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Glance on Development of Solar Energy in India

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Abstract-- Solar energy – a clean, zero-emission renewable resource – has the enormous energy capacity to be exploited by various devices. With recent advances, solar power systems with the added benefit of minimal maintenance are easily accessible for industrial and domestic use. With government tax incentives and rebates, solar energy could become financially viable. Most developed nations turn to solar energy as one of the leading energy sources for clean energy. The latest architectural designs include the necessary photovoltaic cells and circuitry during construction. A major initiative of the government and government of India to foster ecologically sustainable growth while addressing the challenges of India's energy security is the National Solar Mission. Indian participation in the global initiative to address climate change issues would also make this a significant contribution. The goal of the Solar National Mission is to create India as a world leader in solar energy by creating as quickly as possible the political conditions for it to spread throughout the country. The mission's immediate goal is to establish an atmosphere that allows the country to penetrate solar technology on a centralized and decentralized basis. "India is a tropical region, with sunshine available for longer hours per day with great strength," the National Action Plan on Climate Change points out. As a possible source of electricity, solar energy thus has great potential. The benefit of this system is also to allow for a decentralized energy delivery that empowers people at the grassroots level.”

Keywords--*Solar power, future and analysis*

I. INTRODUCTION

Solar energy is the energy provided by the Sun for generating electricity or heat, by light (photovoltaic energy) and warmth (solar thermal energy). Sun energy, because it comes from the Sun, is inexhaustible and renewable. The panels and mirrors are included.

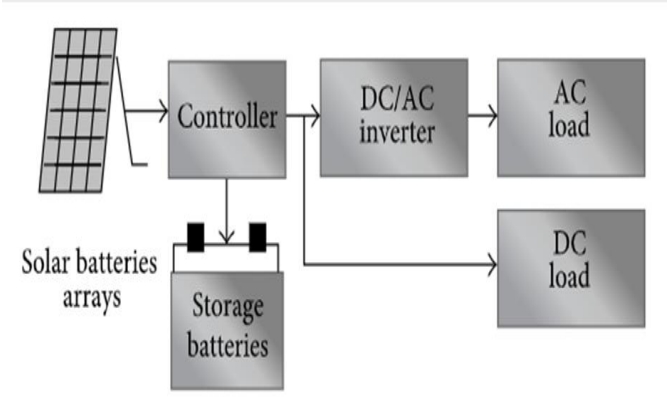


Figure 1: solar energy system

In photovoltaic solar cells, the photovoltaic effect, in which certain materials absorb and liberate photons (light particles) generating an electric current, transforms sunlight directly into electrical power. On the other hand, thermal collectors use panels or mirrors in order to absorb and concentrate the Sun's heat, then transform it into a fluid and pipeline it into houses, plants and electricity generation (solar thermoelectric). In 2010, India's National Solar Mission was launched with a modest goal of 20 gigawatts solar by the end of 2020. Since then, however, there have been several activities in this area and by 2022 the Indian Government now intends to raise the consumption of solar energy to 100 GW.

II. RECENT STATURE AND INITIATED ABILITY OF SOLAR ENERGY IN INDIA

Solar power played a practically non-existent role in India's energy mix. India now has a grid-connected capacity of 481,48 MW as of 31 January 2012. (all PV). However, due to increased demand for electricity and the fossil-fuel prices, the ambitious National Solar Mission, various state-level programmes, renewable energy quotas such as solar energy production quotas, and lower international technology costs, the market will grow significantly over the next ten years. Promoting the spread of solar electricity (both CSP and PV) and the goal of grid parity by 2022 (currently RS.5/kWh), and coal power generation (currently RS.4/kWh) by 2030, are a key element of the broad and long-term energy supply strategy of India. With the annual solar insolation in mind, solar power could thus easily meet India's long-term power needs. It must, however, be reasonably priced. Solar power generation in India costs about RS.10/kWh as of December 2011, which is more than 2.5 times the cost of coal power. Importantly, the industry requires the appropriate policy support to ensure that programmes are properly executed and performed.

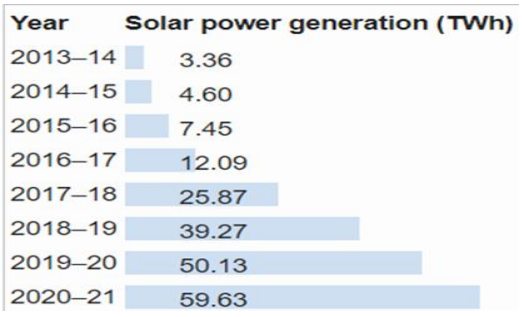


Figure 2: Annual solar power generation

III. USAGE OF SOLAR POWER IN INDIA

Table 1: Usage of solar power in India

S. No.	STATES / UTs	Solar Power		
		Ground Mounted(MW)	Roof Top(MW)	Total(MW)
1	Andhra Pradesh	3470.99	88.03	3559.02
2	Arunachal Pradesh	1.27	4.34	5.61
3	Assam	10.67	30.56	41.23
4	Bihar	138.93	10.42	149.35
5	Chhattisgarh	215.83	15.52	231.35
6	Goa	0.95	3.83	4.78
7	Gujarat	2346.92	416.63	2763.55
8	Haryana	130.80	118.47	249.27
9	Himachal Pradesh	17.00	15.57	32.57
10	Jammu & Kashmir	8.49	10.81	19.30
11	Jharkhand	19.05	19.35	38.40
12	Karnataka	7042.16	232.77	7274.93
13	Kerala	100.00	41.75	141.75
14	Madhya Pradesh	2188.08	49.41	2237.49
15	Maharashtra	1447.30	216.12	1663.42
16	Manipur	0.00	4.58	4.58
17	Meghalaya	0.00	0.12	0.12
18	Mizoram	0.10	1.42	1.52
19	Nagaland	0.00	1.00	1.00
20	Odisha	383.56	14.28	397.84
21	Punjab	828.58	118.52	947.10
22	Rajasthan	4637.48	206.73	4844.21
23	Sikkim	0.00	0.07	0.07
24	Tamil Nadu	3632.52	155.84	3788.36
25	Telangana	3530.29	90.46	3620.75
26	Tripura	5.00	4.41	9.41
27	Uttar Pradesh	899.00	146.10	1045.10
28	Uttarakhand	239.78	75.71	315.49
29	West Bengal	66.25	43.16	109.41
30	Andaman & Nicobar	7.60	4.59	12.19
31	Chandigarh	6.34	30.65	36.99
32	Dadar & Nagar Haveli	2.49	2.97	5.46
33	Daman & Diu	10.15	6.41	16.56
34	Delhi	8.96	147.16	156.12
35	Lakshwadeep	0.75	0.00	0.75
36	Pondicherry	0.03	5.48	5.51
	Total (MW)	31397.32	2333.24	33730.56
MW = Megawatt				

Source: ENRE, Government of India

IV. SOLAR ENERGY DEVELOPMENT IN DIFFERENT STATES

The two major solar power countries in India are Karnataka and Andhra Pradesh. The nation hopes that the technology will yield a large portion of its renewable energy goal of 450 gigawatts by 2030 in order to reduce its reliance on fossil fuels to a minimum. In 2010 only 10 (megawatt) MW of solar power is deployed on the grid, with a goal of 20GW by 2020. The Indian National Solar Mission began its activities in India. However, the country's aim was to achieve 100 GW of solar energy by 2022 because of increasing investment in the photovoltaic field in the following years. It is currently the fourth largest solar producer worldwide and represents more than a third of its overall electricity production from renewable energies. The west and south of the world are home to the most solar power producers.

A. Karnataka—7,100MW

Karnataka, in India's southwest ,is the state that produces the most energy. Karnataka is well ahead of the other nations, with a cumulative installed solar power capacity of about 7,100MW—not including the 1,000MW of projects in the pipeline. The pavagada solar park (or shakti sthala) in tumakuru district of karnataka is india's second -largest solar power project , having previously been the world's largest of it's kind , with a production capacity of 2,050MW. In the districts of bidar ,koppal, and gadag, the state is expected to see three more ultra -mega solar power parks eack with a capacity of 2,500MW.

B. Telangana –5,000MW

Telangana, India's southernmost state, ranks second in terms of solar power capability.

Telangana's cumulative installed solar energy has reached about 5,000MW, a figure it had set for itself by 2020 after the bifurcation of Andhra Pradesh in 2014. This includes both stand-alone and grid-connected rooftop solar panels. The state also chose a distributed solar installation model, which has resulted in savings of about 450 Indian rupees crore. Telangana has dispersed these ventures through more than 180 locations rather than concentrating them in a single city.

C. Rajasthan –4,400MW

Rajasthan is more likely than any other place in the world to generate solar electricity, but it remains behind Karnataka and Telangana. In Rajasthan, solar energy operations accounted for about 4400MW of solar energy as of November 2019, while 1,900MW of pipeline energy is still under construction. By 2025, Rajasthan intends to install an overall solar energy power of 30,000 MW. The 14 000 acres of Jodhpur's Bhadla Solar Plant, with an installed capacity of 245 megawatts solar, is reportedly the biggest fully operating solar park in the country. The only thermal power plant in India is also located in Rajasthan.A 25,000 MW ultra-mega renewable power park has been uncovered by the central government. 10,000MW of solar power will be deployed in the State in the next three years, during the first phase of the program.

D. Andhra Pradesh—3,470MW

Andhra Pradesh claims to be the second-largest green state in India with a clean energy potential of around 10 per cent. The state's gross solar power output is more than 3,470MW, making it the fourth largest with its solar and winnipeg facilities totaling around 7,700MW. The

area hosts the Kurnool district's 1,000MW ultra-mega-solar park. The Andhra Pradesh government is preparing a 10GW mega solar energy project because of the increasing demand in the state. It is intended to provide the agricultural sector with free, uninterrupted fuel.

E. Gujarat—2,654MW

Of the current Gujarat total output of 9,670MW of renewable energy, some 2,654MW of solar energy is produced. By the year 2022 the State plans to increase its capacity for renewables to 30 000 MW. It ranked at top level in India by March 2020 – with a total of 50 915 – for domestic solar rooftop installations, accounting for 64% of the country's total of 79 950 equipment. Gujarat aims to achieve a solar power capability of 8 024MW by 2022, with the addition of a 3 200 MW over the roof segment to support India's goal of installing 100GW solar capacity, 40GW of which is expected on solar rooftops. In Patan District, Charanka Solar Park, which currently produces 600 MW, Gujarat's one-largest solar energy generation capacity can be found.

V. DEVELOPMENT OF SOLAR ENERGY IN INDIA

Since ancient times, the Sun has been revered as a life-giver to our world. The Industrial Revolution taught us how to use sunlight as a source of energy. India has a tremendous amount of solar energy potential. India's land area receives about 5,000 trillion kWh of energy per year, with most areas receiving 4-7 kWh per sq. m per day. Solar photovoltaic power can be effectively harnessed in India, allowing for massive scalability. Solar also allows for distributed power generation and allows for rapid capacity expansion with short lead times. Rural electrification, as well as meeting other energy needs for electricity, heating, and cooling in both rural and urban areas, would benefit from off-grid decentralized and low-temperature applications. Solar is the most reliable of all energy sources in terms of energy security, due to its widespread availability. In theory, a small fraction of total incident solar energy can satisfy the entire country's power needs (if collected effectively).

During the last few years, solar energy has had a noticeable effect on the Indian energy landscape. Millions of people in Indian villages have benefited from solar energy-based decentralized and distributed applications that meet their cooking, lighting, and other energy needs in an environmentally friendly manner. The social and economic benefits include a reduction in drudgery among rural women and girls who collect fuel wood over long distances and cook in smoky kitchens, a reduction in the risk of contracting lung and eye diseases, the creation of jobs at the village level, and, ultimately, an improvement in the standard of living and the creation of opportunities for economic activities at the village level. In addition, India's solar energy sector has grown to become a major player in grid-connected power generation capacity over the years. It promotes the government's agenda of long-term growth while also establishing itself as an important contributor to meeting the country's energy needs and a key player in ensuring energy security .

Source: NS Energy

Figure 3: Solar panels

The National Institute of Solar Energy estimated the country's solar capacity to be about 748 GW, assuming that solar PV modules cover 3% of the waste land area. Solar energy is one of the main missions in India's National Action Plan on Climate Change, with the National Solar Mission being one of them. On January 11th, 2010, the National Solar Mission (NSM) was launched. The National Sustainable Growth Mission (NSM) is a major initiative of the Indian government, with active participation from states, to encourage environmentally sustainable growth while addressing India's energy security challenges. It will also be a significant contribution by India to the global initiative to address climate change challenges. It aims to establish India as a global solar energy pioneer by establishing the political conditions for the dissemination of solar power across the world as rapidly as possible. By 2022, the Mission hopes to have installed 100 GW of grid-connected solar power plants. This is in line with India's Intended Nationally Determined Contributions (INDCs) goal of 40 percent cumulative electric power installed capacity from non-fossil fuel dependent energy resources by 2030, and a reduction of 33 to 35 percent in the emission intensity of its GDP from 2005 levels. In order to achieve this aim, the Indian government has adopted various policies, including the Solar Parks Scheme, the VGF schemes (VGF) Schemes, the CPSU Schemes (CPSU) and the Defence Schemes.

The announcement of a trajectory for the Renewable Purchase Obligation (RPO), which includes Solar, was one of the policy steps taken. , Waiver of ISTS charges and losses for inter-state solar and wind power sales for projects to be completed by March 2022, Must-run status, Guidelines for solar power procurement through a tariff-based competitive bidding mechanism, Solar Photovoltaic Systems and Applications Implementation Standards Rooftop solar and smart city planning guidelines are available. Amendments to building codes to make roof top solar mandatory for new construction or buildings with a higher Floor Area Ratio, Solar project infrastructure status, raising tax-free solar bonds, obtaining long-term loans from multilateral institutions, and so on.

India recently surpassed Italy to take fifth place in the world for solar power deployment. The Solar capability has grown by over eleven times over the last five years, from 2.6 GW in March 2014 to 30 GW in July 2019. Solar tariffs in India have hit grid parity and are already very competitive.

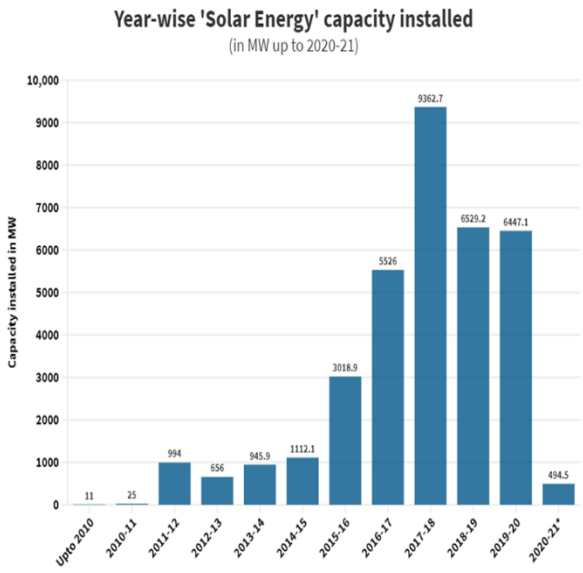


Figure 4: year wise solar energy capacity installed in India

VI. GROWTH OF SOLAR ENERGY IN INDIA

The Indian government has started to recognize the value of solar energy in the country's economic development. In 2010, Prime Minister Manmohan Singh launched the National Solar Mission, claiming that solar energy will transform rural India. The initial growth has been spectacular, although from a small starting point. Solar power generation in the country increased from less than 12 MW in 2009 to 190 MW in 2011. It is projected to rise fivefold to 1,000 MW by March 2013, but the country still has a long way to go to meet its 2020 target of 20 gigawatts of solar power generation. Thousands of villages across India still have plenty of sun but not enough steam.

VII. FUTURE GROWTH OF SOLAR IN INDIA

If most people hear the words 'solar power,' they are thinking immediately of good solar panels on the surface of the roof or in a desert solar farm. And rightly so: the solar industry was dominated by the conventional utility and rooftop panels. But now there are some promising new technology for the solar panels either on or in the pipeline. These promising innovations will revolutionise the way we do not only think about solar, but about energy generation. Solar doesn't need to look bland and it does not take huge parcels of land or roof space longer.

Figure 5: Building integrated photovoltaic

Five solar technologies with the greatest effect on the solar industry in the next few years:

A. Floating solar farms:

The daily cost of silicone panels is increasingly low and functional. According to experts they give even greater efficiencies and a host of other benefits if photovoltaic panels are located in lakes and in other bodies. The 'Floatovoltaics' are solar energy photovoltaic systems for floating in lakes and dams.

Figure 6: Floating solar farms

Solar floating farms can produce enormous quantities of energy without using precious property or property. The costs of installing photovoltaic floating panels are less than photovoltaic panels based on ground.

B. BIPV Solar technology :

Builden photovoltaics, as their name implies, blend into the architecture of buildings seamlessly in the form of roofs, canopies and curtain walls. Instead of compromise on a building's architecture, the BIPV may be aesthetic, as opposed to conventional solar solar panels. Of course, for solar purchasers, aesthetics alone are not enough; economic issues are also significant. The good news is that homeowners are able to save on construction materials and electrical energy costs with BIPV solar panel systems. The extra cost of solar panel systems can be reduced by replacing BIPV with normal building materials.

C. Solar skins:

Solar skins are a new PV technology for the integration of individual designs into solar panels. The technology

for solar skin is identical to the ad wraps on the bus screens.

Figure 7: Comparing the traditional solar panel (Left) and solar skin installation on top (Right).

In the U.S. National Renewable Energy Laboratory, Sistine, the solar skin producer is testing the technology to enhance its production. Due to their selective light filtration progress, solar thin-film skins retain high performance. Sunlight is filtered into the underlying solar cells by dropping into solar skins. In this way, it shows the custom picture at the same time and supplies solar power.

D. Solar fabric:

Solar textiles are being developed by researchers to use solar power in each fibre. These solar filaments can be built into your t-shirts, winter clothing or some other garments so that you can stay warmer. power up your telephone. Household solar cleaning will save on the installation and installation costs of the solar panel.

E. Photovoltaic solar noise barriers (PVNB):

PVNBs are the technology intended to reduce noise, protect recipients from noise pollution by vehicles and produce a renewable energy environment. PVNBs are a technology for noise reduction. Its configuration consists of a photovoltaic (PV) noise barrier device that converts solar energy to power.

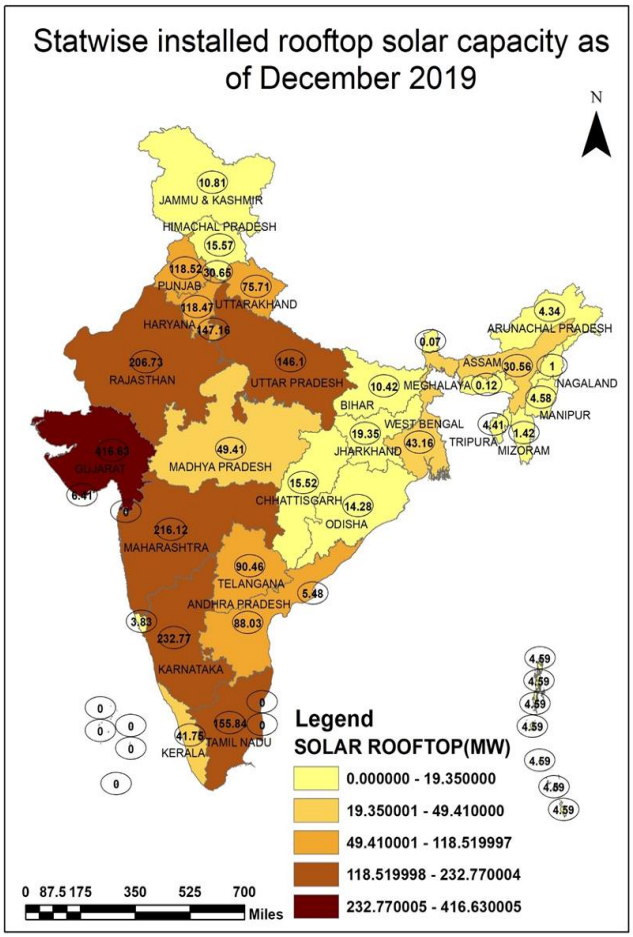
Figure 8: PVNB

VIII. THE FUTURE OF SOLAR LOOKS BRIGHT

Solar energy has been around for a long time, and although it is still referred to as an alternative energy source, its applications have grown dramatically in recent years. Solar energy can now be used for almost anything, from charging your phone to heating your entire home, and the technology has advanced significantly on both a global and personal level. Although rooftop solar panels are still common, the sun can assist you in a variety of ways.

Figure 9: solar rooftop for home

Solar energy was previously only provided by ground-mounted or rooftop panels. However, as a result of all of the above developments, solar is expected to become lighter, more versatile, and more widely applicable. Imagine having access to all of this technology and travelling to a different area. You can buy food from a solar-powered food cart, eat it on a solar-powered highway, and use solar-powered clothes to charge your phone. This is how the near future appears! There are also a slew of other cutting-edge residential solar innovations in the works or set to launch in 2021. Perovskite solar cells, which will soon be used to make solar paint, are perhaps the most exciting new technology.



Source: ENRE, Government of India

CONCLUSION

Global energy demand is increasingly increasing. Entry to fossil fuels is likely to be restricted in the future due to environmental concerns. As a result, renewable energy sources such as solar power are expected to meet a portion of the rising energy demand. Solar thermal and photovoltaic electricity generation are two promising climate-friendly power technologies with so much promise that they could potentially cover much more than the current global demand for electricity. Both technologies, when combined, can make a significant contribution to climate security. Both technologies, when combined, can make a significant contribution to climate security. Low-power demand, stand-alone systems, and building-integrated grid-connected systems are all advantages of photovoltaic systems. Solar energy-based power generation systems have the potential to play a significant role in meeting industry's energy needs. Such energy production facilities are either operational or under construction in the United States and Europe. The Government of India's Ministry of Nonconventional Energy Sources is attempting to electrify as many villages as possible using solar photovoltaic systems. India's solar power technology has a lot of economically exploitable potential. There are numerous locations in India where solar power plants can be built to generate electricity. Since this solar thermal technology has been successfully applied in developed countries with high solar potential, further development is needed. The rapid expansion of solar power has been fuelled by policy support in the United States, Europe, China, India, and Australia. This brief analysis aims to demonstrate how advances in technology and competition among players in the manufacturing, supply, and installation industries have resulted in cost reductions, but not at the same rapid pace as traditional power.

References

[1] loco media “solar energy for Beginners : The complete guide to solar systems, panels & cells kindle “2015.

[2] Dr . da rosa , Juan c. ordonez, “fundamentals of reenwable energy process” 4th edition 2021.

[3] Shiva gorjian and Ashish Shukla ,biosystems engineering, department ,faculty of agriculture, Iran, “photovoltaic solar energy conversion”.

[4] National institute of solar energy ,Autonomous institute under ministry of new and renewable energy Government of India.

[5] D.P. Kothari, S.D padhyay and u.shanker ,”Renewable energy technology for cooking ;transforming rural lives “, IEEE technology, volume 32, 2013.

[6] P.Kaur , A. Jhunjhuwala , A lolla “solar-dc microgrid for Indian homes :transforming power scenario”, IEEE volume 4 jan 2016

[7] A.Aggarwal,SJ.Darak, A.singhal “clean and green India :Is solar energy the answer?”IEEE, Volume 37.jan 2018.

[8] Rajvikaramm Madurai Elavarasan ,GM Shafiullah sanjeevi kumar padmanaban , Nallapaneni manoj kumar, Annapurna Annam ,Lucian Mihet-popa “A Comprehensive Review on renewable energy development ,challenges and policies of leading Indian States of Internal Perspective, 2020.