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# Solar Energy- A Power For The Future

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**ABSTRACT:** A healthy economy and a healthy environment are essential for sustainable growth. The consequences of our pursuit of economic expansion at the expense of the environment have proven irreparable. The future of our species is in jeopardy due to global warming and rising pollution levels. There is a new normal regarding climate change and natural disasters. Now is the moment to take action before the situation worsens and threatens our future. While essential to economic development, electricity generation has severe ecological consequences. Conventional energy sources, such as fossil fuels, are not economically or ecologically viable.

Additionally, the availability of fossil fuels is decreasing rapidly. The bright side is that renewable energy is a practical option. Solar energy solves these problems; we can make the world considerably greener without compromising economic growth. India has set a lofty goal of 175 GW of renewable energy by 2022. More than 55 percent, or 100 GW, is expected to come from solar power. Out of the 100 GW, 60 GW will go to utility-scale projects, and the remaining 40 GW will be used for rooftop installations. Commercially viable, simple to install, and to boast low cost of operation and maintenance, solar has quickly become the dominant renewable energy source. Modular solar panels, inverters, and other solar energy infrastructure products are in high demand in India due to the country's expanding solar market. Imports from China, Vietnam, Europe, etc., have become extremely important. The increased production of goods in India will favor the economy and help us become less reliant on foreign goods. To keep up with demand, the manufacturing sector will need the help of educated and experienced workers. The solar energy industry in India boosted employment by 1,15,000 in 2018 and is expected to continue growing in the coming years, reports the International Renewable Energy Agency (IRENA).

Now is the time to take action and make a difference in the quest for sustainable living. Breakeven for final consumers can be achieved in as little as two to five years, and the annuity savings of as much as twenty-five percent (25%) remain for the project's lifetime. In addition, every megawatt of solar adopted saves 31,000 tonnes of CO<sub>2</sub> during the project's lifetime, which is about equal to planting 49,000 teak wood trees. India's economy has tremendous potential for expansion, and as a result, the country's electrical needs will increase. The commercial and industrial use in India and the personal usage in that country's more than 20 crore households amount to a trillion-dollar opportunity. To increase solar energy's widespread use, the solar industry and its supporting institutions must concentrate on several fronts: promoting public understanding, providing customers with access to affordable financing, and developing innovative new solar products. There are many situations where problems can be turned into opportunities by adopting solar energy. This would stimulate the economy, support India's "Make in India" initiative, and generate employment opportunities while reducing environmental impact.

**KEYWORDS:** Solar Energy, Economic, India, Environment, Green, Plantation

## I. INTRODUCTION

India is rapidly transitioning toward a cleaner energy mix to meet the needs of its growing middle class. As of August this year, it ranks third in electricity generation and fourth in electricity consumption worldwide. Given the current state of the planet and the unpredictability of future energy prices, making the switch to solar power is a monumental decision. There are indications that the government's strong backing and extensive investment are beginning to bear fruit. Costs for renewables are dropping, making them a more attractive option. The average wholesale price of existing coal-fired power is 20% higher than that of new solar and wind-backed energy sources. Policies and shifting markets both encourage a move away from fossil fuels. Going solar is a huge step for an economy that relies heavily on coal for 60 percent of its energy mix. Government leaders have shown strong support for this effort. An aggressive goal for renewables has been set under Prime Minister Narendra Modi's energy agenda[1,2], with the aim to increase renewable capacity on the grid from around 57GW in May 2017 to 175GW by the end of the year. India has completed solar installation projects totaling 23 GW, with another 40 GW in various stages of bidding and installation. Since the proportion of renewable energy in India's total energy production is rapidly growing, a shift toward this type of energy is inevitable. As the third-largest solar power market in the world, India has already surpassed the United States and is



projected to grow exponentially in the coming years. India has a massive amount of untapped potential for solar power. Most of the country's territory lies in a spot where it will get the most sunlight.

The World Bank has even recognized India as the country best suited to take advantage of solar power. Largely, growth is fueled by substantial financing from commercial and multinational investment banks. In 2017, the European Investment Bank (EIB) and India's YES Bank announced a partnership, with each party allocating \$200 million in loans to support financing for solar and wind projects in India. The World Bank has also pledged \$1 billion in lending for FY17, its largest-ever support for solar energy in any country. It also backs the International Solar Alliance, an organization that came together in the wake of the 2015 Paris Climate Conference. This may prove to be a pivotal financing enabler for the Indian solar industry in the future. Data from the Department for Promotion of Industry and Internal Trade (DPIIT) show that Indian non-conventional energy received US\$7.48 billion in foreign direct investment (FDI) between April 2000 and December 2018. As a result, demand for large-scale solar parks continues to rise rapidly, prompting the government to double the solar park capacity.

New positions are continually being created in the solar industry through its three main phases of operation: installation, operation, and maintenance. Investments at home and abroad could boost the economy and create new jobs. Manufacturing experts, project managers, installers, maintenance technicians, builders, turbine installers, shippers, and logistics planners are all positions that would need to be filled to get the wind energy industry up and running. There will be a need for construction workers as local governments construct factories to perform support functions. Indicators of economic health primarily drive this expansion. Sustainable development is essential to successful companies' viability, productivity, and investment returns today. Solar and wind energy products have also become more affordable as their costs have decreased. Developing the Indian solar industry is crucial to shaping the future of renewable energy in a significant way and reducing the costs of solar development in a substantial way as domestic manufacturers struggle to compete with Chinese firms.

India's solar industry's future hinges on how to best invest in domestic capacity and technology development in the coming years. [5,6] This is especially true for cost-conscious, small-scale solar panel installations on rooftops. India is still a good place for the solar sector, and with all the new solar technology and projects being developed, the country may be able to speed its way to meeting its international climate change objective as well. [7,8]

## II. DISCUSSION

Solar energy generation in India has enormous potential. This tropical nation boasts about 300 bright, sunny days per year. In several ways, improvements in the solar industry can aid India's efforts to become self-sufficient, or Atmanirbharta. As a result, new jobs will be made available.

- It will lead to the growth of rural areas.
- On the other side, the costs are related to gasoline imports will go down, which is a positive development.
- Additionally, it will lessen the reliance on nations that are major oil producers.
- Increasing the rate at which electricity-producing units are being installed.
- Additionally, it will help keep the environment clean and improve people's overall quality of life. [9,10]

It is possible for the solar power sector to generate employment for a wide range of workers, such as skilled, semi-skilled, and unskilled workers, by manufacturing solar equipment, building solar power plants, and installing rooftop solar panels. In India's rural areas, the demand for installing solar panels on rooftops would give rise to new business opportunities and employment opportunities. In rural areas of India, power availability would encourage the growth of cottages and other types of small-scale industries. In addition, the disparity in income between urban and rural India will be reduced. On the other hand, it takes about 18 months to build a solar plant with a capacity of 500 megawatts (MW), whereas making a thermal or hydroelectric plant could take anywhere from two to three times as long. The construction and financing costs for a new solar plant are 14% lower than for a thermal or hydroelectric plant. This is the key takeaway from this section. China is a major source of solar power in India, a fact that cannot be denied.

India has the potential to produce solar cells at roughly 3 gigawatts per year, but the country's average annual demand for solar power is 20 gigawatts. India has an aggressive goal of increasing its use of solar energy. Seven of the top 10 module suppliers in India come from China. These organizations are located in China. During the preceding five years, India has already procured solar equipment at a value of almost \$16 billion. As a result, it should come as no surprise that India requires a plan to manufacture solar panels. There are four stages involved in the manufacturing of solar equipment:

- Production of semiconductor ingots.
- Production of semiconductor wafers from ingots.



- Manufacturing of photovoltaic cells from semiconductor wafers.
- Assembling photovoltaic cells to manufacture solar panels.[11,12]

India is not producing enough of these semiconductors, which is a problem. Also, for India to become self-sufficient in producing solar equipment, the country requires a plan and a new solar sector development policy. This policy should be centered on the following three issues:

- Establishing semiconductor manufacturing as a core competency.
- The government requires a fair policy to subsidize the solar manufacturing sector.
- Moreover, cheap loans or low capital costs need to be reduced. [13,14]

Solar cell production requires a significant investment of time and money due to the complexity of the manufacturing process. Most Indian firms are involved in the module assembly stage of the solar PV manufacturing process, which requires polysilicon, wafer, cell, and module assembly, as stated above. India lacks the requisite technological know-how for the capital-intensive silicon and ingot production processes. It plans to increase investment in R&D for the next generation's domestic, low-cost solar panel manufacturing technology. Consequently, we can see that the semiconductor business requires ingot formation and wafer production. When the solar industry began to boom in 2011, Indian semiconductor manufacturers were caught without a learning curve. As part of a focused industrial policy, state governments should encourage semiconductor production to help build up this capacity. Experts estimate a 5- to 10-year learning curve for humans and technology. Land acquisition, labour laws, tax raw material procurement, and export policy subsidies are all areas where the solar industry could benefit from government support. Therefore, a substantial initial investment is required to establish a solar manufacturing infrastructure. Compare that to China, where the cost of borrowing money is only 5%, and you can see why India has the highest interest rate on debt in the Asia-Pacific region at 11%. Under Atmanirbhar Bharat Abhiyaan, India's solar ambitions have been considerably boosted. It is time for the government to implement the necessary reforms at the grassroots level. [15,16]

Industrial and residential energy use are both very high in the modern world. Renewable energy sources should be prioritized over their nonrenewable counterparts because of their diminishing availability. Technology has made it feasible to harness renewable sources of energy like sunshine. Solar panels act as a centralized power plant, turning solar radiation into electricity that may be used for various commercial, industrial, and domestic needs. Solar energy is one of the finest alternatives for generating electricity in places where building a traditional power grid is either not feasible or prohibitively expensive. Power generation and availability have entered a new era thanks to solar energy.

Solar power's easiness of production and widespread distribution has helped industries and households satisfy their energy needs. Producing electricity from the sun uses a sustainable method. By harnessing the sun's energy, we can produce electricity while simultaneously decreasing our reliance on fossil fuels and other nonrenewable resources. Solar power doesn't use the combustion of dirty fossil fuels like oil or coal to generate electricity. Solar cells can be used to create enough energy to meet electrical demands entirely independently of the grid. Producing energy using solar panels is a cheap and efficient option. It's also an easy and efficient way to generate electricity, making it suitable for use in remote places. Solar-powered electricity generation systems have been demonstrated to be effective in the commercial and industrial sectors. [17,18]

People are considering alternative energy options as conventional thermal energy sources are gradually depleting. India has made significant progress toward producing solar energy to meet the country's expanding energy needs. New solar thermal power plants are being built across the country to supplement existing power grids. India is one of the world's forerunners in harnessing solar power, a clean and reliable energy source. Solar energy has the potential to supply all of the world's rising energy needs, including those of the industrial, commercial, and residential sectors. We can solve the problem of excessive use of nonrenewable energy sources by shifting away from traditional energy sources and toward solar power. An abundant renewable resource, it could help India keep up with its rising energy needs. [19,20]

### III. RESULTS

Solar power is viewed as an economically viable option for generating electricity. Although it may be expensive to set up initially, once it's up and running, it might help save costs over time. Sunlight-to-electricity conversion



solar panels typically last for decades and are simple to maintain. Given the versatility of solar electricity, it's easy to see why solar energy has such a bright future in India. Modern appliances and gadgets can now be run entirely on solar power. Everything from household appliances to solar-powered traffic signals and streetlights falls under this category. Solar energy will be used to power electronics independently of the grid. Solar energy can potentially lessen the burden on the environment and the wallet by cutting down on both residential and commercial electricity use. India is home to some of the world's best solar projects, and even more, are in the works. Gujarat is in the vanguard when it comes to producing electricity from the sun. The government of India has devised a plan to convert several Indian cities into "solar cities," where solar energy will be the primary source of electricity. The Jawaharlal Nehru National Solar Mission aims to make India a global leader in the solar energy industry. There is great potential for harnessing solar energy for power generation in many Indian states, including Maharashtra, Madhya Pradesh, Rajasthan, Punjab, Andhra Pradesh, and Haryana, due to their advantageous geographical positions.

Electricity can be generated from the sun, so solar parks are planned to be built. When a building's floor space exceeds 100 square meters, the Indian government's Ministry of Defense has implemented a scheme making solar power mandatory. Incentives in the form of tax breaks will be offered to structures that instal solar panels. [21,22]

While it is one of the world's leading electricity producers, India has historically suffered from chronic energy shortages. Since more people means more need for electricity, capacity must be adequately increased using renewable energy sources. The advent of solar energy, which is both limitless and cheap to produce, is a huge step in the right direction. By tapping into an alternative and plentiful supply of power, it may be possible to expand current energy production. Solar energy is a viable option to reduce our reliance on fossil fuels. It also lessens environmental damage by cutting down on the use of fossil fuels. India's progress in adopting renewable energy technologies, particularly solar photovoltaic (PV) systems, is the primary emphasis of this ESG risk briefing. Along with rapid population growth, urbanization, and modernization, India's energy needs are rising quickly. This country boasts one of the world's largest economies but uses only 6% of the world's energy. This briefing aims to highlight the vast potential of solar energy in India, how solar energy may aid in the country's modernization and development, and the obstacles that will need to be overcome to achieve the government's solar ambitions. According to the World Health Organization's Urban Ambient Air Pollution Database, seven Indian cities have the worst air quality. Air pollution is exacerbated by the proliferation of thermal power plants, which release harmful environmental emissions. Greenpeace's recent research shows that the current fleet of coal-fired power plants has serious adverse effects, such as the early deaths of 76,000 people in India in 2017 due to exposure associated with particulate matter pollution.

Currently, 64% of India's energy capacity comes from thermal power (Oil, Gas, and Coal). Governments worldwide, and in India in particular, are starting to pay attention to emissions-related health risks. Efforts are being made to both boost the use of renewable energy and enhance the quality of the air we breathe. So, in just two years, the Indian Ministry of Power implemented a programme that gave 37 million low-income women access to clean-burning Liquid Petroleum Gas at no cost to them. Director General of the Indian Energy and Resources Institute Ajay Mathur predicts that coal-based power generation capacity will peak later and should decrease to negligible levels in the future. As of October 31, 2018, India had a total installed power capacity of 346.048 MW from RES (Renewable Energy Sources), such solar and wind power, as well as smaller hydroelectric and biomass gasification and power plants. [23,24]

The Indian government has actively supported the creation of solar park complexes. A solar park is a specially designated area where solar energy projects can be built in isolation from any other kind of energy generation. Taking this action will inspire more builders to launch solar energy projects across India. More than 25 solar parks, each having an installed capacity of over 500 MW, are scheduled for construction by the Indian government during the next five years. One more piece of evidence that large-scale solar production needs government backing comes from Desert Power India. The analysis highlighted the need for the substantial initial investment in medium and small-scale projects to establish critical facilities, including transmission lines, site development, and other necessities. Therefore, economies of scale provided by large-scale systems allow for surmounting such financial hurdles. India is committed to becoming a leading solar power producer, but this goal has several obstacles, including those experienced by large solar companies. Using the water's



surface on canals, lakes, or reservoirs for huge solar-power plants is one option being considered for utility-scale power plants. Two infrastructure issues can be solved with one solution if these bodies of water are used to clean solar panels and to prevent water from evaporating. [25]

Less than ten percent of India's potential energy output comes from renewable sources like wind and solar. But we see an increase in production capacity. According to Bloomberg's New Energy Outlook 2018, the average wholesale price for existing coal-fired power is 20% more expensive than the cost of new solar and wind generation combined. Government goals and evolving markets contribute to pushing away fossil fuels. The most recent estimations of the country's solar power potential have given the country a massive boost in its goal to become one of the world's major solar power markets. India's National Institute of Solar Energy estimates the country's solar power potential at 750 GW. This estimate is based on the utilization of 3 percent of currently available land that is unsuitable for either agricultural or residential use (i.e., "wasteland"). The National Remote Sensing Center estimates that India has approximately 47 million hectares of unused land. Compared to traditional power sources, the external expenses associated with building a utility-scale power plant in India are reduced. These include pollution, installation time, water use, and fuel supply risk. The amount of available sunlight is a significant consideration for the spread of solar energy. India is ideally situated to harness solar power due to its latitude, longitude, and altitude. The sun constantly shines throughout the year, and nearly everywhere in India receives more than 4 kWh of solar energy per square meter, or 3,000 hours of sunshine annually. Each megawatt of solar power capacity requires about 3.2 acres of land. Because of this potentially exploitable resource, India is an excellent location for constructing large-scale utility-scale power plants. India is now the world's third most promising market for renewable energy, behind only China and the United States. [26]

#### IV. CONCLUSIONS

Four major factors have hampered the expansion of solar energy in India :

1. Research and development are deficient, as well as in cutting-edge manufacturing facilities that make it challenging to build a solar power plant on a large scale. Despite India's efforts in recent years to address these issues, other challenges have been identified as threats to its success, including a lack of local knowledge and familiarity among financiers (which can hinder financial support), a lack of long-term policy clarity, and poor product quality. Infrastructure in India has not yet caught up to the production levels of other countries like Germany or China. As a result, India must rely on international solar PV markets and providers. The high cost of debt in India makes solar projects expensive at the beginning and require longer payback periods. Compared to similar projects financed in Europe or the US, this issue raises the cost of renewable energy in India by more than 25%.
2. Two more challenges are openness and responsibility. According to Transparency International's 2018 Corruption Perceptions Index, India is the 78th most corrupt country in the world. According to a Renewable and Sustainable Energy Reviews report, over 28% of developers reported being bribed in some way during the development process. According to the article, a whopping 70% of solar power producers said they wouldn't prioritize investing in India because of how tough it is to do business there compared to many other countries. They estimate that acquiring necessary permits, grants, inspections, and land takes up to 60% of the time needed to complete a solar installation. According to the World Bank, out of 185 nations, India ranks 130th for how easy it is to start a business there. Therefore, there is a sizable amount of room for development to make the environment more favourable for solar power providers working on a grand scale. [24]
3. The Indian context can give birth to several infrastructure-related challenges. Project delays may occur due to the time it takes to complete India's lengthy and complicated land acquisition procedure. Transportation of solar PV panels is challenging since the authorized land is not always conveniently located near roads or railroads.

Transmission and distribution losses are another key infrastructural impediment for a centralized large-scale solar utility business. However, these constraints are not unique to large-scale, centralized generation from conventional sources. This "barrier" could be a boon to the spread of solar energy on a local level. In the Indian setting, solar power is still in its infancy, thus, there are challenges to overcome, especially from the perspective of insurance companies. A paper from the National Renewable Energy Laboratory (NREL) details the primary



obstacles insurers face when expanding their presence in the renewable energy sector. Some highlights from the report are as follows:

Because of the industry's infancy, renewable energy companies have a hard time finding appropriate insurance. Insurers' lack of expertise with PV technology, a shortage of loss history data (in the form of insurance claims), and a scarcity of durability tests for PV devices in real-world situations all contribute to these difficulties. Insurance underwriters and brokers' lack of familiarity with the solar PV business contributes to the perception of greater risk associated with the technology and installation methods, resulting in higher rates than would likely prevail in a more developed market. [26]

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