A Project on

"ROLE OF SOLAR ENERGY TO SAVE ELECTRCITY"

Submitted to,

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Content

ROLE OF SOLAR ENERGY TO SAVE ELECTRICITY

1. ABSTRACT:

Solar Energy a clean renewable resource with zero emission, has got tremendous potential of energy which can be harnessed using a variety of devices. With recent developments, solar energy systems are easily available for industrial and domestic use with the added advantage of minimum maintenance. Solar energy could be made financially viable with government tax incentives and rebates. Most of the developed countries are switching overto solar energy as one of the prime renewable energysource. The current architectural designs make provision for photovoltaic cells and necessary circuitry while makingbuilding plans. 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 challenge. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change. The objective of the National Solar Mission is to establish Indiaas 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 onsetting up an enabling environment for solar technology penetration in the country both at a centralized and decentralized level. The National Action Plan on Climate Change also points out: "India is a tropical country, wheresunshine is available for longer hours per day and in great intensity. Solar energy, therefore, has great potential as future energy source. It also has the advantage of permitting the decentralized distribution of energy, therebyempowering people at the grassroots level".

Keywords: : Photovoltaic Cells, Zero Emission, Geothermal Energy, Biomass Energy, Solar India

2. INTRODUCTION:

India is facing an acute energy scarcity which is hampering its industrial growth and economic progress.Setting up of new power plants is inevitably dependenton import of highly volatile fossil fuels. Thus, it is essential to tackle the energy crisis through judicious utilization of abundant the renewable energy resources,such as Biomass Energy solar Energy, Wind Energy andGeothermal Energy. Apart from augmenting the energy

supply, renewable resources will help India in mitigating climate change. India is heavily dependent on fossil fuels for its energy needs. Most of the power generation is carried out by coal and mineral oil-based power plants which contribute heavily to greenhouse gases emission.

Solar Power a clean renewable resource with zero emission, has got tremendous potential of energy whichcan be harnessed using a variety of devices. With recentdevelopments, solar energy systems are easily availablefor industrial and domestic use with the addedadvantage of minimum maintenance. Solar energy could be made financially viable with government tax incentives and rebates. Most of the developed countriesare switching over to solar energy as one of the prime renewable energy source. The current architectural designs make provision for photovoltaic cells and necessary circuitry while making building plans.Because of its location between the Tropic of Cancer and the Equator, India has an average annual temperature that ranges from 25°C – 27.5 °C. This means that India has huge solar potential. The sunniest parts are situated in the south/east coast, from Calcutta to Madras.

3 HISTORY OF SOLAR ENERGY :

1982 Volkswagen of Germany begins testing photovoltaicarrays mounted on the roofs of Dasher station wagons, generating 160 watts for the ignition system.

1982 Worldwide photovoltaic production exceeds 9.3 megawatts.

1983 Solar Design Associates completes a stand-alone, 4- kilowatt powered home in the Hudson River Valley.

1985 The University of South Wales breaks the 20% efficiency barrier for silicon solar cells under 1-sun conditions.

1986 The world's largest solar thermal facility, located inKramer Junction, California, was commissioned. The solarfield contained rows of mirrors that concentrated the sun'senergy onto a system of pipes circulating a heat transfer fluid. The heat transfer fluid was used to produce steam, which powered a conventional turbine to generate electricity

1988 Dr. Alvin Marks receives patents for two solar powertechnologies he developed: Lepcon and Lumeloid. Lepconconsists of glass panels covered with a vast array of millions of aluminum or copper strips, each less than a micron or thousandth of a millimeter wide. As sunlight hitsthe metal strips, the energy in the light is transferred to electrons in the metal, which escape at one end in the formof electricity. Lumeloid uses a similar approach but substitutes cheaper, film-like sheets of plastic for the glasspanels and covers the plastic with conductive polymers, long chains of molecular plastic units

Institute asthe National Renewable Energy Laboratory.

1992 University of South Florida develops a 15.9% efficient thin-film photovoltaic cell made of cadmium telluride, breaking the 15% barrier for the first time for thistechnology.

1993 1993 Pacific Gas & Electric completes installation ofthe first grid-supported photovoltaic system in Kerman, California. The 500-kilowatt system was the first "distributed power" effort

1994 First solar dish generator using a free-piston Stirlingengine is tied to a utility grid.

1996 The world's most advanced solar-powered airplane, the Icare, flew over Germany. The wings and tail surfacesof the Icare are covered by 3,000 super-efficient solar cells,with a total area of 21 m2. "Solar Aircraft of the Universityof Stuttgart" for more information about Icare.

1998 The remote-controlled, solar-powered aircraft, "Pathfinder" sets an altitude record, 80,000 feet, on its 39thconsecutive flight on August 6, in Monrovia, California. This altitude is higher than any prop-driven aircraft thus far.

1991 President George Bush redesignates the U.S. Department of Energy's Solar Energy Research Institute asthe National Renewable Energy Laboratory.

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4 PRESENT STATUS AND INSTALLED CAPACITYOF SOLAR ENERGY IN INDIA:

Solar power has so far played an almost non-existent role in the Indian energy mix. The grid-connected capacity (all PV) in India now stands at 481.48 MW asof 31st January 2012. 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 statelevel 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 (bothCSP 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 termenergy 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. As of December2011, solar power generation in India costs aroundRS.10/kWh, or over 2.5 times as much as power from
coal. Importantly, it is crucial that the industry receivesthe right policy support to ensure that projects are executed and performed up to the mar

5 GROWTH OF SOLAR ENERGY IN INDIA:

India's government has begun to acknowledge theimportance of solar energy to the country's economic growth. Prime Minister Manmohan Singh, who has said solar energy will transform rural India, launched a National Solar Mission in 2010. Initial growth has been dramatic, albeit froma tiny base. From less than 12 MW in 2009, solar-power generation in the country grew to 190 MWin 2011. By March 2013, it is expected to grow fivefold to 1,000 MW, but the country has a long way to go to reach its goal of increasing solar- power generation to 20 gigawatts by 2020. AcrossIndia, there are still thousands of villages with plenty of sun but not enough power

6 DECREASING INVESTMENT COST OF SOLARIN INDIA:

With the cost of solar photovoltaic cells falling —prices dropped by 50% last year and are now a quarter of what they were in 2008 — renewable- energy advocates say India is ripe for a solar-power revolution. And it could use it. More than 40% of the countryside is still not connected to thenational power grid, and a 2010 report by theNational Renewable Energy Laboratory in the U.S. said power demand in India trails supply by 12.7%. Closing this gap "will be critical for India to achieve its growth targets," the report said.Failure to meet that unsatisfied demand could hamper India's growth, the World Economic Forum (WEF) said in a recent Report

7 INDIAS POTENTIAL OF SOLAR ENERGY:

India has a great potential to generate electricity from solar energy and the Country is on course to emerge asa solar energy hub. The techno-commercial potential ofphotovoltaics in India is enormous. With GDP growingin excess of 8%, the energy 'gap' between supply and demand will only widen. Solar PV is a renewable energy resource capable of bridging this 'gap'. Most parts of India have 300 – 330 sunny days in a year, which is equivalent to over 5000 trillion kWh per year more than India's total energy consumption per year.Average solar incidence stands at a robust 4 – 7 kWh/sq.meter/day. About 66 MW of aggregate capacityis installed for various applications comprising onemillion industrial PV systems – 80% of which is solar lanterns, home/street lighting systems and solar water pumps, etc. The estimated potential envisaged by the Ministry for the solar PV programme, i.e. solar street/home lighting systems, solar lanterns is 20 MW/sq. kilometer. The potential of the solar

thermal sector in India also remains untapped. The Ministry of Renewable Energy proposes an addition of 500 MW during the phase 1 of JNNSM. Establishing manufacturing units at Export Oriented Units, SEZs or under the SIPS programme presents a good opportunityfor firms which can leverage India's cost advantage to export solar modules at competitive prices to markets inEurope and the United States. In terms of all renewableenergy, currently India is ranked fifth in the world with15,691.4 MW grid-connected and 367.9 MW off-grid renewable energy based power capacity. India is amongtop 5 destinations worldwide for solar energy development as per Ernst & Young's renewable energyattractiveness index. Solar power is attractive because itis abundant and offers a solution to fossil fuel emissionsand global climate change. Earth receives solar energy at the rate of approximately 1,73,000 TW. This enormously exceeds both the current annual global

energy consumption rate of about 15 TW, and anyconceivable requirement in the future. India is both densely populated and has high solar insolation,providing an ideal combination for solar power in India.India is already a leader in wind power generation. In solar energy sector, some large projects have been proposed, and a 35,000 km² area of the Thar Desert hasbeen set aside for solar power projects, sufficient to generate 700 to 2,100 GW. The India Energy Portal estimates that if 10% of the land were used for harnessing solar energy, the installed solar capacitywould be at 8,000GW, or around fifty times the currenttotal installed power capacity in the country. For example, even assuming 10% conversion efficiency forPV modules, it will still be thousand times greater thanthe likely electricity demand in India by the year 2015.Daytime production peak coincides with peak electricity demand making solar ideal supplement to grid. With around 300 sunny days a year nationwide, solar energy's potential in India is immense. And with

$10.2 billion investments in clean energy, money is starting to follow the opportunity. India received $95 million in venture-capital funding and over $1.1 billionin large-scale funding for solar projects in 2011, according to a report by Mercom Capital, a clean-energy consulting firm. The biggest funding deal was a

$694 million loan raised by Maharashtra State Power Generation Co. for its 150-MW Dhule and 125-MW Sakri solar projects

8 SOLAR ENERGY DEVELOPMENT IN DIFFERENT STATES:

The Gujarat solar policy initiated a process of the states formulating their own policy frameworks independent of the federal guidelines. The renewable purchase obligations for state distribution companies, a demand-driven scheme, further accelerated the formulation of solar policies at the state level. These policies exist independent of each other as well as the NSM. Other states like Karnataka, Andhra Pradesh and Rajasthan have followed suit in developing solar power development programs. Rajasthan has implemented land banks as well to make land acquisition easier. As more states plan to meet their solar power obligations, new policies are expected to be offered, creating as veryvibrant set of markets across the subcontinent

8.1 GUJARAT SOLAR POWER POLICY -2009

Gujarat is the first state to launch its own solar policy in 2009. The Gujarat solar policy was in place a year

before the NSM was announced. The initial target is toachieve 500 MW of installed capacity by the end of thisperiod. Gujarat Energy Development Agency (GEDA) and Gujarat Power Corporation Limited (GPCL) have been appointed as nodal agencies for the facilitation and implementation of the policy. Gujarat Solar Power Policy is the only policy, which has awarded projects with a fixed FiT, on a first-come-first serve basis. This has resulted in the allocation of a number of projects toin-experienced or unknown developers.

After the NSM policy was formalized in December 2009, developers moved away from Gujarat towards theNSM. In the first phase of the Gujarat policy, only 396.5MW worth of PPAs were signed out of 716 MW allotments, leading to a conversion rate of 55% (PPAs signed as a percentage of projects allotted). The tremendous interest from developers for NSM led to the competitive bidding for projects and a subsequent fall in tariffs. The fall in the NSM tariff below the levelizedtariff in Gujarat suddenly made the Gujarat policy veryattractive again to developers. Further, a significantly higher feed-in-tariff in the first 12 years in Gujarat matches investor's timelines, as they would look to cover the cost of debt during this period. To ensure developer commitment, Gujarat's solar policy for the

second phase has been amended to include a deposit thatwould be encashed, if the developers fail to sign the PPAs. Larger available project sizes and the relative ease of land acquisition has led to larger developers getting serious about the Gujarat policy and signing PPAs and starting the implementation of projects. Gujarat has significantly improved the credibility of itssolar program from the first to the second phase.

8.2 INDIA'S FIRST SOLAR PARK

On December 29th 2010, India's first solar park was inaugurated at Charanaka in Patan district of northernGujarat. So far, land has been allotted in the solar park forprojects worth 176MW to 16 companies from the first andsecond phases. The total capacity of the solar park is500MW with 30,000 sq. m per MW land allotted to Solar Thermal and 20,000 sq. m per MW of land allotted to PV projects. The solar park has been financed with over Rs. 12billion by financial institutions like the International Finance Corporation (IFC), the Asian Development Bank (ADB) and the Infrastructure Development FinanceCorporation (IDFC). The park tackles land procurement, water availability and grid connectivity issues and offers a"single-window" clearance process. Sixteen companies,

including SunEdison Energy India (25MW), Alex Astral Power (25MW), Roha Energy (25MW), GMR GujaratSolar (25MW), Kiran Energy (20MW), Emami Cement (10MW) and Azure Power (5MW) have been allottedprojects worth a total of 176MW in the park. They have allsigned PPAs with the state government.

8.3 KARNATAKA SOLAR POWER POLICY (2011-16)

Karnataka, a south-western state of India, announced its solar policy on July 1, 2011. Under the solar policy 2011- 16, the Karnataka Government proposes to promote solar power as part of renewable energy generation policy in thestate.

1. It targets 350 MW worth of projects till 2016.
2. 200 MW is to be developed for direct sale to the distribution companies in the state (40 MW to be addedeach year)
3. 100 MW under REC Mechanism
4. 50 MW for bundling of power with thermal power fromoutside the state at rates to be determined by the State Government subject to approval of KERC.

The minimum capacity of solar PV projects is 3 MW andmaximum capacity of 10 MW, while for Solar Thermal theminimum is 5MW with no cap on maximum. The quantumof power to be procured by ESCOMs from solar resourcesunder purchase obligation is 0.25% of the total consumption and the shortfall in procurement of solarenergy by the ESCOMs can be made good by purchase of solar specific RECs. Though the state has come up with itsown policy, it will continue to support programs like the NSM. The state has set a combined target of 126 MW of solar power to be developed by 2013-14 through NSM andits own solar policy.

8.4. RAJASTHAN SOLAR POWER POLICY – 2011

On April 19th 2011, Government of Rajasthan issuedRajasthan Solar Energy Policy, 2011 to promote solarenergy in the state.The policy aims to help Rajasthan,develop as a global hub of solar power for 10000-12000 MW capacity over the next 10 to 12 years to meet energy requirements of Rajasthan and other states of India

1. It targets a minimum of 550MW of grid connected solarpower in Phase 1 (up to 2013).

2. Projects will be awarded through a process of competitive bidding.

3. PV projects will be worth 300MW, out of which 100MW are reserved for project developers and 200MW for panel manufacture

4. The minimum and maximum sizes for PV projects are 5MW and 10MW. Module manufacturers that set up their manufacturing plant in Rajasthan can bid for either 10MW or 20MW worth of PV projects based on their manufacturing capacity.

5. A further 50MW will be allocated for rooftop PV (1MWeach) and other small solar power plants.

6. The DISCOMS in Rajasthan will provide PPAs for theprojects. In addition, projects worth 100MW (50MW PV and 50MW CSP) are targeted for bundled solar power. In such projects, the developer can sell conventional power and solar power in a ratio of 4:1 at the weighted average tariff to the distribution utilities in Rajasthan. Varied project sizes will attract small as well as large developers looking to invest in projects of different scale

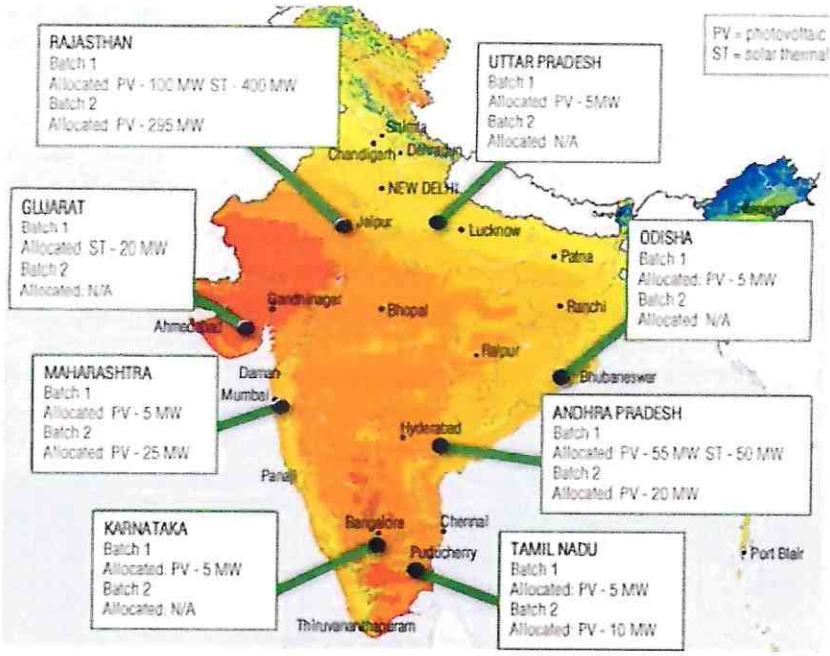


Figure 1: Figure shows the Solar Energy production in different states in India.

9. USES/BENEFITS OF SOLAR ENERGY IN DAYTO DAY LIFE:

1. Use solar heaters for heating water

The majority of people use huge amounts of energy on heating water. In a bid to cut on electricity or gas costs and save energy, you can go solar by heating your waterusing the sun's free energy. Simply install a solar water heater. It works by circulating water through a black insulated collector to maximize absorption and retentionof the sun's energy to effectively heat the water.

Once the water is heated, it is collected and directed to areservoir tank or directly fed into the water system for use. Again, the initial investment can be a bit costly but you are guaranteed of potential savings amounting to hundreds of dollars a year.

2. Use solar light bulbs

The use of solar light bulbs for lighting can go a long wayin reducing the need for artificial lighting,

which consumes a great deal of electricity. Furthermore, solar light bulbs are durable and provide the same or even higher lighting efficiency as compared to the conventionallight bulbs.

On this account, if you are looking for a simple way tosave on energy, consider replacing some of your light bulbs particularly those for outdoor lighting with solar light bulbs. The payback is almost immediate and doesn'trequire high initial investment costs. Also, they are suitable for both home and the office.

3. Use solar power banks and solar chargers

Solar power banks and chargers directly utilize sun's energy to power electronic devices. The advantage with them is that they are very portable. This means that evenif you are traveling, you don't have to worry about finding places with electricity to plug in your electrical devices to charge.

And if you are really serious about saving energy, you canmake your solar power bank and charger your primary charging option. You simply have to leave the charger outduring the day to trap sun's energy then use it during the night to charge you

4 Use the clothesline instead of the dryer

By having a clothesline in your backyard or near the windows in your home and using it to dry your clothes, especially in summer, you'll save on the energy that you would have used running the clothes in the dryer. What'smore, using the clothesline comes with an added advantage in that; you'll save on cooling costs

Using the dryer during summer generates heat and will thus require the occasional use of air conditioner or fun tocool down your apartment or home. With all these factorsconsidered, the summer energy bills can be substantially reduced by simply going solar on drying your clothes. Besides, this is a do it yourself initiative so it has zerocosts.

5 Use solar to dry your food

There are various ways of making food last longer, which is also termed as food preservation. One of the longstanding techniques is drying or dehydration whichwas used as early as 12,000 BC. In as much as the modern techniques in existence today weren't available then, people still successfully managed to preserve theirfood.

What I'm I trying to say? My point is, you can save on energy by using solar food dehydrator for food preservation. Instead of heavily relying on the refrigeratorto prolong the longevity of food staffs such as vegetables, fruits, and or even meat, you can use the free sun's energyto dehydrate and keep them in good condition for future use. Solar dehydrators work by collecting heat from the sunas using it to dry food.

6 Purchase solar hot water panels for heating your pool

Pools offer great places for relaxation and at times, you may want it heated to enjoy the moment. Instead of usingelectricity for heating the pool, solar hot water panels canprovide worthy solution particularly in terms of saving onenergy. Moreover, incentives for solar hot water panels for heating the pool are available in various states.

According to the average financial payback estimations for purchase and installation on such solar panel systems,it takes less than 4 years to realize the savings on energy.Initial investment may be costly, but it surely pays off in the long-term as you are assured of saving money and energy.

7 Use a solar oven to cook food

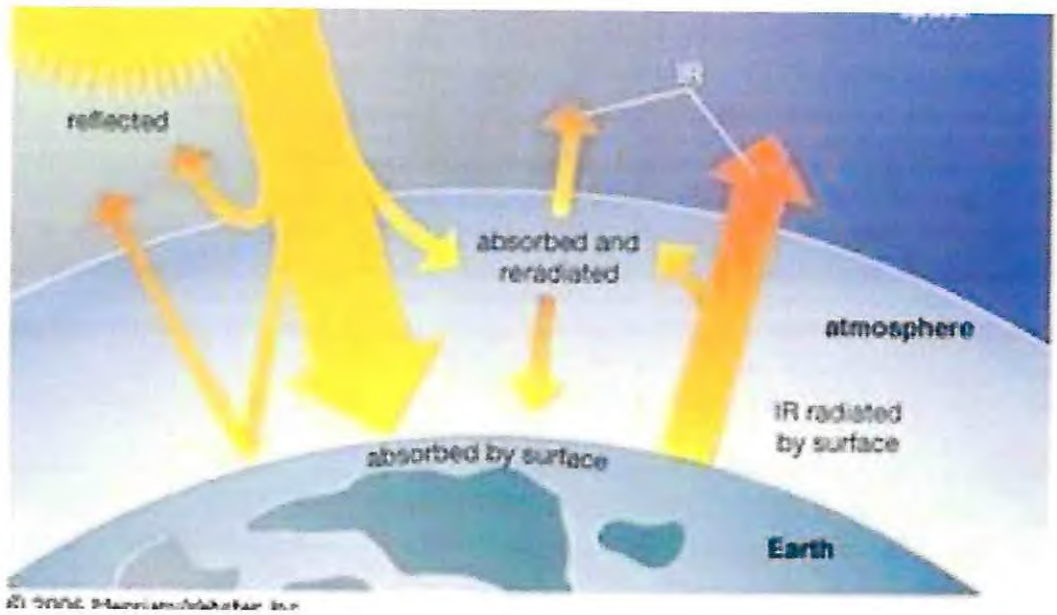
Why not save on energy by investing in a solar oven and reap the benefits of off-the-grid cooking? People may question the performance quality of a solar oven on cooking food or getting it hot enough. Well, solar ovens can get hot enough to cook food by reaching temperaturesof 120 to 178 degrees Celsius. At these temperatures, youcan safely cook food such as cereals, vegetables and even meat by cooking at lower temperatures for an extended period.

8 Passive solar heating

Passive solar heating is one of the simplest methods of tapping solar energy because it doesn't need any specialtechnology. Provided your windows are facing the direction of the sun, that's all you need to have your house heated and retain warmth during winter. By opening the curtains, it allows the windows to capture thewarmth and radiate it into the house thereby providing free indoor heating.

13 CONCLUSION:

Providing electricity for meeting lighting needs ofhouseholds and rural markets can bring severalpositive impacts including improvement of quality of life and increasing in income and employment opportunities. So, rural electrification through solar energy is a model to the users is that they are free from the responsibility of maintaining the system. Therisk of the whole system has been avoided with the involvement of local community in management. Demonstration of solar energy system has been successful to create interest among the rural people and demand from other location also observed



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