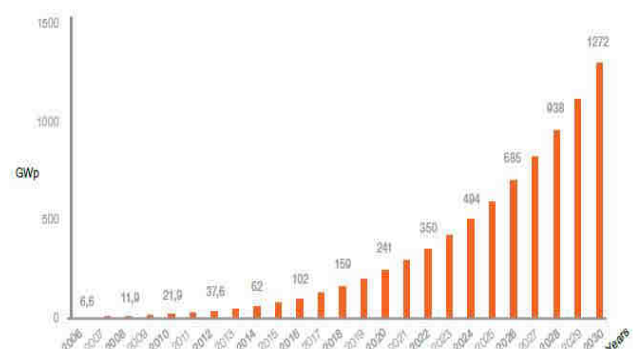


Fig. 3: Advanced scenario of Globally Cumulative Capacity up to 2030 [5].

IV. SOLAR ENERGY: AT A GLANCE

Solar power is becoming more and more popular as the oil prices keep increasing. The demand of natural resources such as coal, oil and gas continues to grow on a daily basis worldwide. These types of fuels are playing a role of destruction in terms of global warming and increasing air pollution. Consequently, solar power is one of the best alternatives that provide solutions of above problems. Solar power is known to be one of the cleanest renewable energies today. Worldwide, electric power generation creates 40 percent of the pollution contributing to global warming, and is the fastest-growing source of such pollution. However, usage of solar energy is spreading significantly as the demand for electricity increases throughout the world. Solar electricity is an equally significant energy option for developed and developing countries because of the cost of transmission lines and the difficulty of transporting fuel to remote areas, developing countries are increasingly turning to solar energy as a cost-effective way to supply electricity.

The solar energy provides electricity without giving rise to any carbon dioxide emission. Although the cost of generation of electricity through solar is high but for large plant & in long term, the running cost & maintenance cost per peak KW are reduced at a level which is low as compared to other conventional plants. Also the efficiency of solar power plant is constantly increased due to new innovations in the field of material of PV cell. In today's scenario, cost of solar power has become down to \$ 0.12 per KWH and concentrated solar power has become \$ 0.21 per KWH in India [4]. Due to this process & MNRE provides some beneficial financial schemes, the prices of PV cell further reduces and hence expected generation through solar increases. The mission of Jawaharlal Nehru National Solar Mission (JNNSM) is to meet its total deployment target 20000 MW by 2022.

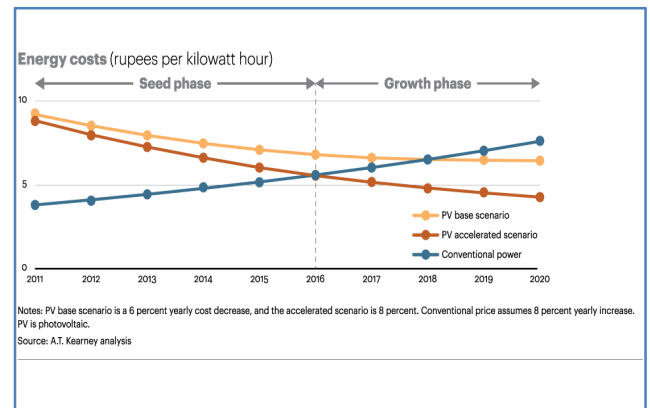


Fig. 4: Solar reaches grid parity with conventional power between 2016 and 2018 (Source: A T Kearney)[10] Between years 2016 to 2018, the structure of solar industry will rapidly evolve as solar reaches grid parity with conventional power as shown in fig. 4 [10].

Solar power technologies may be divided as follows [1]:

- Photovoltaic Cells (PV)
- Concentrating Solar Power (CSP)
- Crystalline solar cells
- Amorphous Solar Cells
- Other Solar Cells (Edge Defined Film fed Growth)

According to their applications, the type of solar power technology is used. The advantages of using solar power are proven itself due to its economic & environmental aspects:

- For solar power generation, fuel is freely available.
- Most of the PV cells are from silicon which is abundant and nontoxic element.
- It does not generate any types of polluting gases and harmful emissions.
- Life of PV cell is approximately 30 years and also it is safe & reliable.
- Recycling of PV cell is possible as this may help environmentally and reduce the cost of fabrication.
- PV cells & its modules are almost maintenance free and may install easily.
- Solar power for rural areas is advantageous where the power transportation from conventional sources is not possible.
- Solar PV modules may install at roof top of the public & residential buildings which makes eco-buildings and positive energy buildings.
- It creates job & business opportunities globally.
- It increases the security of energy supply, economic growth and environment protection.

Solar power has many applications in which following are very common [1]:

- *Grid-connected domestic systems*
- *Grid-connected power plants*
- *Off-grid systems for rural electrification*
- *Hybrid systems*
- *Consumer goods*
- *Off-grid industrial applications*

The above applications include all the fields where solar power is used like house lighting, solar cooker, solar water heater, solar water pumping, telecommunications, watches, calculators, toys, battery chargers, professional sun roofs for automobiles, water sprinklers, road signs, phone boxes, traffic signals, marine navigation aids, security phones, remote lighting, highway signs and waste water treatment plants[1].

V. CONCLUSION

It has been realized that development of clean & sustainable energy is necessary for human being. Since the non-availability & dependency on fossil fuels may create a big problems in lack of generation of electricity therefore the promotional activities & accountability of Renewable Energy are required to prevent our earth from darkness. Therefore, a common person should also have an aim to reduce energy utilization and use the applications of solar energy in various fields which is clean & sustainable. India has a huge potential of solar energy and due to its applicability in various fields & advantages, Central & State Government also provide various schemes, as discussed in this paper, to promote solar energy & other RE sources which have no adverse environmental impacts and no warriors for completion. Development of solar power is expected to contribute in bringing down emissions per unit of GDP by 20-25 percent by 2020. India has total installed capacity through RE 31,707 MW (as on June 2014) in which installed capacity of solar energy is 2647 MW. MNRE has planned to improve solar energy generation from 2647 MW to 10,000 MW up to March 2017. As discussed their advantages & applications, this will also help to improve industrial & economic growth of India. Also it helps the security of energy supply, economic growth, environment protection and open new job & business opportunities. Thus there is a need to strengthen the efforts for balancing non-conventional sources with other sources for a quality & reliable power supply.

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