

Renewable Energy : Solar Power in India

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Abstract

Renewable energy is basically the energy that comes from natural sources such as wind, sunlight, tides, rain, and geothermal heat. Generally renewable energy projects are used on a large scale, however, this does not mean that renewable energy cannot be used in smaller areas such as villages or more generally rural areas. A clear example can be seen in Kenya, where it is estimated that roughly 30,000 small solar power units with a capacity of 20 to 100 watts are sold every year. This is the largest solar ownership rate in the world for residential communities.

Even though energy from renewable energy sources is growing rapidly, with markets such as solar cells, wind and bio-diesel experiencing annual double digit growth, the overall share is only expected to increase marginally over the coming decades as the demand for energy also grows rapidly, particularly in many developing countries. In India, the scientific focus is deliberately moving towards transforming coal into clean energy as well as harnessing hydropower. The recent surge in nuclear energy is also diverting focus from the solar energy enhancement. In all probability, the Indian government will support off-grid solar energy production through a decentralized manner. In spite of this, India needs to focus research on solar energy and cheaper photovoltaic to provide affordable energy to all.

A fact about Solar Energy Power Houses Installation of 1 kilowatt power system requires the user to possess \$10,000 initially, but this can bring many long run benefits.. A 1 kilowatt solar power house requires 8 to 10 solar panels. The 1kilowatt solar system is capable of producing 1400 to 1600 kilowatt per hour in a year. The installation of 1 kilowatt solar system can save 105 gallons of water, 170 pounds coal and 300 pounds of carbon dioxide to be discharged in the air. The solar panels work efficiently only if they face north. The solar panels can tolerate the harmful ultraviolet rays and comes with a warranty of 20 years. Solar panels have many colors and they are capable of providing electricity 24/7.

1. RENEWABLE ENERGY : SOLOR POWER IN INDIA

Human civilization has been witnessing a gradual shift towards cleaner fuels—from wood to coal, from coal to oil, from oil to natural gas; renewable are the present demand. With the fluctuating high cost of petroleum, minimizing dependence on importing conventional energy resources, stewardship to protect the Planet and providing affordable energy to all, countries including India have stepped up their energy path for harnessing indigenous renewable resources. To tap the infinite energy and transform as well as transmit it to each household, the Indian government has accelerated promotion of the use of universally available Solar Energy.

2. WHAT IS RENEWABLE ENERGY? HOW RENEWABLE ENERGY WORKS

Renewable energy is basically the energy that comes from natural sources such as wind, sunlight, tides, rain, and geothermal heat. Generally renewable energy projects are used on a large scale, however, this does not mean that renewable energy cannot be used in smaller areas such as villages or more generally rural areas. A clear example can be seen in Kenya, where it is estimated that roughly 30,000 small solar power units with a capacity of 20 to 100 watts are sold every year. This is the largest solar ownership rate in the world for residential communities. There are some renewable energy technologies that are disliked for being unreliable but at the same time if you

are to look at the renewable energy market it seems to be growing every day.

India due to its geo-physical location receives solar energy equivalent to nearly 5,000 trillion KWh per year, which is far more than the total energy consumption of the country today. But India produces a very negligible amount of solar energy – a mere 0.2 percent compared to other energy resources. Power generation from solar thermal energy is still in the experimental stages in India. Up till now, India's energy base has been more on conventional energy like coal and oil. However, India has now attained 7th place worldwide in Solar Photovoltaic (PV) Cell production and 9th place in Solar Thermal Systems. Grid-interactive renewable power installed capacity as on 31.10.2006 aggregated 9,013 MW corresponding to around 7 percent of the total power installed capacity which equates to over 2 percent of total electricity.

3. INDIA : STATUS OF SOLAR ENERGY

The solar PV program was begun in the mid 70's in India. While the world has progressed substantially in production of basic silicon monocrystalline photovoltaic cells, India has fallen short to achieve the worldwide momentum. In early 2000, nine Indian companies were manufacturing solar cells. During 1997-98 it was estimated that about 8.2 MW capacity solar cells were produced in the country. The total installed manufacturing capacity was estimated to be 19 MW per year. The major players in Solar PV are Bharat Heavy Electrical Ltd. (BHEL); Central Electronics Ltd., and Rajasthan Electrical & Instruments Ltd., as well as by several companies in the private sector. The latest, 100 million dollars investment from Tata BPSolar in India is the pointer towards the booming solar market in India. Of late, the market is growing for SPV applications based products with the active encouragement of the government.

4. PRESENT SCENARIO OF SOLAR POWER

The MNES has been implementing installation of solar PV water pumping systems for irrigation and drinking water applications through subsidy since 1993-94. Typically, a 1,800 Wp PV array capacity solar PV water pumping system, which cost about Rs. 3.65 lakh, is being used for irrigation purposes. The Ministry is providing a subsidy of Rs.30 per watt of PV array capacity used, subject to a maximum of Rs. 50,000 per system. The majority of the pumps fitted with a 200

watt to 3,000 watt motor are powered with 1,800 Wp PV arrays which can deliver about 140,000 liters of water/day from a total head of 10 meters. By 30th September, 2006, a total of 7,068 solar PV water pumping systems have been installed. State-wise details of cumulative achievements under various non-conventional energy programmes, as on 31.03.2006 are shown in the table below:

Table 1

Energy Generated (Mega Watt Years Wise)				
S.No.	States	2003	2004	2005
1	Andhra Pradesh	0.21	0.25	0.26
2	Arunachal Pradesh	0.02	0.03	0.04
3	Assam	0.03	0.04	0.05
4	Bihar	0.11	0.11	0.14
5	Chatisghar	0.08	0.19	0.21
6	Goa	0.00	0.00	0.01
7	Gujrat	0.10	0.11	0.12
8	Haryana	0.17	0.21	0.26
9	Himachal Pradesh	0.14	0.14	0.15
10	Jammu & Kashmir	0.13	0.22	0.24
11	Jharkhand	0.03	0.03	0.07
12	Karnatka	0.13	0.14	0.22
13	Kerla	0.33	0.43	0.43
14	Madhya Pradesh	0.16	0.16	0.17
15	Maharashtra	0.01	0.13	0.14
16	Manipur	0.02	0.01	0.13
17	Meghalya	0.03	0.03	0.06
18	Mizoram	0.03	0.05	0.05
19	Nagaland	0.01	0.01	0.01
20	Orissa	0.11	0.12	0.27
21	Punjab	0.14	0.41	0.42
22	Rajasthan	0.38	0.40	0.44
23	Sikkim	0.01	0.01	0.01
24	Tamilnadu	0.21	0.22	0.23
25	Tripura	0.07	0.07	0.10
26	Uttarpradesh	0.28	0.33	0.43
27	West Bangal	0.35	0.67	0.68
28	Andman & Nicobar	0.05	0.05	0.06
29	Chandigarh	0.02	0.02	0.02
30	Delhi	0.02	0.02	0.03
31	Lakshadweep	0.13	0.13	0.14
32	Pandicherry	0.01	0.01	0.01
33	Others	0.07	0.11	0.12
	Total	4.14	5.42	6.37

Government-funded solar energy in India only accounted for approximately 6.4 megawatt-years of power as of 2005.

A total of 32 grid interactive solar PV power plants have been installed in the country with financial assistance from the Federal Government. These plants, with aggregate capacity of 2.1 MW, are estimated to generate about 2.52 million units of electricity in a year. In 1995, an aggregate area of 4 lakh square meters of solar collectors were installed in the country for thermal applications such as water heating, drying cooking etc. The thermal energy generated from these devices was assessed at over 250 million kwh per year. In addition, solar PV systems with an aggregate capacity of 12 MW were installed for applications such as lighting, water pumping, communications, etc. These systems are capable of generating 18 million kwh of electricity per year. In 2003 alone, India added 2.5 MW of solar PVs. For rural electrification as well as employment and income generation, about 16,530 solar photovoltaic lighting systems were installed during 2004-05. Over 150,000 square meters of collector area has been installed in the country for solar water heating in domestic, industrial and commercial sectors making the cumulative installed collector area over one million square meters.

5. INDIA'S INTEGRATED RURAL ENERGY PROGRAM REMOTE VILLAGES SELECTED FOR SOLAR ELECTRIFICATION

Similarly, India's Integrated Rural Energy Program using renewable energy had served 300 districts and 2,200 villages by early 2006. More than 250 remote villages in seven states were electrified under the program during 2005, with additional projects under implementation in over 800 villages and 700 hamlets in 13 states and federal territories (see table below). Rural applications of solar PV had increased to 340,000 home lighting systems, 540,000 solar lanterns, and 600,000 solar cookers in use. By 2006 over 2,400 off-grid villages in India had received solar thermal and photovoltaic systems.

Table 2
States off grid villages

S.No.	States	Numbers
1	Andhra pradesh	168
2	Assam	33
3	Gujrat	38
4	Haryana	45
5	Jammu & Kashmir	50
6	Jharkhand	341
7	Karnatka	20
8	Madhya pradesh	50
9	Maharastra	174
10	Manipur	40
11	Mizoram	20
12	Rajasthan	230
13	Tamilnadu	152
14	Tripura	518
15	Utranchal	164
16	Uttarpradesh	97
17	West Bangal	265
	Total	2,405

6. SOLAR POWER PLANT FOR DOMESTIC USE

About 15 years ago the solar power plants were 10 times more expensive than they are today. The development in this field has lent a hand in reducing the prices. The decrease in the prices of solar panels is forecasted dependent upon the growth of the market. Installing a solar panel at the roof top of your home might look like an initial large investment. However if you look at the long terms benefits associated with these solar panels the cost is nothing. Moreover if you compare the benefits and the cost of deploying solar panels, you would end up enjoying its benefits more than its cost. Solar power system gives you enough freedom to use electricity without any further tax payment. It allows you to operate your own electricity power plant. One important factor which should be considered while deploying this system is that analyzes your power consumption prior to installment. The

cost of equipment and installation varies with the size and consumption of the household users.

7. CALCULATION OF COST

Suppose you pay \$60 to \$80 every month in your electricity bill. This cost along with the unapprised increase in electricity charges leaves you with little or no saving. On the other hand installation of solar power plant is a one time expense. For example a single solar panel costs you \$1000 to \$1500 only. This is a one time expense and it includes all the government taxes, rebate and tax credit. Hence you end up using very cost friendly package because now you are able to enjoy the long term benefits of deploying solar power system. If we analyze the cost associated with the efficacy of solar collectors and solar panels it is amazing. An average photovoltaic panel has an estimated energy conversion of about 20 to 25%. hence if any panel receives unobstructed sunlight for constant three hours on 1 square meter is about \$0.05%. therefore it is much lower as compared to use of other bio-fuels. Here it should also be noted that heat consumption efficiency for solar water heaters is same as the efficacy for oil. Whereas the cost of oil is \$2 per gallon while of sun it is only \$0.14.

8. COMPARISON OF SOLAR ENERGY TO OTHER NATURAL RESOURCES

Another important consideration while comparing the **cost of solar system** is its availability. We all know that solar energy is free and it is everywhere. There is no heavy machinery required to drill it out like other bio fuels. This is the only natural resource which is neither the property of any specific government nor any person. Every individual or the planet earth can utilize it in unlimited quantity. The free availability of this natural resource makes it desirable to use by individuals as well as the governments. On the contrary still people believe that cost of solar power systems is more. This is because of many other factors. First of all the amount of electricity generated by solar power houses is very less as compared to the electricity generation by other means. Secondly the solar power houses require a significant backup power system in the form of batteries and wind mills. Single solar panel

can not produce enough electricity to support domestic and commercial needs. Hence an array of solar cells is often required to cater the needs of individuals and businesses. So far the solar panels are really expensive but the increase in the production of these solar panels can help lower down its prices.

9. ENVIRONMENTAL COSTS

In India, of late there has been a debate regarding whether hydro-power and solar power are green or renewable? Since solar power systems generate no air pollution during operation, the primary environmental, health, and safety issues involve how they are manufactured, installed, and ultimately disposed of. Also, an important question is how much fossil energy input is required for solar systems compared to the fossil energy consumed by comparable conventional energy systems. Another concern area is installing solar cells on the land area. The large amount of land required for utility-scale solar power plants – approximately one square kilometer for every 20-60 megawatts (MW) generated – poses an additional problem in India. Instead, solar energy in particular requires unique, massive applications in the agricultural sector, where farmers need electricity exclusively in the daytime. This could be the primary demand driver for solar energy in India

10. CONCLUSION

Even though energy from renewable energy sources is growing rapidly, with markets such as solar cells, wind and bio-diesel experiencing annual double digit growth, the overall share is only expected to increase marginally over the coming decades as the demand for energy also grows rapidly, particularly in many developing countries. In India, the scientific focus is deliberately moving towards transforming coal into clean energy as well as harnessing hydropower. The recent surge in nuclear energy is also diverting focus from the solar energy enhancement. In all probability, the Indian government will support off-grid solar energy production through a decentralized manner. In spite of this, India needs to focus research on solar energy and cheaper photovoltaic to provide affordable energy to all.

A fact about Solar Energy Power Houses Installation of 1 kilowatt power system requires the user to possess \$10,000 initially, but this can bring many long run benefits. Solar energy systems can be connected to electric grids or battery for back up support. The solar power houses which are connected to existing electricity grid can help to reduce the electricity bills. As this system combines the both electricity sources hence per unit load on utility grids is lowered and there is reduction in monthly bills. A 1 kilowatt solar power house requires 8 to 10 solar

panels. The 1kilowatt solar system is capable of producing 1400 to 1600 kilowatt per hour in a year. The installation of 1 kilowatt solar system can save 105 gallons of water, 170 pounds coal and 300 pounds of carbon dioxide to be discharged in the air. The solar panels work efficiently only if they face north. The solar panels can tolerate the harmful ultraviolet rays and comes with a warranty of 20 years. Solar panels have many colors and they are capable of providing electricity 24/7.



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