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SOLAR ENERGY: AN EMERGING ALTERNATIVE ENERGY SOURCE FOR THE CURRENT SCENARIO

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ABSTRACT

The early development of solar technologies starting in the 1860s. The need to increase the use of renewable energy sources for sustainable energy development was recognized in our country in the early 70s. Early 20th century the development of solar technologies is constant because it faces growth in economy, availability and utility of petroleum and coal. Through our dependency on inexhaustible and independent resource we can increase countries' energy security. The impact of which enhance sustainability, reduce fossil fuel prices, costs of mitigating climate change and pollution. To control long-term carbon emissions without compromising its economic growth potential, India can make solar energy as one of the major sources of its economy.

KEYWORDS

Solar energy, Photovoltaic systems, Alternative fuels, Power and Economics.

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INTRODUCTION

Solar energy is genesis for all forms of energy. We can use solar energy in different criteria (Table No.1). First thermal route in which heat is using for heating, cooking, drying, generation of electricity etc. Second through the photovoltaic route which converts solar energy into electricity that can be further used for different purposes viz. lighting, pumping, generation of electricity etc. Because of its pollution free nature, global distribution and inexhaustible supply- solar energy is a very effective energy source in the present scenario[1].

Energy Storage Methods

Modern era energy system requires continuous supply of energy and solar energy is not available at night. Therefore, energy storage is an important issue here[7].

In advancement in technology we can store solar energy in the form of heat by various thermal systems which may be used in seasonal durations. For the manufacture of these storage systems we use readily available materials viz. Water, earth and stone having high specific heat capacities. Well-designed systems can lower peak demand, shift time-of-use to off-peak hours and reduce overall heating and cooling requirements[8,9].

Thermal storage media can be made by Phase change materials viz. paraffin wax and Glauber's salt. Because these materials are inexpensive and their availability is good. They are working at approximately 64°C. The "Dover House" (in Dover, Massachusetts) was the first to use a Glauber's salt heating system, in 1948[10].

By using molten salts and at high temperatures we can stored solar energy. Salts are an effective storage medium because of their low-cost and high specific heat capacity. Advantage of this medium is that it can deliver heat at temperatures compatible with conventional power systems. The Solar system used this method of energy storage, allowing it to store 1.44 TJ in its 68 m^3 storage tank with an annual storage efficiency of about 99%[11].

To store extra electricity, Off-grid PV systems have traditionally used rechargeable batteries. This extra electricity can sent to the transmission grid with the use of grid-tied systems, while standard grid electricity can be used to meet shortfalls. For any electricity they deliver to the grid net metering programs are used. Which are often controlled by 'rolling back' the meter. If the net electricity use is below zero, the utility is required to pay for the extra at the same rate as they charge consumers[12]. Other legal approaches involve the use of two parallel meters, one to measure electricity consumed and other to produce electricity.

When energy is available from a lower elevation reservoir to a higher one Pumped-storage hydroelectricity are used. The energy is recovered when demand is high by releasing the water to run through a hydroelectric power generator[13].

With the use of nanotechnology we store solar electromagnetic energy in the form of chemical bonds. Here, we dissociate water to produce hydrogen or combining with CO_2 to produce biopolymers (methanol). They further used as fuels. All these process comes under Artificial Photosynthesis. Now a day's national and regional research projects on artificial photosynthesis are trying to develop such techniques in which we can use cheap catalyst, we can improve light capture and also used quantum coherence methods of electron transfer materials that operate under a variety of atmospheric conditions[14].

Development, Deployment and Economics

The early development of solar technologies starting in the 1860s. The need to increase the use of renewable energy sources for sustainable energy development was recognized in our country in the early 70s[15].

Commercial solar water heaters started in the 1890s. These systems continuous increase its use until 1920s. But sometimes replaced by cheaper and more reliable heating fuels[16]. Throughout 1990s development in the solar water heating sector progressed steadily. Solar water heating and cooling is by far the most widely deployed solar technology with an estimated capacity of 154 GW as of 2007[17].

Affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits due to which countries' energy security increases. These advantages are global. Therefore, additional costs of the incentives for early deployment should be considered learning investments[18].

International Energy Agency (IEA) said that "solar energy technologies such as photovoltaic panels, solar water heaters and power stations built with mirrors could provide a third of the world's energy by 2060 if politicians commit to limiting climate change"[19].

Photovoltaic Power Systems

A photovoltaic cell (PV) is a device that converts light into electric current using the photoelectric effect (Figure No.1). The first solar cell was constructed in the 1880s[20]. A German engineer,

Dr Bruno Lange in 1931 developed a photo cell using silver selenide[21]. Although the prototype selenium cells converted less than 1% of incident light into electricity[22]. Following the work of Russell Ohl in the 1940s created the silicon solar cell in 1954[23]. These early solar cells cost 286 USD/watt and reached efficiencies of 4.5-6%[24].

Solar cells produce DC, which fluctuates with intensity of the irradiated light. That requires conversion to certain desired voltages or AC, which requires the use of the inverters. Inside modules multiple solar cells are connected. Modules are wired together to form arrays, then tied to inverter, which produces power with the desired voltage and frequency/phase (when it's AC) (Table No.2)[25].

Solar Power in India

In July 2009, India unveiled a US$19 billion plan to produce 20 GW of solar power by 2020[26]. Under the plan, the use of solar-powered equipment and applications would be made compulsory in all government sectors[27]. In 2009, India was ready to launch its National Solar Mission under the National Action Plan on Climate Change, with plans to generate 1,000 MW of power by 2013[28].

The falling prices of PV panels, mostly from China but also from the U.S., have coincided with the growing cost of grid power in India[29]. As of 2005 Government-funded solar energy in India approximately 6.4MW-yr of power. In October 2009, India was ranked number one along with the United States in terms of solar energy production per watt installed (Table No.3)[30-32].

Challenges and Opportunities

Being a densely populated country, India should implement a policy of developing solar power as it is a dominant renewable energy source. In one of the analyzed scenarios, India can make renewable resources as a backbone of its economy by 2050.

Government support solar resources have also helped to increase solar adoption. Because India need 10-13% electricity as daily need, therefore as a growing economy India is facing electricity deficit problem[29].

Government Support

India's government is promoting the use of solar energy through various strategies. The government of India has announced in the budget year 2010-2011, an allocation of ₹10 billion to Jawaharlal Nehru National Solar Mission and the establishment of a clean energy fund. It is an increase of ₹3.8 billion (US$72.2 million) from the previous budget.

MNRE (Ministry of New and Renewable Energy) provides 70% subsidy on the installation cost of a solar photovoltaic power plant for North-East states and 30 % subsidy to the other regions[33].

Alternative Fuels Programme

There are so many alternative fuel programmes. Some of them are,

1. Hydrogen fueled power-generating sets, two-wheelers and catalytic burners for industrial and residential use have been developed. The advantage of these programmes is that the hydrogen powered vehicles and fuel cell vehicles are truly zero-emission vehicles.
2. Some companies including BHEL and scooters India Ltd are developing and deploying battery operated passenger vehicles.
3. Manufacture of hybrid electric vehicle has also been taken up.

Table No.1: Yearly solar fluxes and human energy consumption

S.No	Yearly Solar fluxes and Human Energy Consumption	
1	Solar	3,850,000 EJ[2]
2	Wind	2,250 EJ[3]
3	Biomass	3,000 EJ[4]
4	Primary energy use (2005)	487 EJ[5]
5	Electricity (2005)	56.7 EJ[6]

Table No.2: World's largest photovoltaic power stations (50MW or larger)

S.No	World's largest photovoltaic power stations (50MW or larger)			
	PV power station	**Country**	**DC peak power (MW_p)**	**Notes**
1	Golmud Solar Park	China	200	Completed 2011
2	Sarnia Photovoltaic Power Plant	Canada	97	Constructed 2009-2010
3	Montalto di Castro Photovoltaic Power Station	Italy	84.2	Constructed 2009-2010
4	Finsterwalde Solar Park	Germany	80.7	Phase I completed 2009, phase II and III 2010
5	Ohotnikovo Solar Park	Ukraine	80	Completed 2011
6	Solarpark Senftenberg	Germany	78	Phase II and III completed 2011, another 70 MW phase planned
7	Lieberose Photovoltaic Park	Germany	71.8	
8	Rovigo Photovoltaic Power Plant	Italy	70	Completed November 2010
9	Olmedilla Photovoltaic Park	Spain	60	Completed September 2008
10	Strasskirchen Solar Park	Germany	54	
11	Puertollano Photovoltaic Park	Spain	50	opened 2008

Table No.3: India's Largest Photovoltaic (PV) Power Plants

S.No	Name of Plant	DC Peak Power (MW)	Notes
1	Reliance Power Pokaran Solar PV Plant, Rajasthan	40	Commissioning in March 2012
2	Adani Bitta Solar Plant, Gujarat	40	Completed in January 2012
3	Mahindra Solar Plant, Jodhpur, Rajastan	5	Completed in January 2012
4	Sivaganga Photovoltaic Plant	5	Completed December 2010
5	Kolar Photovoltaic Plant	3	Completed May 2010
6	Itnal Photovoltaic Plant, Belgaum	3	Completed April 2010
7	Azure Power - Photovoltaic Plant	2	2009
8	Chesdin Power - Biomass and Solar Photovoltaic Plants	4.1	Completes December 2011
9	Jamuria Photovoltaic Plant	2	2009
10	NDPC Photovoltaic Plant	1	2010
11	Thyagaraj stadium Plant-Delhi	1	April, 2010
12	Gandhinagar Solar Plant	1	January 21, 2011
13	Tata - Mulshi, Maharashtra	3	Commissioned April 2011
14	Azure Power - Sabarkantha, Gujarat	10	Commissioned June 2011
15	Moser Baer - Patan, Gujarat	30	To Be Commissioned July 2011
16	Tata - Mayiladuthurai, Tamil Nadu	1	Commissioned July 2011
17	REHPL - Sadeipali, (Bolangir) Orissa	1	Commissioned July 2011
18	Tata - Patapur, Orissa	1	Commissioned August 2011
19	Tata - Osmanabad, Maharastra	1	Commissioned 1st Aug 2011
20	Abengoa - Gwal Pahari, Haryana	3	Commissioned September 2011
21	Chandraleela Power Energy - Narnaul, Haryana (EPC by Aryav Green Energy Solutions Pvt. Ltd.)	0.8	To be Commissioned December 2011
22	Green Infra Solar Energy Limited - Rajkot, Gujarat	10	Commissioned November 2011
23	Total	167.9	

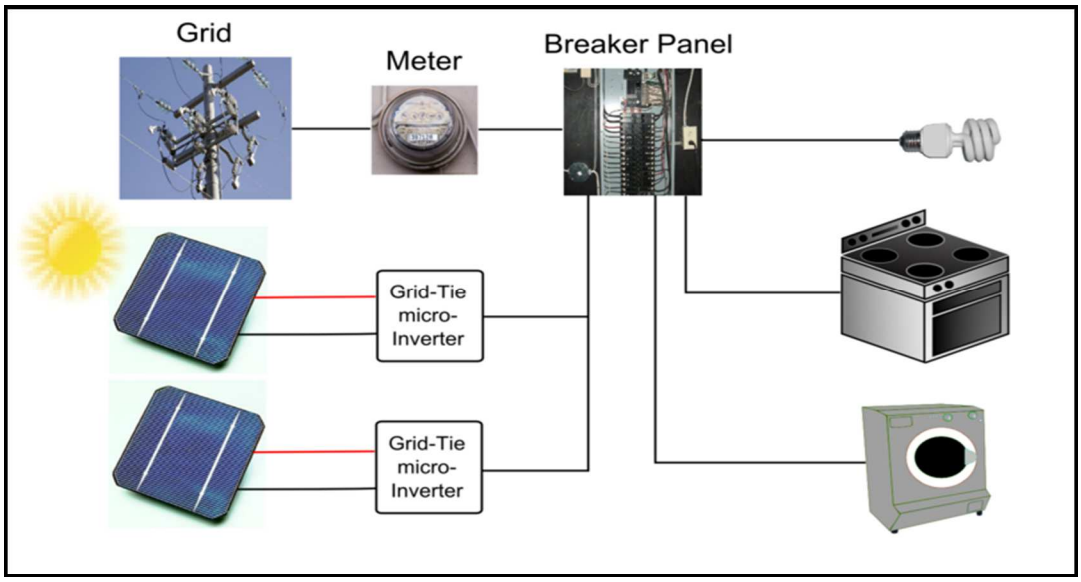

Figure No.1: Residential grid-connected PV system

CONCLUSION

The level of use however, depends on availability of fossil fuels and their price. Recent success through market approach ensures larger applications on a sustainable basis. One framework for these activities is anticipatory governance. Public engagement increasingly moving "upstream" to the early stages of technological development[34].

WHAT'S OUR ENERGY FUTURE?

The world energy council projects that renewable could provide about 40% of world cumulative energy consumption under an idealized "ecological" scenario assuming that political leaders take global warming seriously and pass taxes to encourage conservation and protect the environment. By the end of 21st century, renewable sources could provide all our energy needs if we take the necessary steps to make this happen.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

BIBLIOGRAPHY

1. India Solar Energy, From Wikipedia, Accessed October 2012.
2. Vaclav Smil. 21st Century energy some sobering thoughts, *Energy,* 2006, 12.
3. Cristina L. Archer and Mark Z. Jacobson. Evaluation of global wind power, *Journal of Geophysical Research,* 110(D12), 2005, 1-20.
4. Energy conversion by photosynthetic organisms, *Food and Agriculture Organization of the United Nations,* Retrieved 2008-05-25.
5. World consumption of primary energy by energy type and selected country groups, 1980-2004, *Energy Information Administration,* Retrieved 2008-05-17.
6. World total net electricity consumption, 1980-2005", *Energy Information Administration,* Retrieved 2008-05-25.
7. Carr. 1976, 85.
8. Balcomb. Passive Solar Buildings, *The MIT Press, Cambridge,* 1992, 6.
9. Request for participation summer 2005 demand shifting with thermal mass, *Demand Response Research Center,* Retrieved 2007-11-26.
10. Butti and Perlin, 1981, 212-214.

11. Advantages of Using Molten Salt, *Sandia National Laboratory,* Retrieved 2007-09-29.
12. PV Systems and Net Metering, *Department of Energy,* Archived from the original on 2008-07-04.
13. Pumped Hydro Storage, *Electricity Storage Association,* Retrieved 2008- 07-31.
14. Collings A F, Critchley C. Artificial photosynthesis: From Basic Biology to Industrial Application, *Wiley-VCH, Weinheim,* 2005, 339.
15. Butti and Perlin. 1981, 63, 77, 101.
16. Butti and Perlin. A Golden thread: 2500 years of solar architecture and terminology, *Marion Boyars, London,* 1st Edition, 1981, 290.
17. Weiss, Werner, Bergmann, Irene, Faninger, Gerhard. Solar heat worldwide-markets and contribution to the energy supply 2006, *International Energy Agency,* 2008. Retrieved 2008-06-09.
18. Solar Energy Perspectives: Executive Summary, *International Energy Agency,* 2011. Archived from the original on 2011-12-03.
19. IEA says solar may provide a third of global energy by 2060, *Bloomberg Businessweek,* December 01, 2011.
20. Perlin. 1999, 147.
21. Magic Plates, Tap Sun for Power, *Popular Science,* June 1931. Retrieved 19 April 2011.
22. Perlin. Saved by the space race, *Solar Today,* July/August, 1999, 18-20.
23. Susan A Perlin, Ken Sexton, David W S Wong. An examination of race and poverty for populations living near industrial sources of air pollution, *Journal of Exposure Science and Environmental Epidemiology,* 9(1), 1999, 29-48.
24. John Perlin. From space to earth: The story of solar electricity, *Earthscan,* illustrated Edition, 1999, 224.
25. Lewis M. Fraas, Larry D. Partain. Solar cells and their applications, *Solar Energy and Photovoltaics, Wiley,* 2nd Edition, 2010, 648.
26. India to unveil 20GW solar target under climate plan, *Reuters,* July 28, 2009.
27. India's national solar plan under debate, *Pv-Tech.org,* Retrieved 2010-11-27.
28. Nitin Sethi TNN. 12.42am IST (2009-11-18), *1gw solar power in 2013,* 2009. Retrieved 2010-11-27.
29. Steve Leone. Report projects massive solar growth in India, *Renewable Energy World,* 2011. Retrieved Tuesday-December 13-2011.
30. India's solar power greening India's future energy demand, *Ecoworld.com,* 2007-05-15. Retrieved 2010-11-27.
31. Estimated medium-term (2032) potential and cumulative achievements on Renewable energy as on 30-06-2007.
32. Chittaranjan Tembhekar. India tops with US in solar power, *Economic Times,* 2009. http://economictimes.indiatimes.com/India-tops- with-US-in-solar power/.
33. http://mnre.gov.in/pdf/MNRE_REC_Report.pdf.
34. Sarah R D and Cynthia S. Energy futures: Five dilemmas of the practice of anticipatory governance, *Environmental Communication: A Journal of Nature and Culture,* 6(1), 2012, 119-136.

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