iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.35197

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

Solar Photovoltaic System in India: Challenges and Barriers

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Abstract: ***In today's world we are going towards the major share of renewable energy to reduce the effect Green House Gases (GHG) in the atmosphere. The limitation of energy sources which produces clean energy, the rise in the pollution in the environment, and programs initiated by the Indian Government have encouraged lots of open field researches on Solar Photovoltaic Systems or Solar Energy Systems. As producing the clean and renewable energy is main component of energy sector, solar photovoltaic could be considered as an alternative in various regions. Although Solar Photovoltaic does have different advantages and can be used for various purposes, but also there are several challenges for it. This paper took a whole overview of the advantages and uses of Solar Photovoltaic and barriers in their adaptation/opportunities.***

Keywords: Solar Photovoltaic, Energy Sources, Solar Energy System, Adaptation /opportunities of Solar Photovoltaic

I. INTRODUCTION

The various energy producing sectors and equipment such as thermal power plants, Hydro Power plants, etc. are not only encouraging pollution but also affecting the biodiversity, resulting in climate change due to the Green House Gases (GHG), whereas the energy produced by the Solar Photovoltaics t seems to be a very promising step towards urban sustainability. The GOI has announced its different policies and programs such as National Solar Mission [1] which will promote solar power to achieve the 100GW target by then of year 2022.

They also have established the schemes in 2014 like Solar Parks and UMSPP which was revised to 34 Solar Parks across 21 states in 2016 of country with each of the power project having minimum 500 MW capacity [2].

In November 2020 the installed capacity was 36.9 GW in India, Currently, the total installed solar parks were 42 in India letting them to provide the land for solar power plant promoters [3]. Apart from all these government has also planned to generate the solar power from installing the rooftops Solar PV systems the MNRE has introduced advisory for Rooftop Solar scheme. Which includes the generation of electricity by installing solar panels on the rooftops of houses, institutions, industrials, and commercial establishments. This will promote the grid connected solar photovoltaic systems on small solar photovoltaic system in which the DC power generated from panel will be converted in AC power. Diminishing the fuel-based generation of electricity and providing eco-friendly power generation for longer time. MNRE, Government of India will also provide subsidy which will include the subsidy of 40% for starting 3kW and 20% for rest beyond 3kW and up to 10kW [4]. Even though with all these initiatives since last few years the growth of the Solar PV systems is still lagging in India because of many factors such as Geographical barriers, Market barriers, Financial barriers, Technical barriers socio-community barriers. Such majority of factors are affecting the growth of Solar Photovoltaic systems which will be explained further.

II. BARRIERS IN SOLAR PV ADAPTATION IN INDIA

The major barriers to the Solar Photovoltaic system adaption in India include the Geographical factors, Market barriers, Financial and economic barriers, Lack of awareness & Lack of manufacturers.

A. Geographical Barriers

India shows varying geographical conditions and natural conditions which is the major barriers in harnessing solar energy. Like in the areas where there are irregularities in incidence of solar energy on surface will affect the performance of the solar panels.

Likewise, temperature will also be affecting the harnessing of solar energy in some the regions. Also, improper mechanism to manage the waste produced by solar panels manufacturing industries which are hazardous in nature. The proper recycling of e-waste is one the challenge in managing the production of solar PV cells. The proper land availability, non-hazardous resources for manufacturing need to be focused more. The land resources should be compromises by the different states for the major production.

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B. Market Barriers

The initial cost of investment is usually high, which makes it non-affordable for the customers. There is always high production cost for renewable energy systems like solar energy when compared to conventional energy sources. Thus, resulting in high and unfair competition to the fossil fuel market whose costs can be easily subsidised. The dependency of manufacturers over the export markets which comprises of high-end prices and prioritization on export demand reducing the supplies in rapidly growing local market. Also, involvement of different agencies for subsidy structure making difficult to start Solar PV projects.

C. Economical Barriers

High initial cost of investment is making it low engaging technology amongst the producers/Consumers thus holding them to invest in Solar PV technologies. Studies over the period of time shows that investment varies in the developing countries due to the variety of factors, these factors are making it difficult to adapt solar PV systems in various regions of the country, Implementation of various tax exemptions on solar PV technologies, tax is still considered as wall between Low cost plant in some areas, factors like cost of PV panels, battery sizing, peak ratings of load, power factor required etc. [5] are considered during economics of power generation through solar PV panels. All these factors are borne by the consumer which makes the installation of technology much costly and discouraging them over use of such technology

D. Lack of Awareness and Lack of PV Manufactures

Lack of awareness about the solar PV technology is coming out to be major hurdle for the acceptance of technology among the consumers in different areas. Also lack of guidance which will promote the solar industry among the people. Low availability of land area for the installation of solar panels for the major projects.

Manufacturing the solar cells is consist of challenger like huge investment in infrastructure cost associated with it, due to complexity in manufacturing it requires such a huge investment in it. Manufacturing cost is consisting of land and infrastructure cost which is huge investment. If, manufacturers decide to invest in it there is no guarantee of demand as government changes it policies too often within a period of

Considering all the above facts the key barrier to the Solar PV adaptation in India includes Market barriers, Lack of awareness/Lack of Manufacturers, these factors are related to Solar PV infrastructure.

III. SOLAR PV INFRASTRUCTURE IN INDIA

From recent developments in renewable energy systems have shown that what they are capable of and why are they considered as important for the growth of country. Infrastructure of Solar PV systems in India has been facing lots of challenges and thus it's been creating barriers and hurdling the growth of technology in Indian market. Thus, Government of India had initiated various plans and policies to promote the technology among the consumers. Major programs and schemes that are implemented throughout recent years included of; National Solar Mission, Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan (PM-KUSUM), Off-Grid Solar PV Application Programme Phase III, Atal Jyoti Yojana II, Rooftop Solar Programme phase II, Solar Parks Schemes, Public Sectors Undertaking (CPSU) schemes [6]. But implementation of such schemes also has introduced challenges on Solar industry which can hurdle its growth some of the challenges we have included in our research work will be discussed later in this section. Now we will talk about our different infrastructure policies initiated by MNRE, Government of India.

A. National Solar Mission

National Solar Mission was started in year 2010 with the target of achieving 20GW by the year 2022. But the target was achieved four years before the actual time. Later, in year 2015 the target was revised to 100GW up to year 2022. The objective of the mission was to establish India as a global leader in solar energy. the various programs and schemes were introduced under this plan. Which are as follows:

1) *Pradhan Mantri Kisan Urja Suraksha Evam Utthan Mahabhiyan:* This scheme was launched by MNRE in order to support the installation of off-grid solar pumps in rural areas. Cabinet Committee of Economic Affairs (CCEA) in year 2019 approved the schemes with the objective of providing financial and water security. This scheme was favoring the DISCOMS, Farmers, States and Environment. But, there are some concerns regarding this schemes like domestic availability of equipment's for the installation of plants, Ignoring the small farmers as they have pumps of lower than 3 HP capacity which is making it difficult to avail them the solar pumps .Depleting of water table in land can be more worse as they have to upgrade to higher capacities pumps which requires installation of more solar panel thus making it more expensive

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2) *Off-Grid Solar PV Application Phase III:* This programme was for establishing the solar PV applications such as solar street light, solar study lamps etc. it was extended in the north-eastern states of Indian in later 2020. In October 2020 there was around 30 thousand street light and around 2 lakhs solar study lamps were distributed among the states.
3) *Atal Jyoti Yojana II:* This scheme was initiated in the year 2016, focusing on the installation of solar streets light in the states covering the 50% households which are covered with the grid power. Around 1.5 lakhs of solar street lightning were proposed under this scheme in March 2020 and around 80 thousand lights were installed in around October 2020.
4) *Rooftop Solar Programme Phase II:* The aim of this scheme was to generate the solar power by installing the solar panels on the roof of houses, institutions, industrial areas buildings. The target was to achieve 40,000 MW from rooftop solar projects by the end of year 2022.In this system the solar PV generated DC power is converted into AC power using power conditioning unit and fed to the grid. The objectives of this programme was to promote the grid connected Solar PV system to the residential, Institutional, Commercial establishments. It encourages the people to environmentally friendly electricity generation and diminishing the conventional fuel-based electricity generation at different parts in country. This scheme also allowed to supply solar power through rooftops and smaller plant to the grid. This scheme was already implemented in state by the distribution companies (DISCOM)This scheme is expected to be a boost for the adding of solar cell and manufacturing in India.
5) *Solar Park Schemes:* To facilitates the large-scale grid connected solar power projects this scheme was introduced in the year 2014 with the target of 20 GW capacity which was increased in Jan 2018 to 40 GW capacity at the end of 2022. INR 2 million per MW, or 30 percent of projects including grid-connectivity cost etc. additional amount INR 2.5 million per plant was allotted to prepare the Detailed Project Reports [6].
6) *Public Sector Undertaking (CPSU) Scheme:* In March 2019 the Government of India approved around 85 billion for the second phase of CPSU scheme. This scheme was for setting the 12 GW Grid-connected solar PV projects by PSUs with domestic cells and module which is under implementation. Viability gap funding is supported in this scheme for self-use or by the government through distributing companies or directly. This scheme will also create the demand for domestically made solar cells or modules and promote domestic manufacturing of technology in country.

B. Challenges in Solar PV Technology

With the innovations in fast forwarding Solar PV technology there are still few challenges that country is facing at present. Some of the challenges are shortly discussed below:

1) *Waste Management:* As manufacturing of sola cells/modules consist various toxic and hazardous materials they are affecting the environment as the proper need of recycling or re-use has to be taken in consideration. The solar waste produce by manufacturers is estimated to 1.8 million tonnes by 2050.
2) *Dependency:* Being top producer of solar energy as being a developing country manufactures are still dependent on export modules technology. With the Implementation of ‘Aatmanirbhar Bharat’ and ‘Make in India’ schemes this challenge will be sort out quickly in upcoming years
3) *Low Tariffs and Policies:* Low tariffs in India can lead to unsustainable and compromise in the solar cell/module quality production by manufacturers.
4) *Conversion Efficiency:* Low efficiency of solar PV cells/modules caused by different factors like improper radiation, dust accumulation which reduces the area for solar radiation absorption. Regular maintenance of solar cells/modules can be used to overcome this problem.
5) *Funding:* Funding for the installation of Solar PV technology is the major problem amongst the small-scale users. High initial cost for installation makes it difficult for them to adapt this technology. Flexible loan schemes by government can make it possible to use solar panels also removing duties over the imports of panels leads to the reduction in high capital cost of Solar PV plants.
6) *Rooftop Generation Policies:* Land unavailability is also considered as the challenge for the production of solar energy over a period of time. The proper awareness programs among the residential, commercial and providing them proper information about the factors regarding rooftop generation like maintenance, availability etc. It will also promote the low transmission cost as power can be used directly in households.

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ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

IV. CONCLUSION

The major barriers to the adaptation of Solar PV's in India are Geographical barriers, Market barriers, Economical barriers and lack of awareness & lack of EV manufactures. The Geographical barriers can be solved by states providing helping hand to each other in land availability and material availability required for manufacturing quality Solar cells. The Market barriers can be overcome by availability of flexible loans and schemes for installation of Solar panels at different levels also, relaxation in import taxes on solar PV systems which can minimize the High initial cost. Economical barriers will be relaxed by installing rooftops solar panels as it reduces the cost of transmission. Initiation of awareness programs regarding renewable energy at ground levels can help to overcome awareness and manufacturing problems. The opening of solar parks in different region by Government of India, Programs like 'Make in India' and 'Aatmanirbhar Bharat' will be helping to make country self-reliable and to achieve the target of 100GW solar energy at the end of 2022. All these steps taken will improves the reliability of people on renewable energy resources and moving from convention fossil fuel methods to produce energy. Also, it will support clean and green energy to the environment making the country global energy market leader.

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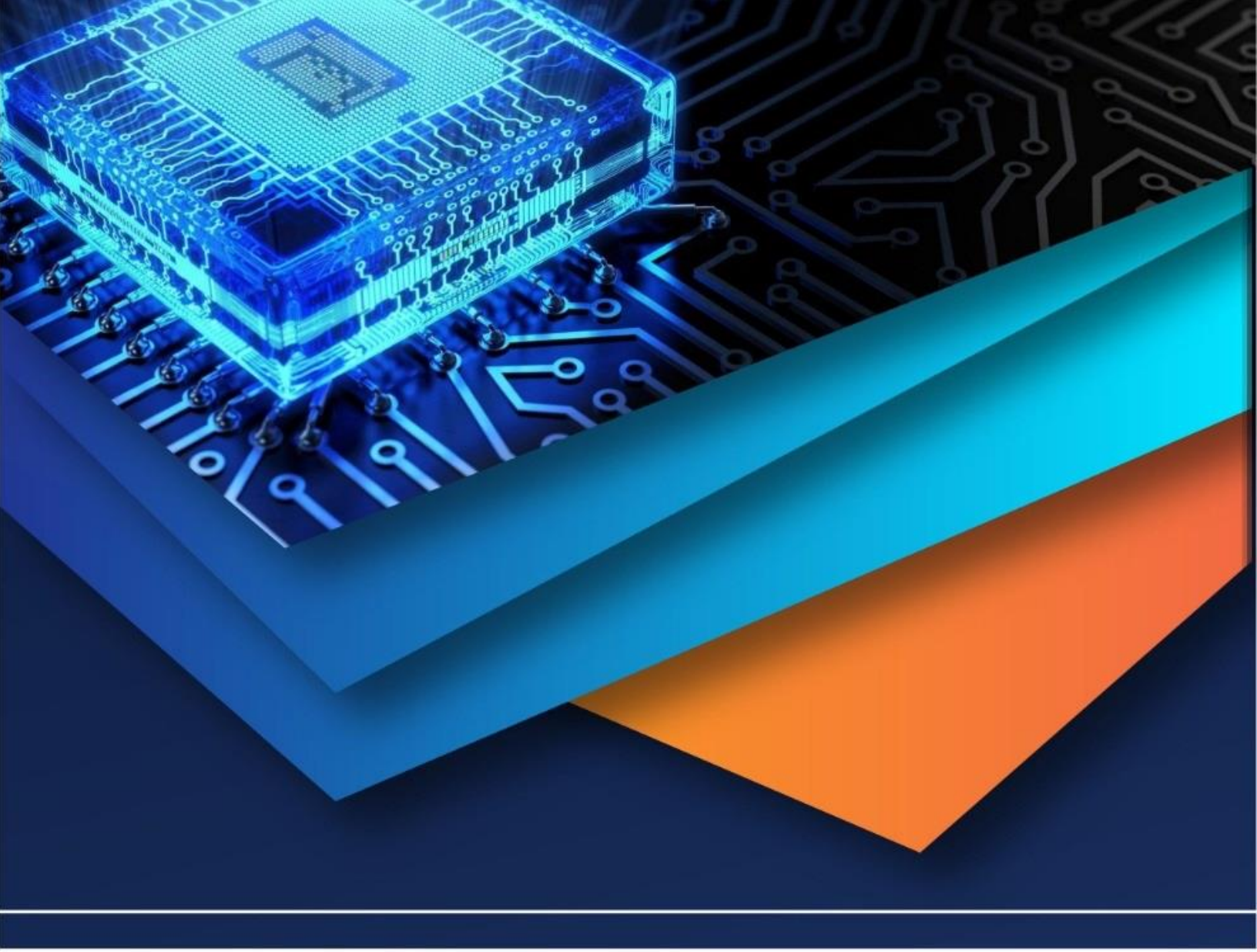

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