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ASSESSMENT OF CURRENT STATUS OF SOLAR ENERGY SYSTEM IN INDIA: A REVIEW

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Abstract: ***India is the fourth largest energy consumer in the world after the United States, China, and Russia. India's energy policy focuses on securing energy sources to meet the need of its growing economy. Ministry of New and Renewable energy has initiated an exercise to track the evolving solar power regulatory framework and develop a repository of information in a consolidated manner. This exercise is expected to help understand the dynamic nature of the solar energy regulations and related issues and also create a platform to share information on pertinent issues. The purpose of this paper is to present an updated overview of the current status of solar energy in India, along with the potential location assessment, state-wise solar capacity, grid parity technology, domestic conditions, and indigenous industries related to solar energy system.***
Keywords: Solar energy system, solar capacity, grid parity, site assessment

1. *Introduction:*

Power is the key factor for industrialization, urbanization, financial development, and improvement of personal satisfaction in the public arena. India is the world's fifth common in the power division. The utility power area in India has one National Grid with an introduced limit of 356.100 GW as on 31 March 2019. Sustainable power plants which incorporate huge hydro additionally comprised 34.5% of all out introduced limit. In financial year 2017-18, the gross power produced by utilities in India was 1,303.49 TWh and the total power created (utilities and non utilities) in the nation was 1,486.5 TWh. The gross power utilization was 1,149 kWh per capita in the year 2017-18. India is the world's third biggest maker and third biggest buyer of power. Electric energy utilization in horticulture was recorded most astounding (17.89%) in 2015-16 among all nations. The per capita power utilization is low as compared to number of countries.

India has a surplus power age limit, yet needs a satisfactory foundation for providing power to every single poor individual. To provide satisfactory power to everyone in the nation by March 2019, the Government of India propelled a plan called "Power for all". This plan is aimed to guarantee constant and continuous power supply to all families, enterprises, and business foundations by making and improving the fundamental framework. It is a joint cooperation of the Government of India with states to share financing and make generally speaking monetary development. India's power area is overwhelmed by non-renewable energy sources, and specifically coal, which in 2017-18 created around three fourths of all power. The National Electricity Plan of 2018 Government of India expresses that the nation does not require extra non-sustainable power plants in the utility segment until 2027, with the authorizing of a 50,025 MW coal-based power plants under development and achieving 275,000 MW of inexhaustible power limit of almost 48,000 MW more seasoned coal terminated plants **[1,2]**. **Figure 1** shows the total installed capacity of power plant till 2019 in India. According to the given data highest percentage of electricity generated through the thermal power plant and followed by hydro and renewable energy sources.

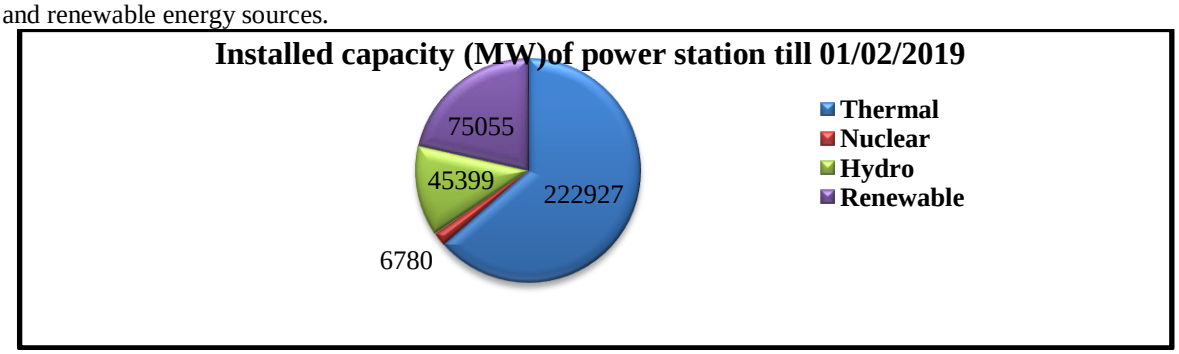

Figure 1: Installed capacity of power station in India [7]

At the present government of India totally worked towards the renewable energy source. Renewable energy in India comes under the purview of the Ministry of New and Renewable Energy (MNRE). India was the first country in the world to set up a ministry of non-conventional energy resources, in the early 1980s. Solar Energy Corporation of India has layed a key role in the development

of solar energy industry in India blessed with enough sun shine. Hydroelectricity is administered separately by the Ministry of Power and not included in MNRE targets. India is one of the countries with the largest production of energy from renewable sources. In the electricity sector, renewable energy accounted for 34.6% of the total installed power capacity. Large hydro installed capacity was 45.399 GW as of 31 March 2019, contributing to 13% of the total power capacity. ***Khare et al.*** **[3]** present status of solar wind energy system in terms of installed, cumulative capacity and also government policy and barriers towards the solar energy system in India in the year 2013. ***Tang N.*** **et al. [4]** explained status of solar curtailment in China. The current status of the solar energy curtailment is reviewed with a detailed analysis of power generation and electric grid of China. This review focuses on the cases of the two typical provinces (Gansu province and Xinjiang Uygur Autonomous Region) with large-scale solar energy curtailment together with related analysis. ***Ozoegwu C.G. et. al.[5]*** explained the status of solar energy integration and policy in Nigeria. Nigeria policy landscape and near-to-zero status of solar integration is on the result of poor implementation of the existing policies the Government. Recommendations were made on the basis of the existing policies and proposed policies. ***Chimres N. et al.[6]*** explained current status of solar energy system in Thailand. In particular, the use of solar power for electricity generation is important to reduce imported energy because Thailand's primary commercial energy imports comprise approximately 50%, of all of Thailand's energy. **Figure 2** shows the renewable energy capacity in India.

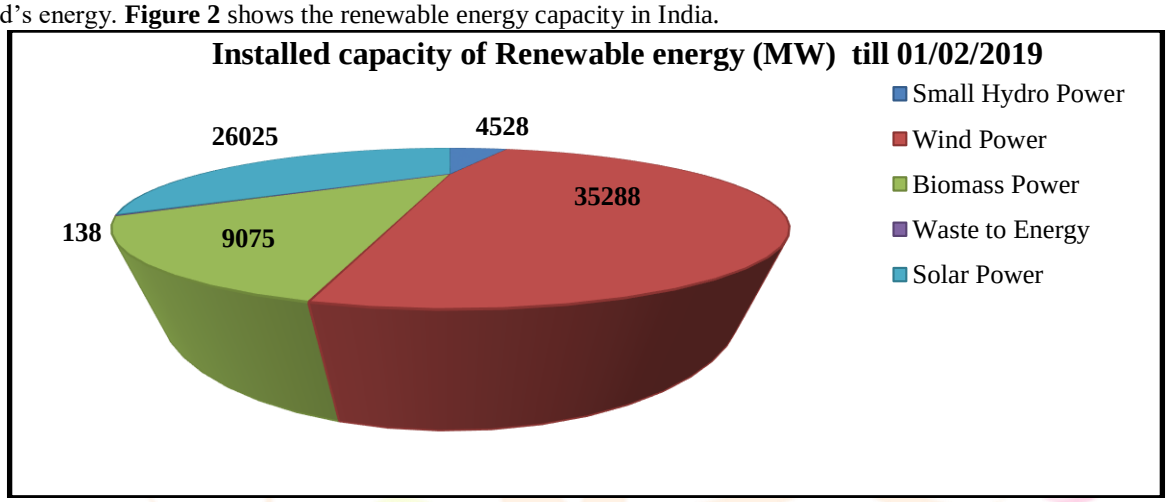

Figure 2: Installed capacity of renewable energy in India [7, 8]

2. *Overview of Solar Energy in India:*

India is endowed with vast solar energy. The solar radiation of about 5,000 trillion kWh per year is incident over its land mass with average daily solar power potential of 0.25 kWh per m^2 of used land area with the available commercially proven technologies. As on 31 March 2018, the installed capacity was 21.65 GW meeting 2% of the utility electricity generation in India **[9, 10, 11]**. Installation of solar power plants requires nearly 2.4 hectares (0.024 km^2) land per MW capacity, which is similar to coal-fired power plants when life cycle coal mining, consumptive water storage & ash disposal areas are also accounted, in hydro power plants the submergence area of water reservoir must also be accounted for. 1.33 million MW capacity solar plants can be installed in India on its 1% unused land (32,000 square km). There are vast tracts of land suitable for solar power in all parts of India exceeding 8% of its total area which are unproductive barren and devoid of vegetation. Part of waste land (32,000 square km) when installed with solar power plants can produce 2,000 billion kWh of electricity (two times the total generation in the year 2013-14) with land annual productivity/yield of ₹1.0 million (US$14,000) per acre (at 4 Rs/kWh price) which is at par with many industrial areas and many times more than the best productive irrigated agriculture lands [12, 13, 14]. Moreover, these solar power plants are not dependent on the supply of any raw material and are self produced. There is unlimited scope for solar electricity to replace all fossil fuel energy requirements (natural gas, coal, lignite, nuclear fuels and crude oil) if all the marginally productive lands are occupied by solar power plants in the future. The solar power potential of India can meet perennially to cater per capita energy consumption at par with USA/Japan for the peak population in its demographic transition. Solar PV power tariff has fallen to ₹2.44 (3.5¢ US) per kWh in May 2017 which is lower than any other type of power generation in India. In the year 2017, the leveled tariff in US$ for solar electricity has fallen to 1.79 cents/kWh, which is far cheaper than the fuel cost incurred by coal based power plants in India.

Solar thermal power plants with thermal storage are emerging as cheaper (US 5 ¢/kWh) and clean, plants compared to fossil fuel power plants. They can cater the load/ demand round the clock perfectly and work as base load power plants also when the extracted solar energy is found in excess in a day. Some state governments are doing exemplary work to address land availability through innovation; for example, by exploring the means to deploy solar capacity over their extensive irrigation canal projects, thereby harvesting solar energy while reducing the loss of irrigation water by solar evaporation. The state of Gujarat was first to implement the Canal Solar Power Project, to use 19,000 km (12,000 mi) long network of Narmada canals across the state for setting up solar panels to generate electricity. It was the first ever such innovative project in India **[10, 11, 12, 13, 14, 15]**.

3. *Solar Potential Site Assessment in India:*

Prior to installation and operation, the pre-feasibility study of solar energy system is very necessary. A precise feasibility study should provide a chronological background of the projects. In addition to climate condition of the application site, availability of solar energy sources, the potential of solar energy sources, load demand of application sites are included to find out the best location to develop a solar energy system. Generally feasibility precedes technical development and project implementation. It must therefore be conducted with a balanced approach to provide information upon which decisions can be based. India is blessed with enormous sun energy which can be used to produce electrical energy. The Ministry of New and Renewable Energy has set up 115 automatic solar and meteorological measuring stations known as SRRA stations all over the country **[16, 17, 18]**. Solar radiation varies throughout the day and it is very importance to have precise data for design, development, and performance analysis of solar power plants. For a continuous spatial coverage of wide regional, satellite-based irradiation estimates are generally used, but the

best quality data is provided by ground-based measurements which are also used for validating or benchmarking and improving satellite-derived data. The average intensity of solar radiation received in India is 200 MW/km square (megawatt per kilometre square). With a geographical area of 3.287 million km square, this amounts to 657.4 million MW.To meet the requirement, India Meteorological Department (I.M.D.) is maintaining a network of radiation measuring stations in India. The network, which initially had 4 stations in 1957, has gradually expanded to the present 40 odd stations [16, 17, 18, 19, 20]. **Table 1** shows the coordinates of a solar station in India. The most basic parameter, the incident solar radiant energy directly and scattered is measured at all the stations.

Table 1: Coordinates of Solar Station in India

City Name	Latitude (N)	Longitude (E)	Height (m) amsl	Solar Radiation (kWh/m2/day)	Temperature(C)	Humidity(%)
Minicoy	08 18	73 09	1	4.1	27	54
Thiruvananthapuram	08 29	76 57	60	5.16	31	74
Port blair	11 40	92 43	13	4.61	30	76
Bangalore	12 58	77 35	921	5.32	30	73
Chennai	13 00	80 11	10	5.08	33	44
Goa	15 29	73 49	58	5.18	29	74
Hyderabad	17 27	78 28	530	5.27	32	52
Visakhapatnam	17 41	83 18	7	4.97	33	63
Pune	18 32	73 51	555	5.44	32	52
Mumbai	19 07	72 51	8	5.35	31	70
Nagpur	21 06	79 03	308	5.47	34	24
Bhavnagar	21 45	72 11	5	5.43	27	24
Kolkata	22 39	88 27	5	4.12	29	74
Ahmedabad	23 04	72 38	55	5.82	34	47
Bhopal	23 17	77 21	523	5.61	27	27
Ranchi	23 19	85 19	652	5.15	29	52
Varanshi	25 18	83 01	90	4.5	32	46
Shillong	25 34	91 53	1598	3.9	18	79
Patna	25 36	85 10	51	4.37	26	62
Jodhpur	26 18	73 01	217	5.63	32	14
Jaipur	26 49	75 48	390	5.75	32	14
New Delhi	28 29	77 08	273	4.29	24	47
Srinagar	34 05	74 50	1585	4.81	14	29

Solar mapping of the entire country based on satellite imagery and duly validated by ground truth data will provide information of both Direct Normal Irradiance (DNI) and Global Horizontal Irradiance (GHI) on a continuous basis with an approximate accuracy of 15%. **Figure 3** shows the global only, global & diffuse, global-diffuse & direct, global-diffuse-direct & net terrestrial, net radiation only, global & direct and direct radiation location of all over the India [16, 17, 18, 19]. **Figure 4** shows the month-wise global solar radiation in all over the India. Figure demonstrate that in the month of April, May, June solar radiation is highest and maximum electricity can be harnessed, but due to low solar radiation in July and August hybrid renewable energy system with backup supply is preferred. Areas with higher solar radiation must be identified to set up ground stations for more accurate measurement of solar radiation and other meteorological parameters. State of Gujarat, Rajasthan, Karnataka and Madhya Pradesh possesses highest solar radiation for almost eight months in the year and has large potential of electricity generation using solar. The **Figure 5** shows month wise average solar radiation of all states of India.

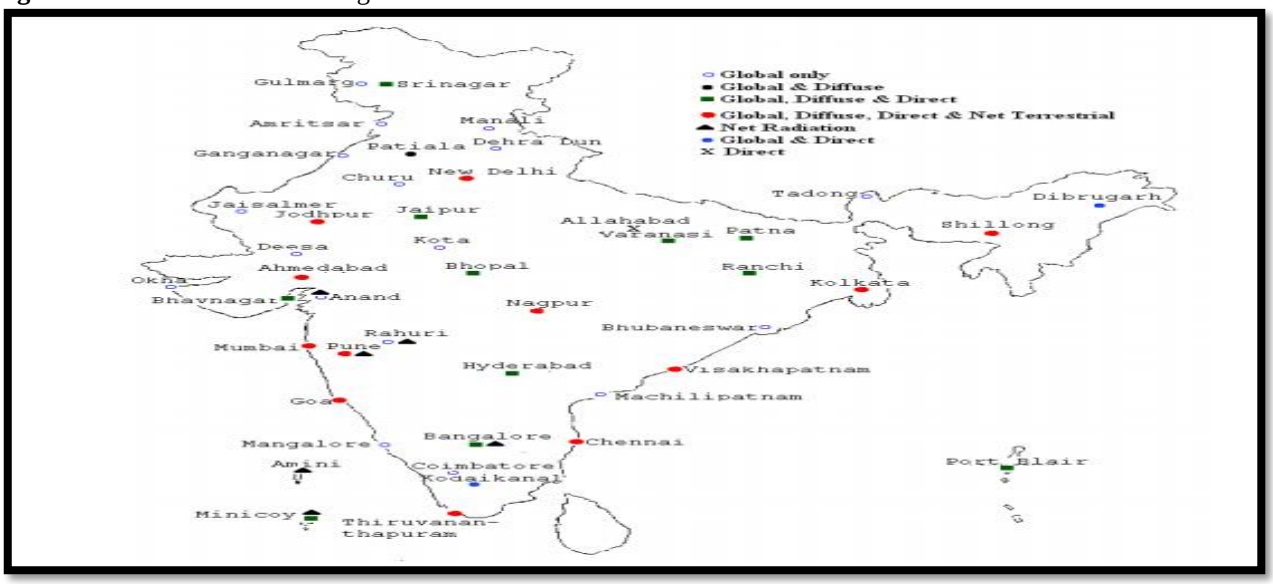

Figure 3: State-wise solar radiation assessment in India [20, 21, 22, 23]

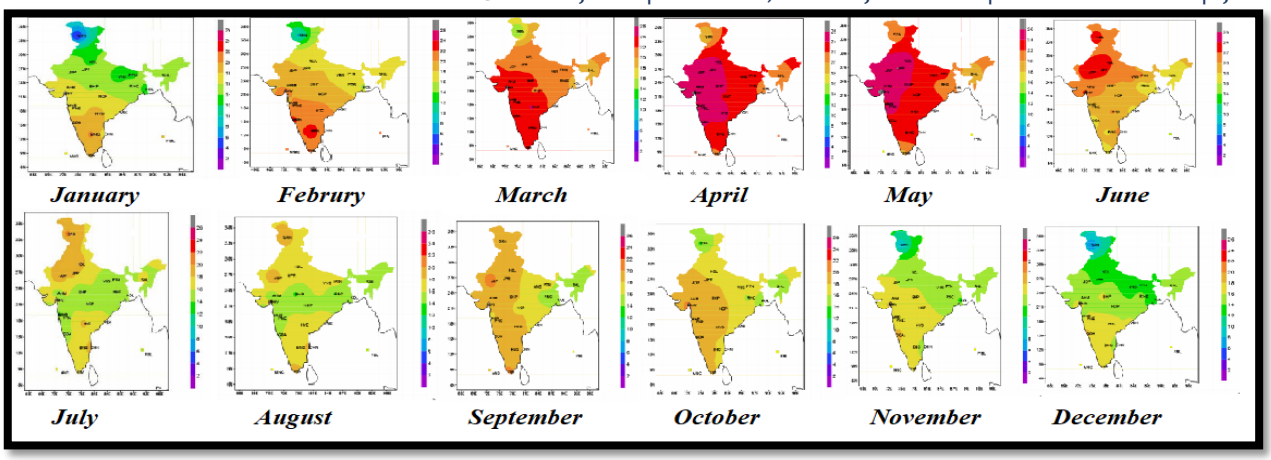

Figure 4: Month-wise solar radiation in all states of India [20, 21, 22, 23]

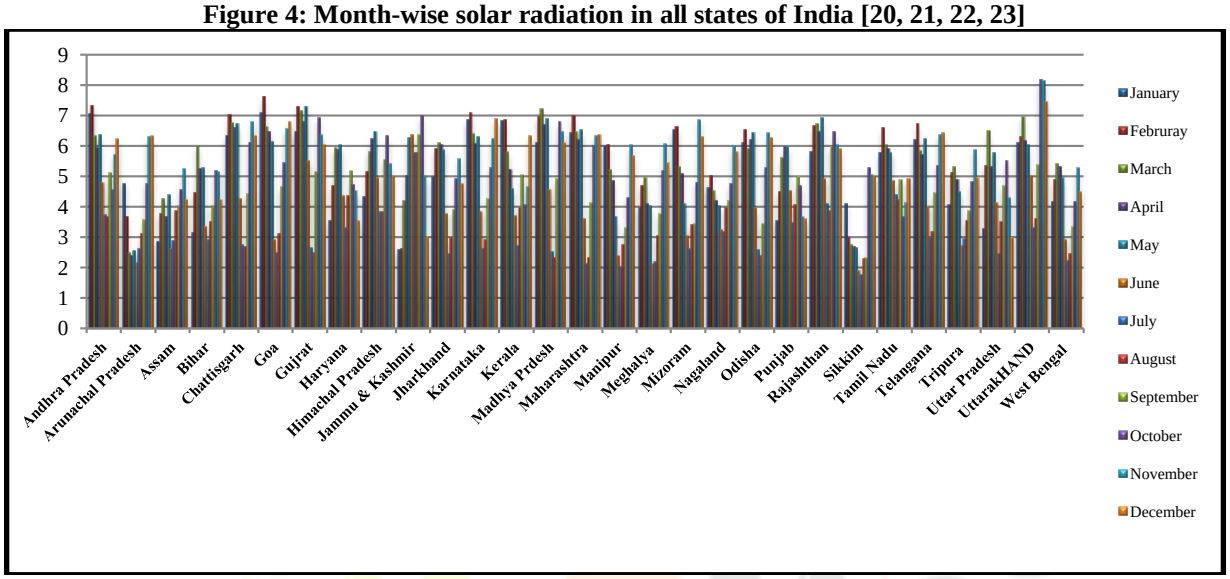

Figure 5: Month-wise Solar Radiation of all the States of India [20, 21, 22, 23]

4. *Solar Energy Capacity in India:*

Solar generation in India is an eye catching affair now a day. The country's solar installed capacity reached 28.18 GW as of 31 March 2019. The Indian government had an initial target of 20 GW capacities of 2022, which was achieved four years ahead of schedule. In 2015 the target was raised to 100 GW of solar capacity (including 40 GW from rooftop solar) by 2022, targeting an investment of US$100 billion. India expanded its solar-generation capacity 8 times from 2,650 MW on 26 May 2014 to over 20 GW as on 31 January 2018. The country added 3 GW of solar capacity in 2015-2016, 5 GW in 2016-2017, and over 10 GW in 2017-2018, with the average current price of solar electricity dropping to 18% below the average price of its coal-fired counterpart [10, 11, 12, 13, 24]. **Figure 6** shows year wise cumulative capacity of solar energy system in India. This Figure shows solar cumulative capacity in India is increased from 161MW to 28181MW. In the last 5 year solar energy capacity is increasing at a very high level and from 2010 to 2019 it increases directly 175 times. This type of data shows the actual present status of India in the field of solar energy system. **Figure 7** shows year wise roof top and large scale solar capacity in India. Rooftop solar power accounts for 3.4 GW, of which 70% is industrial or commercial.

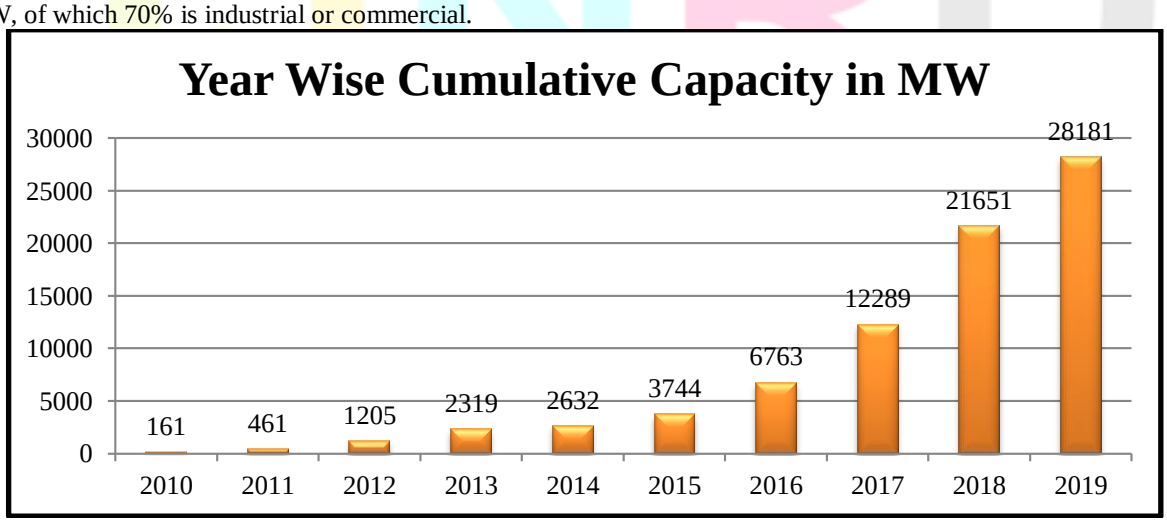

Figure 6: Year wise cumulative capacity in MW [10, 11, 12, 13, 24]

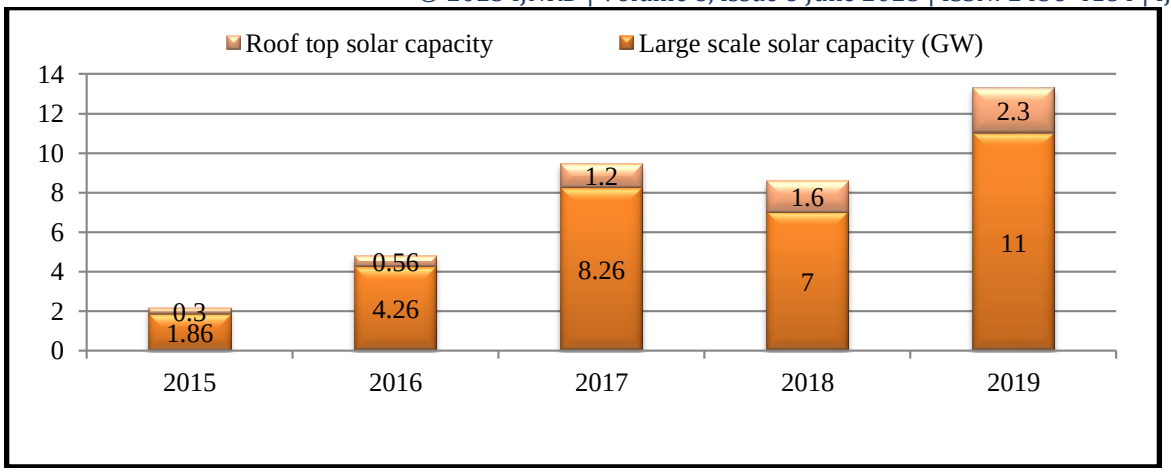

Figure 7: Year wise solar capacity in India [10, 11, 12, 13, 24]

The **Figure 8** shows state-wise solar capacity in India. According to the figure state of Rajasthan, Gujarat, Maharashtra, and Madhya Pradesh have highest solar capacity 3131MW, 1827MW, 1607MW, and 1586MW respectively.

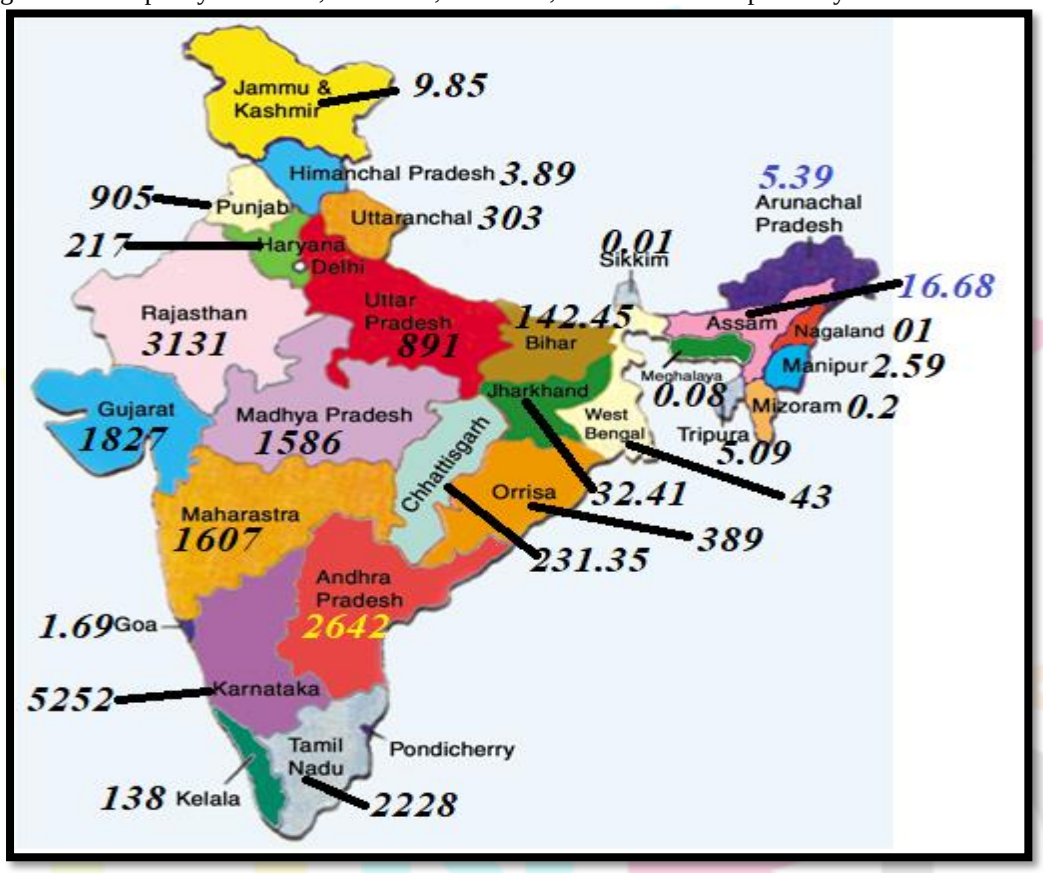

Figure 8: State-wise solar capacity in India

Installed photovoltaic capacity in Andhra Pradesh is more than 2,590 MW as on 30 November 2018. In 2015, NTPC agreed with APTransCo to install the 250-MW NP Kunta Ultra Mega Solar Power Project near Kadiri in Anantapur district. The first phase of park was commissioned on 9 May 2016 with a capacity of 200 MW. An additional 50 MW capacity was commissioned on 29 July 2016. A further 750 MW was planned to have been commissioned by March 2018 in the second phase **[25, 26, 27, 28, 29, 30]**.

In August 2016, Tata Power Solar commissioned a 100 MW solar project at the park built over an area of 500 acres. This was the largest solar project commissioned using domestically manufactured solar cells and modules at the time. In May 2018, Azure Power commissioned a 50 MW solar capacity at the park. In July 2018, Tata Power commissioned another 100 MW capacity, taking total commissioned capacity to 500 MW. In July 2018, 750 MW were awarded for installation at Rs 2.71 per KWh **[25, 26, 27, 28, 29, 30]**. In October 2017, 1000 MW was commissioned at Kurnool Ultra Mega Solar Park, which was the world's largest solar power plant of that time. In August 2018, Greater Visakhapatnam commissioned a 2 MW grid-connected floating solar project, which is largest operational floating solar PV project in India. In February 2019, 200 MW was commissioned at Ananthapuram - II solar park located near Tadipatri **[25, 26, 27, 28, 29, 30]**. With its total photovoltaic capacity reaching 1,637 MW Gujarat is India's most solar-developed states, because to its high solar-power potential, availability of vacant land, connectivity, transmission and distribution infrastructure and utilities. According to a report by the Low Emission Development Strategies, Global Partnership (LEDS GP) report, these attributes are complemented by political will and investment. The 2009 solar power of Gujarat policy framework, financing mechanisms and incentives have contributed to a greener investment climate in the state and targeted for grid-connected solar power. The state has commissioned Asia's largest solar park near the village of Charanka in Patan district. The park is generating 345 MW by March 2016 of its 500 MW total planned capacity and has been cited as an innovative and

environmentally-friendly project by the Confederation of Indian Industry. In December 2018, 700 MW Solar PV plant in the Raghanesda solar park is contracted at 2.89 Rs/unit leveled tariffs.

To make Gandhinagar a solar-power city, the state government has begun a rooftop solar-power generation scheme. Under the scheme, Gujarat plans to generate 5 MW of solar power by putting solar panels on about 50 state-government buildings and 500 private buildings. Haryana state has set the 4.2 GW solar power (including 1.6 GW solar root top) target by 2022 as it has high potential since it has at least 330 sunny days **[31, 32, 33, 34]**. Haryana is one of the fastest growing states in terms of solar energy with installed and commissioned capacity of 73.27MW. Out of this, 57.88MW was commissioned in FY 2016/17. The Haryana solar power policy announced in 2016 offers a 90 % subsidy to farmers for the solar powered water pumps, which also offers subsidy for the solar street lighting, home lighting solutions, solar water heating schemes, solar cooker schemes. It is mandatory for new residential buildings larger than 500 sq. yards to install 3% to 5% solar capacity for no building plan sanctioning is required, and a loan of up to Rs. 10 lakhs are made available to the residential property owners. Haryana provide 100% waiver of electricity, taxes, electricity duty, wheeling charges, cross subsidy charges, transmission and distribution charges, etc for rooftop solar projects **[35, 36, 37]**. Karnataka is the top solar state in India exceeding 5,000 MW installed capacity by the end of financial year 2017-18. The installed capacity of the Pavagada solar park is 1400 MW and its ultimate 2,050 MW installed capacity is expected by the end of year 2020 **[38]**.

Madhya Pradesh is one of India's most solar-developed states, with its total photovoltaic capacity reaching 1,117 MW by the end of July 2017. The Welspun solar MP project, the largest solar-power plant in the state, was built at a cost of ₹1,100 crore (US$160 million) on 305 ha (3.05 km^2) of land and will supply power at ₹8.05 (12¢ US) per kWh. A 130 MW solar power plant project at Bhagwanpura, a village in Neemuch district, was launched by Prime Minister Narendra Modi. It is the largest solar producer, and Welspun Energy is one of the top three companies in India's renewable-energy sector. A planned 750 MW solar-power plant in Rewa district is also planned and expected to be completed in 2018. This is developed by Rewa Ultra Mega Solar Limited. Rajasthan is another solar-developed state, with its total photovoltaic capacity reaching 2289 MW by the end of June 2018 **[39]**. Rajasthan is also home to the world's largest Fresnel type 125 MW CSP plant at the Dhirubhai Ambani solar park. Jodhpur district leads the state with installed capacity of over 1,500 MW, followed by Jaisalmer and Bikaner. The Bhadala solar park, with a total ultimate capacity of 2,255 MW, is being developed in four phases of which 260 MW capacities were commissioned by NTPC Limited. Total installed capacity at the end of June 2018 is 745 MW and the remaining capacity is expected to be commissioned by March 2019. In September 2018 Acme Solar announced that it had commissioned India's cheapest solar power, 200 MW at Bhadala. In addition to its large-scale grid-connected solar photovoltaic (PV) initiative, India is developing off-grid solar power for local energy needs. Solar products have increasingly helped to meet rural needs; by the end of 2015 just fewer than one million solar lanterns were sold in the country, reducing the need for kerosene. That year, 118,700 solar home lighting systems were installed and 46,655 solar street lighting installations were provided under a national program, just over 1.4 million solar cookers were distributed in India [40, 41, 42, 43]. **Table 2** shows state-wise cumulative capacity of installation of solar photo-voltaic system in India.

Table 2: State wise cumulative installation of SPV system 2018 [42, 43]

State	Lanterns & Lamps Nos.	Home Light Nos.	Street Light Nos.	Pumps Nos.	Stand Alone Power Plants
Andhra Pradesh	51360	22972	7812	19526,8907	3786
Arunachal Pradesh	14433	18945	1671	22	650
Assam	13379,12258	6926	318	45	1605
Bihar	210391,160274	12303	955	1882	4168,200
Chhatitisgarh	3311	7754	2042	26673,15203	28660,216
Delhi	4807	0	22018	90	1269
Goa	1093	393	58718	15	32
Gujarat	31603	9253	5806	8010	13576
Haryana	98853	56727	22018	1243,700	2321
Himachal pradesh	33909	29342	58718,6860	6	1905,52
Jammu & Kashmir	51224	65319	5806	39	7720
Jharkhand	138723,115349	9450	787	3598,452	3640
Karnataka	7334	52638	2694	4118,641	7754
Kerala	54367	41912	1735	818,8	15825,1931
Madhya pradesh	529101,519657	4016	9378	5584,1771	3654
Maharashtra	239297,170614	3497	10420	3315,1287	3857
Manipur	4787	3900	1888	40	1241
Meghalaya	24875	7844	4900,3627	19	1084,200
Mizoram	9589	6801	5056	37	2019,300
Nagaland	6766	1045	6235	3	1506
Odisha	99843,89961	5274	5834	8570,1491	568
Punjab	17495	8626	42758	1857	2066
Rajasthan	225851,221135	166978,11709	6852	41377,187	10850
Sikkim	23300	15059	504	0	850
Tamilnadu	16818	273015,42695	39235,2433	4459	12752
Telangana	0	0	351,107	424	6643,1269,
Tripura	64282	32723	1199	151	662
Uttar Pradesh	104791,42776	235909	185091	10877	10041
Uttarakhand	93927	91595	21905	26	2365,826
West Bengal	17662	145332	8726	653	1730

5. Scheme for Development of Solar Parks and Ultra Mega Solar Power Projects:

The scheme for development of Solar Parks and Ultra Mega Solar Power Projects was rolled out by the Ministry of New & Renewable Energy in December, 2014. The Scheme has been conceived on the lines of the "Charanka Solar Park" in Gujarat, which is a first-of-its-kind large scale solar park in India with contiguous developed land and transmission connectivity. This scheme envisages supporting the States in setting up solar parks at various locations in the country with a view to create the required infrastructure for. The solar parks will provide suitable developed land with all clearances, transmission system, water access, road connectivity, communication network, etc. **Table 3** shows the state-wise solar park and their capacity in India **[44]**.

Table 3: State-Wise Solar Park in India [44]

State	Solar Park	Capacity (MW)
Andhra Pradesh	Anatha puramu-I	1500
	Kurnool	1000
	Kadapa	1000
	Anatha puramu-II	500
Arunachal Pradesh	Lohit	30
Assam	Assam	80
Chattisgarh	Rajnandgaon	250
Gujarat	Radhnesada	700
	Harsad	500
Haryana	Haryana	500
Himachal Pradesh	Himachal Pradesh	1000
Jammu & Kashmir	Jammu & Kashmir	100
Karnataka	Pavagada	2000
Kerala	Kasargod	200
Madhya Pradesh	Rewa	750
	Neemuch	700
	Agar	1050
	Morena	250
Maharashtra	Sai guru	500
Meghalaya	Dondaicha	500
	Patoda	500
	Meghalaya	20
Mizoram	Vankal	20
Nagaland	Nagaland	23
Odisha	Odisha	1000
Rajasthan	Bhadla-II	680
	Phalodi-Pokaran	1000
	Bhadla -III	750
	Bhadla -IV	550
	Fathehgarh	421
	Nokh	1000
Tamil Nadu	Tamil Nadu	500
Uttar Pradesh	Uttar Pradesh	440
Uttarakhand	Uttarakhand	50
West Bengal	West Bengal	500

This scheme facilitates and speeds up installation of grid connected solar power projects for electricity generation on a large scale in collaboration with the state governments and their agencies. It was planned to set up at least 25 solar parks and ultra mega solar power projects targeting over 20,000 MW of solar power installed capacity within a span of 5 years, starting from 2014-15. The capacity of the solar parks is normally 500 MW and above. However, smaller parks has to be developed in Himalayan region & other hilly states where contiguous land is difficult to acquire in view of difficult terrain and in states where there is acute shortage of non-agricultural land. The solar parks are developed through implementing agency has sanctioned a grant up to Rs.25 Lakh/Park for preparing the Detailed Project Report (DPR) of the solar park. Thereafter, the application is sent by the implementing agency to Solar Energy Corporation of India (SECI) for the grant up to Rs. 20 Lakh/MW or 30% of the project cost, including Grid-connectivity cost, whichever is lower. The approved grant is released by SECI as per milestones prescribed in the scheme **[44]**.

Grid Parity of Solar Energy System in India:

Grid parity is a situation where the cost of generating electricity from alternative sources of energy is almost same or at par with the conventional sources. Amplus Energy Solutions won projects across 10 states in the bids conducted by Solar Energy Corporation of India (SECI) for rooftop solar power. The tariff offered for projects in Uttarakhand, Himachal Pradesh, Puducherry and Chandigarh were the lowest in history Rs 3 per unit of electricity. In six other states tariff rates between Rs 5 and 6 per unit were offered. The bidding comes at a point where grid parity of renewable energy is being hailed as a turning point of electricity scenario in India.

Unfortunately, the price of Rs 3-per-unit-tariff can be achieved as the government is offering subsidies worth 70 per cent of the capital cost, ranging from Rs 38,500 to Rs 52,500 in the capital expenditure model.

It was beaten by tenders worth 750 MW of solar at Bhadala solar park in Rajasthan which was benchmarked by the tariff of Rs 3.93 per unit of power generated. Again, this low benchmark cost is for a 750 MW that would receive viability gap funding (VGF) of 30 per cent. VGF is capital subsidy to bridge the gap between the project cost dictated by the prevailing electricity rate and the price quoted by a developer. Apart from a capital subsidy for rooftop and VGF for larger solar projects, the government offers a tax benefit called accelerated depreciation (AD) to all the projects that are not entitled to a direct capital subsidy. AD is the depreciation of fixed assets at a faster rate early in their useful lives. This AD is a tax rebate that the project enjoys for the first few years of operation **[3, 45]**.

6. Conclusion:

If operationalised, the model of solar energy system will revolutionize the way power is produced and consumed in India. Millions of households will produce and consume their own electricity. Thousands of renewable energy based mini-grids would promote millions of small businesses and social entrepreneurs to create local jobs and build local economies. Living standards in the villages will improve which in turn will ensure women empowerment, better health, and education which may suits to be the best development agenda for the country and also avoid large fossil fuel plants contribution towards environmental hazard. Solar electricity could prove to be the main source of energy to solve the challenges related to energy poverty, address climate change, build local economies, and move towards a secure energy future for India. Let us develop a blueprint to achieve this future.

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