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Systemization Study on Solar Roof for Houses to Achieve Uninterrupted Power Supply

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Abstract: ***In India the total installed power sector capacity is approximately around 1,47,402 Megawatt (MW). Currently in India the power shortages are estimated at about 11% of total energy and likely to increase in the coming years. In the next 10 years, another 40,000 MW of capacity and an investment of about Rs.1, 00,000 lakh crore is needed into the power sector.***
The power problem that we are facing now has a very simple solution. That is, SOLAR. Our country India is blessed enormously regarding solar power. Fortunately, India lies in the sunny regions of the world. Most parts of India receives 4 to 7kWh of solar radiation per square meter per day with 250-300 sunny days in a year. India has a abundant solar resources, as it receive about 3000 hours of sun shine every year, equivalent to over 5,000 trillion kWh. India can easily utilize the power of solar energy. Today the contribution of solar power with an installed capacity of 9.84 MW, is a fraction (<0.1%) of the total renewable energy installed.
Installing PV (PhotoVoltic) Solar Panels on roof tops provides the answer for this problem.

I. INTRODUCTION

A. General

All life, from single-celled microbes to blue whales, exists in a continuous process of consuming, using, and storing energy. Human communities work in the same way as other communities with regard to energy management. Energy is the primary force in the universe. Energy defines the Earth's biomes and sustains life. Conventional energy sources like coal, oil, natural gas, etc., are limited in quantity, and if these continue to be depleted at the present rate, these will be exhausted in the coming decades. Energy demand is resulting in the creation of fossil fuel based power plants leading to substantial green house gas emissions having an adverse impact on global warming and climate change.

In recent years, scientists have increasingly paid more attention to solar energy. There is a sudden demand in the utilization of solar energy for various applications such as water heating, building heating/cooling, cooking, power generation and refrigeration. Solar energy is the result of electromagnetic radiation released from the Sun by the thermonuclear reactions occurring inside its core. All of the energy resources on earth originate from the sun (directly or indirectly), except for nuclear, tidal and geothermal energy. The sun actually transmits a vast amount of solar energy to the surface of the earth. The term "solar constant" signifies the radiation influx of solar energy.
Any community consumes fuel to produce energy, but the community must also conserve some of the fuel for the next generation.

This conservation of energy sources from one generation to the next is the principle behind sustainability, the process by which a system survives for a period of time. No system in biology lasts forever, and this is also true for sustainability. Sustainability prolongs the time that living things can survive, but it cannot ensure that life will go on forever. Living sustainably means conserving nonrenewable resources by intelligent use of renewable resources. Even renewable resources must be managed carefully or else they too can disappear faster than they are replaced. The world is now experiencing this very problem because in many places forests, plants, wild animals, clean water, clean air, and rich soil have become depleted before nature can replace them. Sustainable use of resources depends on the principles of conservation and resource management. Since the 1960s, some people have known that conservation of nonrenewable energy sources is of paramount importance. At the same time, people must put increased effort into using renewable energy sources from the sun, wind, and water.

Energy security is the ability of a nation to deliver the energy resources needed to ensure its welfare and implies secure supply and stable prices. Energy is vital for progress and development of a nation's economy. The economic growth and technological advancement of every country depends on it, and the amount of available energy reflects that country's quality of life. Economy, population and per capita energy consumption have caused the increase in demand for energy during the last few decades. Fossil fuels continue to supply much of the energy used worldwide, and oil remains the primary energy sources. Therefore, fossil fuels are the major contributor to global warming. Along with the global warming impacts and climate changes, the demands for air-conditioning and refrigeration have increased.

B. Objectives

1) To determine cost effective solar panels that affordable for everyone.
2) To provide a Photo Voltic solar panel at an affordable cost.
3) To study the Solar distribution over India.
4) To study power consumption in different terrains.
5) To understand the efficiency of the solar panels in different terrains.

C. Scope

The scope of the work done to reduce the power shortage problem in India on implementing Solar PV System roof top panels.

1) The focus of the work is to do a detailed study about the utilization of the 5,000 trillion kWh to the maximum .
2) The study is to provide a system that can benefit every man by turning house totally dependent on solar power.

II. LITERATURE REVIEW

A. General

The main objective of a literature review is to give a broad view about the types of solar panels based on their efficiency and price range.One of the most common things people ask when they start to consider going solar or start to plan their life-changing solar expedition is which are the most efficient solar panels. However, first of all, that's not even the right question for most people, and second of all, the literal answer to that question really isn't relevant for the average consumer.

B. Literature

First of all, the important matter is not which solar panels are most efficient, but which solar panels are the best value for the money.

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If you've got space for 10 solar panels on your roof and you have an option between solar panels "AB" (say) that are a bit more efficient but twice the price of solar panels "CD" chances are, you are going to make a much bigger savings by going with "CD". Of course, the important thing would be to see what's available in your situation and simply run the numbers (or, if you are allergic to math, have a friend who can do math run the numbers for you).

But, anyway, if we really want to know which are the most efficient solar panels (or solar cells) out there, here is a list of solar records recently and this can give you a rundown.

Here is a few key notes making the point above a bit clearer. Before looking at solar panels as a whole, let's have a quick look at the producers of some of the most efficient solar *cells* (the key component of solar panels) and their efficiency records:

A. 46% efficient solar cells by Soitec & Fraunhofer Institute. Notably, these world-leading solar cells from Soitec and Fraunhofer Institute are in the concentrator triple-junction solar cell category. Such solar cells are complicated and are not used in residential or commercial application, because they are very expensive. They are used in space applications by the likes of NASA, where a bit of extra space can make a huge difference.

B. 44.4% efficient solar cells by Sharp previously held the overall efficiency record. However, they still hold the record for triple-junction (concentrator) solar cells.

C. 37.9% efficient solar cells by Sharp. A big step down, these are in the triple-junction, non-concentrator solar cell category.The difference is that these solar cells don't use anything to concentrate the light hitting the solar cells, while the 44.7% efficiency cells noted above do use something to concentrate the light (of course, adding to their costs).

D. 32.6% solar cells by a Spanish solar research institute (IES) and university (UPM). These are another step down, as they are in the two-junction, concentrator solar cell category. Again, these are still far different solar cells from what are used in commercial or residential installations.

There are about a dozen or so extra categories. Some categories have very high efficiencies but the solar cells are quite expensive, while others are actually on the other end of the spectrum and are very cheap but have very low efficiency. Of course, some are both inefficient and expensive, but apparently worth researching nonetheless. The key is, finding the best balance between cost and efficiency

III. METHODOLOGY

A. Flow chart of methodology

Figure 3.1 below provides the methodology adapted for accomplishing the task.

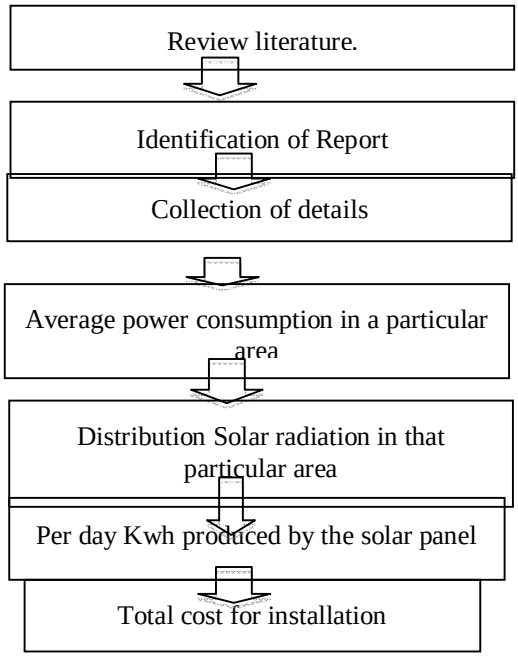

Figure3.1

B. Steps involved

The above said methodology is for systemization of solar roof for houses to achieve uninterrupted power supply.
The detailed methodology can be explained below.

1) India is a country blessed with 250 to 300 sunny days in a year. Another great discovery is that in India we have about 4 to 7 kWh of solar radiation that is being received per day.
2) On a rough figure in India, any person would prefer to have house of 1200sqft. Keeping this data in mind, if person "A" has a house of 1200sqft, he would have a roof of 1200sqft. Now if he is installing a solar panel that can cover 1200sqft.
3) The solar panel would be able to provide him with a solar power of 668.899 kWh in one day. Methods to obtain this elaborated in the following headings.

IV. SOLAR CELLS & SOLAR PANELS

A. Solar cells

A solar cell, or photovoltaic cell, is an electrical device that converts the energy of light directly into electricity by thephotovoltaic effect, which is a physical and chemical phenomenon.[1] It is a form of photoelectric cell, defined as a device whose electrical characteristics, such as current, voltage, or resistance, vary when exposed to light. Solar cells are the building blocks of photovoltaic modules, otherwise known as solar panels.

Solar cells are described as being photovoltaic irrespective of whether the source is sunlight or an artificial light. They are used as a photodetector (for example infrared detectors), detecting light or other electromagnetic radiation near the visible range, or measuring light intensity.

In contrast, a solar thermal collector supplies heat by absorbing sunlight, for the purpose of either direct heating or indirect electrical power generation from heat. A "photoelectrolytic cell" (photoelectrochemical cell), on the other hand, refers either to a type of photovoltaic cell (like that developed by Edmond Becquerel and modern dye-sensitized solar cells), or to a device that splits water directly into hydrogen and oxygen using only solar illumination.

B. Solar panels

A photovoltaic (in short PV) module is a packaged, connected assembly of typically 6×10 solar cells. Solar Photovoltaic panels constitute the solar array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions, and typically ranges from 100 to 365 watts. The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few solar panels available that are exceeding 19% efficiency. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, a solar inverter, and sometimes a battery and/or solar tracker and interconnection wiring.

The price of solar power, together with batteries for storage, has continued to fall so that in many countries it is cheaper than ordinary fossil fuel electricity from the grid (there is "grid parity"). For example in 2015, an average home in Europe or the US could use around 3,000 kilowatt-hour (kWh) in electricity each year.

V. ANALYSIS & DISCUSSION

A. Primary Data

Average size of houses built in India.	1200sqft
Average power consumption in a house in a month.	200kWh or 200 units
Preferred type of solar panel.	3 Phase meter Solar PV (Photo Voltic) system.
Cost of the solar panel.	$750.04 (Rs.54,000)*

* The rate provided here is the Solar PV fee .The total cost will vary depending on the size required.

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B. Secondary Data

Capacity of the solar panel.	6kW

Capacity Of the solar panel.	Enough energy to offset almost all consumption for average domestic use.

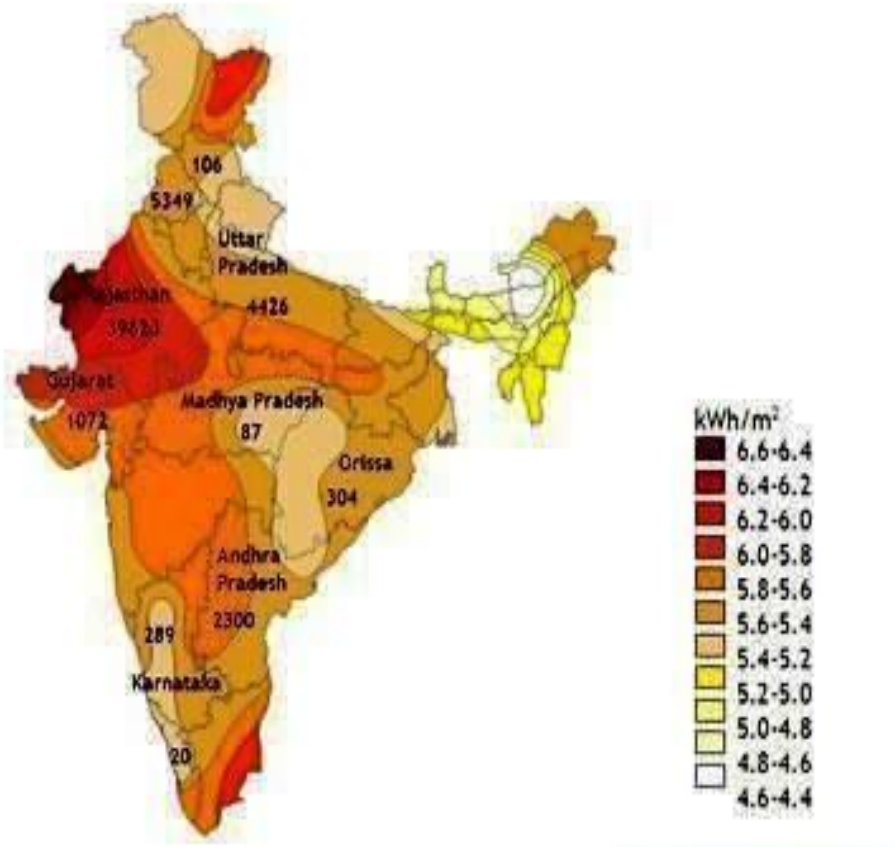
C. Implementation

A solar PV power system is a technology that converts the energy from sunlight into electrical energy. Residential solar PV systems can offset much of your household's power needs, depending on the size of the system and your household's needs.

In a typical system, a set of photovoltaic modules, or 'solar panels', is installed on the roof of your home. The energy generated by these panels is passed through an inverter which creates electricity to match that coming in from the electricity network. This electricity then feeds into your local electricity network via the electricity meter. The meter records the amount of electricity produced and this information is used as a credit to your electricity bill.

The maximum size that can be installed on a normal residential dwelling is a 4.5kW array. For dwellings with a 3 phase connection a 6kW array can be connected without undertaking extensive investigations.

DISTRIBUTION OF SOLAR RADIATION THROUGHOUT INDIA IN kWh/m^2



VI.CONCLUSION

Electricity generated through coal plants is becoming expensive by every passing day. Power cuts and increasing dependence on DG sets is causing a lot of damage to the environment. The demand supply gap for electricity is increasing in the country which makes it

very important for people to start thinking of other ways of realizing their energy needs. Keeping this in mind Ministry of New and Renewable Energy (MNRE), Government of India is promoting off-grid solar PV systems under the Jawaharlal Nehru National Solar Mission in the country.

Many people in the country have started feeling the need of installing solar PV system for their home, apartment complex or small office use, and with this article we would try to provide some information which can be a good starting point for a roof-top Solar PV system project.

Solar PV cell is the basic building block of a PV system. It consists of semiconductor material that absorbs sunlight to generate electricity through a phenomenon called "photoelectric effect". Only sunlight of a certain wavelength can effectively generate electricity. Although a solar PV can generate electricity on a cloudy day, but it is not as effective as it is on a sunny day.

A basic PV cell produces a very small amount of electricity and multiple of them are connected together to form a Solar PV module that can generate 10W to 300W output. If more electricity is required, them multiple such PV modules have to be installed in an array.

Multiple kinds of materials are used to create a solar cell and the efficiency of solar cell depends on the same. The efficiency of a solar cell is defined as its capability to convert a certain amount of sunlight into electricity. Solar cells available in the market are of various efficiencies: 4%, 8%, 12%, 14% and 16%.

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