Solar Power Development: A Root for Sustainable Development of India

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Abstract: Sustainable development of second most populated country of world, India depends on the planning and utilization of conventional and non-conventional energy sources. Presently energy safety has top most prime concerned for sustainable development. Energy barriers/bottleneck, prospect of solar energy with consideration of cost, hot spot of solar energy, government policies, training and education of solar sector and data of solar radiation analyze in this article. Key aspect that helpful in barrier reduction and growth of solar sector suggested through paper. By this study it has been found that sustainable growth of India depend of utilization of solar energy. Full concentration by country over solar sector necessary for satisfying future demand of energy for country growth and development.

Keywords- Sustainable, Solar power, Energy barriers, Non-conventional.

1. INTRODUCTION

As second most populated country in the world India demanding more than 280GW energy for fulfill their existing demand.\textsuperscript{[1]} Due to rise in population and increasing in the energy demand. Current installed capacity in India is in sufficient to meet current demand. By International Energy Agency report up to 2035 India demanding more than 800GW energy as installed capacity.\textsuperscript{[2]} In India approximate 60% of power supply based on coal based thermal power, and market based on fossil fuel is continuously goes down and India needs to switch if power generation from conventional to non-conventional power generation\textsuperscript{[3]}. Our conventional fossil fuel resource continuously deplete and touch the condition of running out.\textsuperscript{[4]} Due to the production of large amount of greenhouse gases by the use of fossil fuel, it is mandatory to switch power production from conventional to non-conventional clean energy resource, but when we talk about solar energy potential in India, its contribution is only 5,000 trillion kilowatt-hours (kWh) approximately with presence of approximately 300 sunny days.\textsuperscript{[5]} Seasonal and periodical variation is the biggest drawback of solar power supply system and this drawback can easily dumbed out by connecting the solar supply system by grid for regular power supply\textsuperscript{[6]}. In India rural electrification can easily handle by PV system. India using centralized power supply system, which suffer with transmission losses (35% in rural and 25% in urban). These losses can reduced by decentralized supply system and PV system I one of the option for that decentralized power supply system.\textsuperscript{[7]} In this manuscript author has shown the potential of solar energy and growth steps taken by Government of India. In this article author discuses regarding the main barrier of solar power growth market. Author also discussed regarding the key recommendation helpful for growth of solar sector in India.

2. METHODOLOGY

In article helpful in the finding of problem faced by solar power sector in India as well as opportunity for its growth. In this research qualitative approach like interview, case study and pilot study are used for the data collection from various sources and after that analysis of this data utilized in problem understanding and suggested best possible solution of the problem.\textsuperscript{[8]}

In this research already published Government/private organization statistical report analyzed deeply. these organization are well known in the field of solar power sector and work on the solar energy development in India.
During study ten developer of solar sector were interviewed on the issues of solar sector in India with discussion on the limitations related to financing, technical aspect, policies, infrastructure, transparency plus accountability. The research team has interacted with technical, academic, research organization, Government officials related to the solar sector to receive perspective of growth, development and bottlenecks in solar power sector.

3. INDIA SOLAR ENERGY PROFILE

India is tropical country and total landmass is approximately 3 million Kilometer$^2$ this landmass indicate the rich solar energy/power profile.
The annual average direct normal irradiance in most of the Indian states are nearby 4.5 to 5.0 KWh/m$^2$/Day this is shown in fig.1. Data regarding global horizontal irradiation shown in fig.2. Average amount of this is about 5.1 to 5.52 KWh/m$^2$/Day.

![Fig. 1 –Data of normal irradiance (direct) in India.](image)
Source: National Renewable Energy Laboratory, U.S Department of Energy

Such high amount of solar profile easily satisfy the power demand of India and also helpful in prevention of greenhouse gasses from fossil fuels based electricity generation. As per the data of Ministry of environment & forest the electricity sector produces the highest greenhouse gasses in a year, in the year 2010 the GHG emission by electricity sector is 37.8%, which can be minimized by utilizing the enormous amount of solar energy available free of cost.
Fig. 2 Annual average of Irradiance (Global Horizontal) in India.
Source: National Renewable Energy Laboratory, U.S Department of Energy

As per figure 1 and figure 2 about 61% land mass contains solar hot spots with insolation (annual global) of 5.2 kWh/m²/day, and these hot spots required a well-defined policy to utilized them.

4. INDIAN GOVERNMENT INITIATIVES

In India up to 2011, solar energy installation is near by 171 MW, but by Government initiative and different action up to Sep, 2018 its touch 24.5 GW installed capacity. The Government of India set the target of 100,000 MW solar energy installation up to 2022 for sustainable development of country under Jawaharlal Nehru National Solar Mission. [9]

Government of India introducing the concept of solar park at numbers of location in country, these park very helpful in the growth of solar power project. These solar parks will have well-established infrastructure for power generation and distribution at minimum cost.

Indian government has planned to set up the solar park with installed capacity of more than 800MW in span of 6 year. SECI (Solar Energy Corporation of India) is guided through Ministry of new and renewable energy (MNRE) to give 30% subsidy to roof top solar power project. Due to these various initiative government has set the target of 100GW installed solar capacity till 2022.

Growth graph of solar installed capacity in India shown in fig 3. These growth increases continually with year wise year.

Fig. 3 Growth graph of installed solar capacity in GW in India
Source: Ministry of New & Renewable Energy Sources, India
As per the Ministry of new & renewable energy till September, 2018, India has an installed solar power generation capacity of 26 GW with a lowest tariff rate of 2.44 per unit. Government of India has launched IT based platform to access information of developer and investor of local and international level. This platform also provide information regarding the guideline released by Government of India. This platform offer a single step process of information of any kind of government approval, contracts, any query and any formality to process any solar power project.

5. **BOTTLENECKS/BARRIERS IN SOLAR POWER GROWTH/DEVELOPMENT IN INDIA**

For sustainable development, it is necessary for us we save energy in all aspect and quickly switch on renewable energy sources, but it is not easy target for India when we face number of growth problem and move for number one position on population. Sustainable development blocked by some energy sustainability barriers in various ways. Lack of education and training, legal, regulatory, market, lack investment in R&D and/or financial barriers are some of energy sustainability bottlenecks/barriers [10].

5.1 **Bottlenecks/barrier due to lack of Education and training**

The Biggest bottleneck in growth of solar sector in India is inefficient education and training system in field of solar power. And India rural sector is facing this problem mainly. In rural area due to lack of education numbers of people used conventional energy source for power production and lighting management. By the help of proper education and training program utilization of solar power can easily enhanced. In India there is an enough scope of development of solar power sector in rural area by education program and training session. Indian Government on regularly announcing the solar development program for awareness of solar power but due to lack of education less number of people’s shown the interest in these training program and not getting benefit of such type of program.

5.2 **Bottlenecks/barrier due to financing schemes**

India is developing country and more than 90% population depends of the conventional energy source and from this fact Indian banking system also not take care too much about development of solar sector in past year but now days due to policies of Indian government banking system also provides financial help to solar power sector and encourages the large and small solar power business sector. Starting cost of any solar power project is too much high as compare to other conventional power projects. But in later stage solar power generation does not have any fuel cost and also hit very less operation and maintenance cost. So in case of any solar project initial cost is too high but later on the cost is very less due to this high initial cost solar power project adopted by very less number of people for house-hold power generation. To encourage the people for adopting solar based electricity generation government of India give subsidies on solar power project.

5.3 **Bottlenecks/barrier in technological support**

5.3.1 **Lack of Investment in Research & Development**

Investment policies in R & D is not up to mark in India in both government and private level. Most of the latest technology is assisted by some another country. The biggest example for that is India don’t have their domestic solar power panel manufacturer and for the supplies of solar panel we depends on our native country China. On the other side in developed country Government and different agency invest good wealth in solar program. Second technological barrier is less information of technology and manufacturing methods for assist solar power sector. As example cell & Module manufacturing facilities are limited and small while Trina Solar produces more than 8GW of manufacturing facility which is more than the total manufacturing facility of the entire Indian module manufacturer put together. But now Indian government take effective steps to put India as a key manufacturer of cell and module but journey is too long.

5.3.2 **Lack of information regarding data of solar radiation**

For the development of any solar power project information of solar and weather forecast is very necessary on daily basis. Global horizontal irradiance (“GHI”) play very significance role in growth of solar PV plants. For selected Mega Watt(MW) capacity, plant size, number panels, land mass, capacity factor and the cost of the plant determine by GHI.
Power production from plant is directly affected by GHI in both aspects of power production as well as profit earned. Solar radiation data also measure of tariff fixation. Total growth of any solar power project is directly related to the available GHI. Presently due to the space program and improvement of weather forecasting fair and clear picture of irradiation data with better weather forecasting come in picture and it’s reduce the chance of risk in solar power project.

6. GROWTH POLICY FOR SOLAR POWER SECTOR

Government of India target 100 GW installed capacity till 2022 for this we must planned some common growth policy for the solar power sector. Some key factors for this suggested by the patrons:

1. Total solar power sector bound with a single policy statement.
2. More focus required on short term courses, development, awareness program and establishment of good number of training centers in overall country in solar power sector.
3. Strong supportive banking system required for financial support of solar power developers.
4. Required more tie-up with developed countries for technology transfer, foreign direct investment and R&D in solar power development.
5. Policy for encouraging manufacturing sector for growth in cell, module, and PV system.

7. CONCLUSION

Population of India is increasing day by day and India is at the top by the end of 2025 and therefore the demand for energy is also at top. Fossil fuel is not sufficient to fulfill this demand due to reduction in fossil fuel resources. If we consider other factors like global warming, changes of climates and energy saving for future, development of solar power sector is necessary. Sustainable development of country is also affected by country solar power mission. Now the time come when we have to switch our power production to solar energy because large scale availability, zero carbon emission and future energy saving plan. Different subsidies plan attains people for solar power adoption and support peoples on financial ground. Enhancement in different education and training program required for growth in solar sector. More support required for easy availability of solar radiation data to the growth and advancement of solar power in the India.

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