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ORIGINAL ARTICLE

Concepts of Solar Power: Status in India with Special Reference to Assam

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ABSTRACT

India is a tropical country, where sunshine is available for longer hours per day and in great intensity. Solar energy, therefore, has great potential as future energy source with the added benefit of permitting the decentralized distribution of energy, thereby empowering people at the grassroots level. The objective of the National Solar Mission is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. The immediate aim of the Mission is to focus on setting up an enabling environment for solar technology penetration in the country both at a centralized and decentralized level. North East India which is often the most neglected area within the country in implementation of various development plans has witnessed a rapid development in the field of solar power. In Assam, Assam Power Development Agency has played a significant role for completion of several projects and also the ongoing project which has resulted in rural electrification thus assisting the local inhabitants in their daily life.

Keywords: *Solar Power, future Energy, Grassroots Level*

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INTRODUCTION

As per countries and dependancy by population India ranks second in the list accounting for 17.6% of the world's population. But in terms of the socio-economical condition India is still lacking behind to find any suitable ranking. India is the fourth largest energy consumer in the world and ranks 16th in the list of countries sitting on the most valuable energy reserves. And also in terms of renewable energy sources India is lagging behind with United States occupying the first position, Germany second, Spain third, Chinal fourth and Brazil fifth. As non renewable energy sources might deplete in the coming 6 to 7 decades, the call of hour for a developing country like India is to find alternate energy sources. Among the alternate energy sources solar energy is the best as the amount of energy the sun sends towards our planet is 35,000 times more than what we currently produce and consume.

At present about four fifth of India's need for electricity are met by fossil fuels which however will deplete in coming 100 years. In India, the solar energy potential alone is many thousand times more than the total energy needs of the country. With over 300 sunny days in a year, India's geo-position allows her to receive over 5000 trillion kWh of pure solar energy each year, with the potential to generate huge quantity of electricity through a high energy security and zero-carbon process. Solar cell is a promising technology for addressing energy needs of India. Presently, renewable (other than hydropower) resources contribute 7.7 per cent of India's energy mix. Out of this, the share of electricity generated through the solar cell is a very small fraction. However, in future,

solar cell based systems may become one of the important sources of power for providing electrical energy for localized use in thousands of remote locations all over India.
The Northeast, which compromises eight per cent of India's total area and just four percent of its total population, has understandably remained on the periphery of mainstream India's sub-conscious. Though, it has of course become fashionable to say that New Delhi has started giving much more importance to the region over the past couple of years and that now, at last, the Northeast will be brought at par with the rest of the country.

AN OVERVIEW OF SOLAR CELL TECHNOLOGY

A solar cell is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect, which is a physical and chemical pheneomenon. It is aform of photoelectric cell, defined as a device whose electrical characterstics, such as current, voltage, or resistance vary when exposed to light. Solar cells are the building blocks of photovoltaic modules, otherwise known as solar panels.

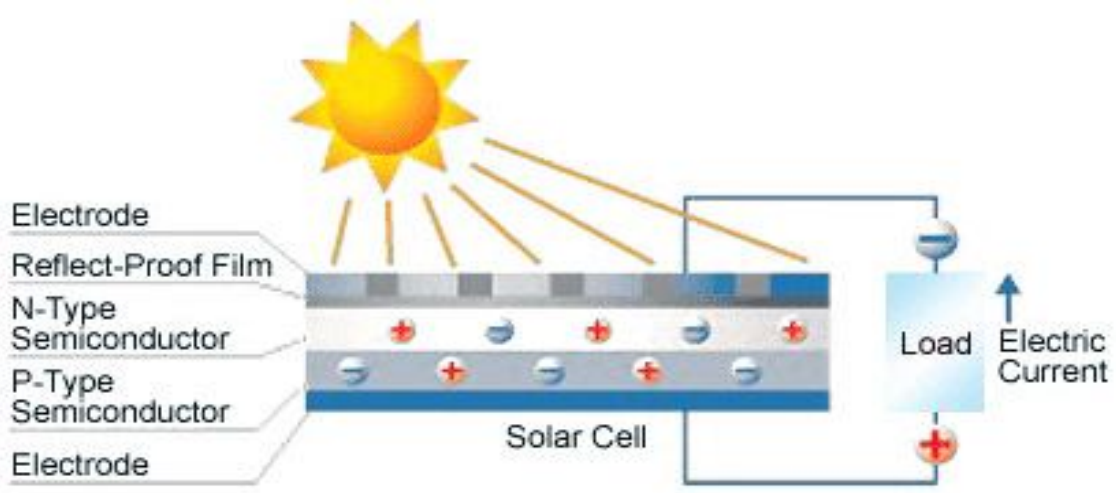

Fig.: Basic functioning of solar cell

Solar cells are described as being photovoltaic irrespective of whether the source is sunlight or an artificial light. They are used as a photodetector (for example infrared detectors), detecting light or other electromagnetic radiation near the visible range, or measuring light intensity.
The operation of a photovoltaic (PV) cell requires three basic attributes:

1. The absorption of light, generating either electron-hole pairs or excitons.
2. The separation of charge carriers of opposite types.
3. The separate extraction of those carriers to an external circuit.

Solar cell technologies are traditionally divided into three generations.

1. First generation solar cells: Based on silicon wafers and typically demonstrate a performance about 15-20 %.
2. Second generation solar cells: Based on amorphous silicon, CIGS and CdTe, where the typical performance is 10 - 15%.
3. Third generation solar cells: Based on organic materials such as small molecules or polymers.

Thus, polymer solar cells are a sub category of organic solar cells. A new class of thin film solar cells currently under investigation are perovskite solar cells and show huge potential with record efficiencies beyond 20% on very small area.Since the second generation solar cells avoid use of silicon wafers and have a lower material consumption it has been possible to reduce production costs of these types of solar cells compared to

the first generation. The second generation solar cells can also be produced so they are flexible to some degree. However, as the production of second generation solar cells still include vacuum processes and high temperature treatments, there is still a large energy consumption associated with the production of these solar cells. Further, the second generation solar cells are based on scarce elements and this is a limiting factor in the price.

OBJECTIVES

In this paper an attempt is made to assess-

1. The functionality of solar panels with an overall view on the installed capacity in differnt states
2. The status of solar power in Assam and its social impact on the beneficiaries inhabiting in villages.

PRESENT STATUS OF SOLAR CELL TECHNOLOGY IN INDIA

Solar power has so far played an almost non-existent role in the Indian energy mix. However, the market is set to grow significantly in the next ten years, driven mainly by rising power demand and prices for fossil fuels, the ambitious National Solar Mission (NSM), various state level initiatives, renewable energy quotas including solar energy quotas for utilities as well as by falling international technology costs. Encouraging the spread of solar power generation (both CSP and PV) and aiming for grid-parity (currently at around RS.5/kWh) by 2022 and parity with coal power generation (currently at around RS.4/kWh) by 2030, is a key element in India's comprehensive, long term energy supply strategy. Keeping in view the solar annual insolation, solar power could therefore easily address India's long-term power requirements. However, it has to be cost-competitive.

The Viability Gap Funding (VGF) scheme will be implemented for setting up over 5000 MW capacity of grid connected solar power projects by solar power developers on build, own and operate basis through open and transparent competitive bidding to provide solar power at a pre-defined tariff of Rs. 4.93 per kWh for the first year. The overall effort is to continuously reduce Government financial support for grid connected solar power as the prices of solar power comes down.

NATIONAL SOLAR MISSION

The Jawaharlal Nehru National Solar Mission (also known as the National Solar Mission is a major initiative of the Government of India and State Governments to promote ecologically sustainable growth while addressing India's energy security challenges. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change. Named after Jawaharlal Nehru, the Mission is one of the several initiatives that are part of National Action Plan on Climate Change. The program was inaugurated by Former Prime Minister of India, Dr. Manmohan Singh on 11 January 2010 with a target of 20GW by 2022 which was later increased to 100 GW in 2015 Union budget of India.

The objective of the National Solar Mission is to establish India as a global leader in solar energy, by creating the policy conditions for its diffusion across the country as quickly as possible. The immediate aim of the Mission is to focus on setting up an enabling environment for solar technology penetration in the country both at a centralized and decentralized level. The first phase (up to 2013) will focus on capturing of the low hanging options in solar thermal; on promoting off-grid systems to serve populations without access to commercial energy and modest capacity addition in grid-based systems. In the second phase, after taking into account the experience of the initial years, capacity will be aggressively ramped up to create conditions for up scaled and competitive solar energy penetration in the country.

The Mission under the aegis of Ministry of New and Renewable Energy will adopt a 3-phase approach, spanning the remaining period of the 11th Plan and first year of the 12th

Plan (up to 2012-13) as Phase 1, the remaining 4 years of the 12th Plan (2013–17) as Phase 2 and the 13th Plan (2017–22) as Phase 3. At the end of each plan, and mid-term during the 12th and 13th Plans, there will be an evaluation of progress, review of capacity and targets for subsequent phases, based on emerging cost and technology trends, both domestic and global. The aim would be to protect Government from subsidy exposure in case expected cost reduction does not materialize or is more rapid than expected.
Government-funded solar electricity in India was approximately 6.40 MW per year as of 2005. India is ranked number one in terms of solar electricity production per watt installed, with an insolation of 1,700 to 1,900 kilowatt hours per kilowatt peak (kWh/KWp).[4] 25.10 MW was added in 2010 and 468.30 MW in 2011.[5] As of 31 March 2016, the installed grid connected solar power capacity is 6762.85 MW[6] and India expects to install an additional 10,000 MW by 2017, and a total of 100,000 MW by 2022.

Table 1: Given table shows the statewise installed capacity as per September 2015

State	Megawatt (MW)
Andaman & Nicobar	5.10
Andhra Pradesh	475.74
Arunachal Pradesh	0.26
Bihar	5.00
Chandigarh	5.04
Chattisgarh	73.18
Daman Diu	4.00
Delhi	6.71
Gujarat	1024.15
Haryana	12.80
Jharkhand	16.00
Karnataka	104.22
Kerala	12.02
Lakhsadweep	0.75
Madhya Pradesh	678.58
Maharashtra	378.70
Odissha	66.92
Puducherry	0.02
Punjab	300.32
Rajasthan	1264.25
Tamil Nadu	562.94
Telangana	392.29
Tripura	5.00
Uttar Pradesh	140.0
Uttarakhand	5.00
West Bengal	7.21
Others	0.79
Total	**5547.21**

Source: "State wise installed solar power capacity". Ministry of New and Renewable Energy, Govt. of India. 1 March 2016. Retrieved 24 March 2016.

SOLAR POWER STATUS IN NORTH EAST WITH SPECIAL REFERENCE TO ASSAM

Solar Revolution is catching up in India at a very rapid state. In the north east areas, the Government plans to make Agartala into a solar city. The largest solar plant in north east India, based in Tripura is a 5 MW Monarchak plant which is run by the North Eastern Electric Power Corporation (NEEPCO). This plant started generating power on 5th February, 2015 and following this, solar hot water systems are being setup in various places in the city such as a hotels, nursing homes, hostels, government guest houses, hospitals are more. This is a part of the city's solar master plan and this is working towards the nation's mission of being a renewable superpower.

Table 2: Data of Completed Installations from Assam Energy Development Agency

Sl. No.	Project/ Programme	Installation so far
1.	Solar PV - Village Electrification	105 Villages
2.	Solar PV- General Programme	3566 Households
3.	Solar Hot Water Systems	15 Locations
4.	Microhydel Project	2 Locations
5.	Wind Monitoring Mast	3 Locations
6.	Energy Park under MNES	11 Locations
7.	State Level Energy Park under MNES	1 Locations
8.	Energy Park under NEC	1 Locations
9.	Solar PV Electrification Project	5 Locations

Table 3: Some of the already implemented success stories

District or location	Achievement	Corporation involved
Solar electrification of nine villages in Cachar district	Altogether 850 households in 36 villages in Cachar District in Assam were electrified by Solar Home Lighting Systems	1) Katigorah Gram Unnayan Parisad, Behara, 2) Barak Valley Headman Association, Rajabazar 3) Socio Educational Upliftment Society, Bhagabazar 4) Chandrapur Gram Unnayan Parisad, Chandrapur
Solar electrification of nine remote villages in Assam	Nine villages viz.Bandorgog, Magursilla, Marlap, Markang, Dondorai, Presamsorok, Pithagog, Kalongpar and Barkasarang were remote unelectrified villages under Sonapur Block of Kamrup District in Assam. The nearest location of the project is 18 km away from all weather motorable road and 10 km from nearest utility grid.	1) The Ministry of Non-conventional Energy Sources, Govt. of India 2) North Eastern Council (NEC) 3) State Govt. of Assam
Solar electrification of 11 villages in Impoi area in North Cachar Hills	Eleven villages viz. Boljang, Tumjang, P. Laikul, Hekaokang, Asalu, Toulpui, Nokhajow, Laisong, Christain Impoi, Impoi (H), Mahur were remote unelectrified villages under Mahur Development Block in N.C Hills District in Assam. These villages are on both side of the Mahur to Laisong road and 8 km from nearest utility grid. The area is inhabited mainly by Jemi Naga tribes. Altogether 357 hoseholds were electrified by Solar Home Lighting System under this project	1) The Ministry of Non-conventional Energy Sources, Govt. of India 2) Ministry of Social Justice and Empowermen 3) Church's Auxiliary for Social Action (CASA)
Providing 400 Solar Home System in homes of Bodo Tribal Women in Sonarpur in Gohpur	Solar Home Systems are provided to 400 Bodo Tribal Women engaged in weaving and spinning activities in Pub Chaiduar Development Bock of Sonipur District. The lighting systems provided to them help in increasing the productivity due to longer working hours and it also helps in uplift the standard of living of these tribal women	1) The Ministry of Non-conventional Energy Sources, Govt. of India 2) Kokila Vikash Asram 3) Chaiduar Rural Development Centre

Data from homepage of Assam Energy Development Agency.

Having plans to generated more than 1500 MW of power from only renewable energy in the northeast by the year 2020, plans are in place to setup another 5MW solar plant in Assam and Arunachal Pradesh is set to get a 2MW windmill project to further add to the renewable energy that is being produced by the state.

Northeast India is already ahead of the curve in terms of renewable energy accounting to much higher percentage of overall state installed capacity; Nagaland has a 65% share of renewable energy in total energy being produced, followed by Sikkim at 64% and Arunachal Pradesh at 62%. There is a huge solar revolution going on in the Northeast parts of India, last year, Meghalaya Government sanctioned Rs. 25 crores towards installation of solar lights under the Green City Project. Nagaland followed suit by setting up innovative solar powered water treatment units in three villages in 2013, more than 2,600 people are being benefited by this initiative today. Aiming to provide more than 10,000 solar heaters to nine districts of the state of Manipal over the next five years, the Government aims to solve the problem of acute shortage of electricity for Manipal. The state generates 80 MW where the demand is a whooping 170 MW. With these solar initiatives, the state's demand supply curve would be reduced.

Mizoram's Government also provides for subsidized solar equipment to users. The state of Assam has between 240 – 260 clear days every year along with 4.4 – 5.6 KWh of solar power potential per square meter per day. 2009 saw India unveiling a US$19 Billion national solar mission which aims to produce more than 20GW of solar power by 2022, putting India on the maps of solar superpowers in the world.

Assam is among the top 10 states with highest number of unelectrified villages in India. According to Assam Energy development agency following are the list of installations already completed.

Welspun Energy in 2013 had considered setting up a 25-MW solar power project at an investment of around Rs 200 crore in Assam. The company sought 100-150 acres of land for such a project.

CONCLUSION

Solar energy being an inexhaustible source of energy and the best replacement to other non-renewable energies in India is basically environment friendly as it puts a halt to release of CO2 from several sources. Applications of this form of energy are varied as for heating, drying, cooking or electricity, which is suitable for the rural areas in India. Solar power is inexhaustible. In an energy deficient country like India, where power generation is costly, solar energy is the best alternate means of power generation. Several surveys of rural India shows that solar home lighting in remote villages can influence the life of people significantly for the better. Solar power is basically benefecial to women and children groups as household chores get easier to be done, children are also benefitted in their education thus shaping a bright future for India.

Prime Minister Manmohan Singh has rightly emphasised that

"The importance of Jawaharlal Nehru National Solar mission is not just limited to providing large-scale grid connected power. It has the potential to provide significant multipliers in our efforts for transformation of India's rural economy. Already, in its decentralized and distributed applications, solar energy is beginning to light the lives of tens of millions of India's energy-poor citizens. The rapid spread of solar lighting systems, solar water pumps and other solar power-based rural applications can change the face of India's rural economy. We intend to significantly expand such applications through this Mission. As a result, the movement for decentralized and disbursed industrialization will acquire an added momentum, a momentum which has not been seen before."

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