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+91 99405 72462



+9163819 07438



ijmrsetm@gmail.com



www.ijmrsetm.com



Role of Solar Energy in the Economic Development of India

Anil Kumar

Assistant Professor, Dept. of Physics, Govt. Bangur College, Didwana (Nagaur), Rajasthan, India

ABSTRACT: Economy and the environment have to go hand in hand for a sustainable growth. We have paid the price for economic growth at the cost of environmental, resulting in irreversible damages. Global warming and escalating pollution levels have endangered our future. Climate change and natural calamities are becoming new normal! This is time to act before it escalates and impact our future further. Electricity is a basic need for economic growth, but unfortunately it directly impacts the environment. Traditional sources like fossil fuel is not commercially and environmentally feasible. In addition, fossil fuel is diminishing at alarming rate. The good news is, renewable energy is a feasible alternative. Solar energy is the answer to these challenges and the world can be much greener without sacrificing economic growth. India set an ambitious target to achieve 175 GW renewable energy. Of this, more than 55% i.e., is 100 GW is to be obtained from solar energy. The 100 GW is further divided into 60 GW for utility-scale and 40 GW for rooftop projects. Solar dominates the renewable energy space, as it is commercially viable, easy to install, and boasts of low cost of operation and maintenance. With the ever-increasing adoption of the solar energy in India, the demand for modules, inverters and allied hardware is also growing. However, there has been a huge dependency on imports from China, Vietnam, Europe etc. Made in India boost will create a positive impact on our economy and reduce our dependency on imports. Manufacturing industries will require skilled professionals to meet high demand, thus creating and providing employment in this sector. According to the International Renewable Energy Agency (IRENA), the Indian solar sector created 1,15,000 employment opportunities in 2018 and it will continue to increase in coming years.

It is the time to act and contribute towards sustainable living. Investment in solar fetches far more returns than any traditional asset class and investment break-even in 2-5 years for an end consumer and the annuity saving of as high as 25% continues for 25 years over the project life. In addition, adoption of every megawatt of solar saves 31,000 tonnes of CO₂ over project life i.e., equivalent to plantation of 49,000 teak wood trees for every megawatt. India is a developing economy with an enormous opportunity to grow and the electricity requirement is going to grow up. When we consider the commercial and industrial consumption, coupled with domestic usage in more than 20 crore households in India – we are looking at a trillion dollar opportunity waiting to be exploited. In order to further enhance solar adoption, the ecosystem needs to focus on few aspects like – building awareness and offering financing options to consumers while focusing on reliable technology. Adoption of solar energy transforms multiple problem areas into opportunities. This would fuel the economic growth, boost up made in India mission and create employment while making the world greener.

KEYWORDS: solar energy, economic, development, India, environment, mission, green, plantation

I. INTRODUCTION

India is fast moving towards a clean energy mix to support its consumer power requirements. It is the world's third largest producer and fourth largest consumer of electricity in the world as of August 2018. Going solar is a decision that has enormous importance in today's world of climate change and uncertainty of rising energy costs. There are signals that significant investments and supportive stance from the government have started to pay off. The falling costs of the renewables are making these alternative sources more viable to explore. In fact new solar and wind backed energy sources are now 20% cheaper than the average wholesale price for existing coal-fired power. The transition away from fossil fuels is supported by policy makers as well as changing markets. For an economy that is still heavily dependent on coal for 60 percent of its energy mix, going solar is a huge step. The policy makers have supported the initiative in a big way. Under Prime Minister Narendra Modi's energy agenda, [1,2] an ambitious target has been set for renewables, with an aim to increase renewable capacity on the grid from around 57GW in May 2017 to 175GW. India has already achieved 23 GW of solar installations with another 40 GW of solar power being at different stages of bidding and installation. The transition of the energy landscape in India is inevitable with the share of renewable energy going up rapidly. India has already overtaken US to become the third largest solar power market in the world and is expected to grow exponentially in the years to come. The potential for solar energy capacity in India is immense. The majority of the country's landmass is optimally located



such as to receive peak solar radiations. The World Bank has in fact termed India as having the best conditions to tap into solar energy and utilize this potential. Significant financing from commercial and multinational investment banks is helping to drive growth. In 2017, the European Investment Bank (EIB) announced a partnership with India's YES Bank, with each partner setting aside \$200m in loans to help finance solar and wind projects in the country. The World Bank too has committed to providing \$1bn in lending across FY17 which is its highest level of support to any country for solar energy. It is also supporting the International Solar Alliance, formed after Paris Climate Conference in 2015. This could be a key facilitator for finance for Indian Solar domain in the years to come. According to data released by the Department for Promotion of Industry and Internal Trade (DPIIT), [3,4] FDI inflows in the Indian non-conventional energy sector between April 2000 and December 2018 stood at US\$ 7.48 billion. This is driving strong growth in large-scale solar parks such that the government has decided to double the solar park capacity.

Solar deployment, operation and maintenance creates recurring additional jobs in the sector. With domestic and foreign investments flowing in the sector, there is a potential for parallel expansion in the job market. For example, to set up a wind industry, one would need to look for specialists for manufacturing, project experts, installations, maintenance, construction, turbine installation, transportation and logistics. The local governments will have to build factories for support function which will in turn need workforce. The main reason for such growth are the economic indicators. Businesses have realized that sustainable development is key to success, long-term performance, and investment. Besides that, the prices on solar and wind products have dropped—making it more affordable. Nurturing the Indian Solar sector domain is crucial for shaping the future of renewable energy in a big way and also control solar development costs at a time when domestic manufacturers are struggling to compete with Chinese firms, both technically and economically. In the coming years, building the domestic capacity and improving technologies will be a defining issue for solar industry in India. [5,6] This could be said in particular for small scale roof-top solar panels which are price-sensitive. With a wealth of emerging solar technologies and new projects, India remains a prime location for an industry that could well catapult it into achieving its international climate change goal as well. [7,8]

II. DISCUSSION

No doubt India has a great potential for the generation of solar energy. It is a tropical country that is around 300 clear sunny days in a year. In various ways, the development of solar sector can help India in achieving Atmanirbharta or self-reliant. It will create employment.

- It will lead to rural development.
- On the other hand, there will be a reduction in fuel import bills.
- It will also reduce the dependency on oil-producing countries.
- Installation of power generation units at a faster rate.
- Also, it will support a clean environment and will enhance the quality of life. [9,10]

If we see employment generation sector then solar power sector can provide employment to all kind of labours including skilled, semi-skilled and unskilled in several activities like manufacturing of solar equipment, development of solar power plant and installation and maintenance of Roof Top Solar Panels. In solar power sector demand of installation of roof-top solar panels will generate entrepreneurship and jobs in rural India. Availability of power will promote cottage and small scale industries in rural India. The income disparity gap will also be bridged between rural India and urban India. But to construct a 500 MW capacity solar plant it takes around 18 months and to construct thermal or hydel plant might take 2 to 3 times more time. The point to be noted here is that the cost of construction and financing for a new solar plant is 14% less than that of a thermal or hydel plant. The ground reality is that the solar power sector of India is heavily dependent on China. Having an ambitious target of solar power generation, India has solar cell manufacturing capacity of about 3 GW annually but the average annual demand is 20 GW. From top 10 India's module suppliers 7 are from China firms. India had already imported around \$16 billion worth of solar equipment in the past five years. Therefore, it is clear that India needs a solar manufacturing strategy. Manufacturing of solar equipment occurs in four phases:

- Semiconductor Ingot production.
- Semiconductor wafer production from Ingot.
- Photovoltaic cell manufacturing from a semiconductor wafer.
- Solar panel manufacturing by assembling photovoltaic cells. [11,12]

India lacks in the production of these semiconductors. Also, to achieve self-sufficiency in solar equipment manufacturing, India needs a strategy, a new solar sector development policy that is focused on three issues namely:



- To develop a core competency in semiconductor manufacturing.
- To subsidise solar manufacturing sector, the government need a proper policy.
- Also, it is necessary to reduce the cost of capital or cheap loans.[13,14]

Manufacturing of solar cell process is a technology and capital intensive. As discussed above solar PV manufacturing involves polysilicon, wafer, cell and module assembly, most of the Indian companies are engaged in later processes of module assembly. In capital intensive processes of silicon and ingot production, India has no technological expertise. It is to step up its own research and development of cost-effective, indigenous, next-generation solar panel manufacturing technology. So now it is clear that ingot formation and wafer production comes in the semiconductor manufacturing industry. In semiconductors, Indian companies have no learning background when the solar industry began to grow from 2011. To develop this capacity for the future, state governments have to support the production of semiconductor as part of a determined industrial policy. According to experts, the human and technical learning curve could be of 5 to 10 year. Subsidies are needed to be provided by the government for the development of solar sector including land acquisition, raw material procurement, labour laws, tax and export policy. Therefore, to develop solar manufacturing facilities it would require high upfront costs. The cost of debt in India is 11% or highest in the Asia-Pacific region as compared to 5% in China. A huge opportunity has been opened under Atmanirbhar Bharat Abhiyaan for India's solar ambition. And it is the time for the government to implement the required reforms on the ground level.[15,16]

In today's world, energy demand is quite high in the industrial and domestic sectors. Non-renewable energy sources are getting exhausted rapidly, so, we have to go for renewable energy sources as far as possible. With the help of modern technology, it becomes possible to utilize natural resources like sunlight to generate energy. Solar panels function as a central power station converting sunlight into electrical energy that can be used for industrial, commercial, and residential purposes. Solar energy is one of the best resources to produce electricity in those areas where conventional power generation is either not possible or quite expensive. Solar power has brought a new era of power generation and accessibility to power in India. The ability of solar power to be produced easily and distributed widely has benefitted industrial and domestic sectors by meeting their energy needs. Solar power generation is done from a renewable source of energy. The power from the sun is utilized to produce energy which also reduces the use of non-renewable energy sources like fossil fuels. Solar energy does not release harmful gasses or require the burning of fossil fuels like oils and coals. The energy produced using solar cells can provide power without any need to depend on other sources of electricity. Solar power is a very affordable solution to produce energy. It is also a very convenient and effective means of generating electricity that can cater to the needs of rural areas. In the industrial sector, solar energy-based power generating systems have proven to be capable of meeting adequate energy requirements.[17,18]

People are thinking of non-conventional energy sources as thermal energy sources are getting exhausted day by day. India has taken some major steps toward the generation of solar energy to handle the growing energy demands in the country. Solar thermal power plants are coming up in different parts of the country to produce electricity like conventional power stations. India has emerged as one of the leading countries to utilize the benefits of a viable and environment-friendly option for energy production using solar power. Solar power has the capacity to meet the increased energy requirements of industrial, commercial, and domestic sectors. The transition from conventional energy resources to non-conventional solar energy will handle the issue of over-consumption of non-renewable energy resources. It is a renewable source available in abundance in India that should be utilized effectively to meet the growing energy demands in the country. [19,20]

III.RESULTS

Solar energy is considered a cost-effective solution for energy production. The initial installation cost may be a bit high, but once started working it can help save money in the long run. The solar panels used for converting sunlight to electric power usually have a lifespan of many years and maintenance is also easier. The future of solar energy in India looks very bright because of the number of ways in which solar power can be put to use. Today, we have solar-powered equipment and appliances that can function with the help of solar energy. This includes lights, fans, inverters, cables, power conditioning units, home appliances, solar road safety equipment, and street lights. The electric energy produced from solar power will be used to run electrical appliances without any dependency on the steady supply of electricity. Solar power can help reduce electricity consumption and the cost of electricity for domestic and industrial use. At present, there are some best solar projects in India and more are coming up. The state of Gujarat is in a leading position in solar power generation. The Indian government has made a plan to upgrade some of the Indian cities to solar cities where solar power production will be carried out extensively. The Jawaharlal Nehru National Solar Mission has the objective of establishing India as one of the leading solar energy producers.



Many states in India, like Maharashtra, Andhra Pradesh, Rajasthan, Madhya Pradesh, Punjab, and Haryana have been identified as having good potential to harness the solar energy for power generation, due to their strategic locations. Solar parks are planned to be set up to utilize solar power for electricity generation. The Ministry of Defense, Government of India has launched a scheme where solar power becomes compulsory for building areas covering more than 100 square meters. Such buildings will receive tax benefits to encourage promoting solar power.[21,22]

India has always faced a shortage of energy despite being one of the largest producers of electricity in the world. There will be an increase in electricity demands with the increasing population. There is a need for adequate capacity enhancement with alternative sources of energy. A major and very important step in this regard is the development of solar energy, which is inexhaustible and can be produced at a low marginal cost. It has the potential to increase energy capacity by utilizing a non-conventional and abundant power resource. Solar power is a good alternative to the conventional power supply. It also reduces the requirement for fossil fuels and minimizes environmental pollution. This ESG risk briefing focuses on India and its development towards renewable energy sources, especially solar photovoltaic (PV) systems. Energy demand in India is swiftly increasing alongside a growing population, urbanization and modernization. The country also has one of the largest economies in the world but only accounts for 6% of global energy use. The aim of this briefing is to showcase the high potential of solar energy in India, how solar energy can help develop and modernize the country but also to identify barriers, challenges and bottlenecks to be encountered while reaching the governmental solar goals. According to the World Health Organization's Urban Ambient Air Pollution Database, seven Indian cities rank in the top 30 for worst air quality. Emissions from the large number of thermal power plants contribute to the air pollution problem. Recent Greenpeace analysis points out significant negative impacts from the existing fleet of coal-fired power plants including approximately 76,000 premature deaths in 2017 in India due to exposure linked to particulate matter emissions. In India's current energy mix, thermal power (Oil, Gas and Coal) still adds up to 64% of the total energy capacity. Emissions-related health concerns are increasingly receiving the attention from governments all around the world, and especially in India. Actions to improve air quality and also increase the amount of renewable energy are being developed. For example, in only two years, a scheme developed by India's Ministry of Power has provided some 37 million women living below the poverty line with free Liquid Petroleum Gas connections to switch to clean household energy use. According to Ajay Mathur, Director General of the Indian Energy and Resources Institute, the installed generation capacity of coal-based power will peak later and should reduce to negligible levels later. Total Installed Power Capacity in India (as on 31.10.2018): 346.048 MW RES (Renewable Energy Sources) include Small Hydro Project, Biomass Gasifier, Biomass Power, Urban & Industrial Waste Power, Solar and Wind Energy.[23,24]

One initiative promoted by the Indian Government has been the development of solar parks. Solar parks are concentrated zones, dedicated only to the development of solar power projects. This step will encourage developers to set up more solar power projects in India. The Indian government plans to set up more than 25 solar parks in the next 5 years, each with an installed capacity of more than 500 MW. A report from Desert Power India further reinforces the need for centralized support for large scale solar development. This report showed that for medium and small scale projects, a high amount of capital investment is required in setting up supporting infrastructure like transmission lines, development of the site and other necessary amenities. Large scale systems therefore offer economies of scale to overcome such cost impediments. Even though India has ambitious plans to achieve their solar targets, the country still has to overcome many constraints faced by large solar developers for becoming a top solar power producing country. One alternative being explored for utility scale power plant is to use the water-surface area on canals, lakes or reservoir for large solar-power plants. These water bodies can also provide water to clean the solar panels and also help saving water from evaporation, which effectively addresses two infrastructure needs with a single solution.[25]

So far, India is producing less than 10% of the energy it could potentially generate using wind or solar resources. But capacity is expanding. According to Bloomberg's New Energy Outlook 2018, falling costs make renewables increasingly competitive with fossil fuels, with new solar and wind now 20% cheaper than the average wholesale price for existing coal-fired power. The transition away from fossil fuels is supported by government targets as well as changing markets. The country's plan to become one of the largest solar power markets in the world has received a massive boost as the latest estimates of its solar power potential show. The National Institute of Solar Energy in India has determined the country's solar power potential capacity at about 750 GW. For this estimation, it is assumed that 3% of the available land which is neither fit for any agricultural purpose nor for residential purpose (i.e., it is "wasteland") is used for future solar power projects. According to the National Remote Sensing



Centre, there are around 47Mn hectares of wasteland available in India. Another benefit of constructing a utility scale power plant in India is, that the effect of external costs (e.g., pollution, installation time, water consumption, fuel supply risk) is minimized compared to conventional power sources. One of the most important factors influencing solar power establishment is the availability of solar radiation. The geographical location of India is beneficial for generating solar energy. There is solar radiation almost throughout the entire year and nearly all parts of India receive more than 4 kWh of solar radiation per square meter which adds up to 3000 hours of sunshine per year. Approximately 3.2 hectares of land are required for each MW of installed solar generation capacity. Therefore India is an ideal country for development and installation of utility scale power plants because of the availability of potentially exploitable resource. This makes India the third most attractive renewable energy market in the world alongside China and the USA.[26]

IV.CONCLUSIONS

Four broad barriers to solar development in India have been identified:

1. A general lack of R&D and modern manufacturing facilities for setting up a large scale solar power plant has been identified. India has tried, over the last few years to overcome these bottlenecks but other problems such as lack of local awareness and familiarity among financiers (which can hinder financial support), a lack of long term policy clarity and poor product quality have been identified as potentially undermining the effort. Facilities in India have not reached the production capacity of other states such as Germany or China. Hence, India depends on foreign suppliers and foreign solar market to meet the solar PV requirements.
2. Solar projects require a high investment at the beginning and have longer payback periods, largely due to the high cost of debt identified in India for such projects. This issue raises the cost of renewable energy in India by more than 25% compared to similar projects financed in Europe or the USA.
3. Transparency and accountability are also barriers to overcome. In 2018, India was ranked 78th in the Transparency International's Corruption Perceptions Index. As stated in an article from Renewable and Sustainable Energy Reviews, about 28% of developers said that they were forced directly or indirectly to pay bribe during the process. The article also states that 70% of the solar power developers think that it's difficult to do business in India as compared to many other countries and they will give less priority for investment in India. According to them 60% of the total duration of the solar project is used in taking approvals, grants, inspection, and land acquisition. As reported by the World Bank, India ranked 130th in ease of doing business index among 185 countries. Thus, there is a very big scope of improvement in order to provide a conducive environment for large scale solar power developers.[24]
4. Various infrastructure-related issues can arise in the Indian context. The land acquisition process in India is very complex and therefore it can take considerable time to acquire the land needed for a project. In many cases, the allotted land might not be very well connected with roads or railways and therefore transportation of solar PV panels is very difficult. Panels have reportedly been broken in transportation, or suffered delays and damage from exposure to the natural elements.

Transmission and distribution losses are another major infrastructural barrier for a centralized large-scale solar utility sector. However, such limitations also apply to large scale centralized generation from traditional sources. This "barrier" might in fact serve as an incentive for small scale solar proliferation. Solar energy is still considered an emerging technology in the Indian context and there are some barriers for insurance providers in particular to overcome. When it comes to barriers in terms of insurance business, a report from the National Renewable Energy Laboratory (NREL) shows the main challenges insurers have to overcome to successfully gain stakes in the renewable energy industry. The report highlights the follows:

"The fledgling nature of the renewable energy industry makes obtaining affordable insurance challenging. These challenges include insurers' unfamiliarity with PV technologies, a lack of historical loss data (i.e., insurance claims), and limited test data for the long-term viability of PV products under real-life conditions. The lack of information and insight about the solar PV industry contributes to perceived risk associated with the technology and installation techniques among insurance underwriters and brokers, which leads to higher premiums than would likely prevail in a more mature market." [26]



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