Abstract for Solar Thermal and Solar Photovoltaic Systems

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INTRODUCTION

The sun has always been viewed as a viable, inexhaustible form of energy for thousands of years. In the golden days, man was aware that the sun not only provided light but was also a source of warmth. Fast track to today and new methods has been found to make more beneficial use of the sun. It became even more important when the realization came that the traditional sources of power were being depleted and that alternative sources were needed.

The primary concerns for the use of solar power were with the generation of electricity, cooking and heating. Those were the fundamental uses of solar energy. There is a notable growing need for countries to reduce their emissions and achieve greater energy independence due to these factors:

- Increasing volatility in fossil fuel prices;
- Significant increase in energy demand and CO2 emissions in emerging countries;
- Decreased nuclear generation in the energy mix of developed and developing countries.

Solar power is one of the fastest growing sources of renewable power in the world today. Only in the USA, the state of Michigan alone garnered $4.1 billion worth of public and private investment for projects over the past three years. At the same time, the federal government maintains a 30% investment tax credit for solar installations. With all of this attention given to solar, one has only to wonder which solar technology is the most efficient, solar thermal or photovoltaic.

Solar Thermal Versus Photovoltaic Energy

Solar thermal technology is not the same as solar panel, or photovoltaic technology. Solar thermal electric energy generation concentrates the light from the sun to create heat and this heat is used to run a heat engine, which turns a generator to make electricity. The working fluid that is heated by the concentrated sunlight can be a liquid or a gas. Different working fluids include water, oil, salts, air, nitrogen, helium, etc. Different engine types include steam engines, gas

SOLAR THERMAL VERSUS PHOTOVOLTAIC ENERGY

turbines, stirring engines, etc. All of these engines can be quite efficient, often between 30% and 40%, and are capable of producing 10's to 100's of megawatts of power.

Photovoltaic, or PV energy conversion, on the other hand, directly converts the sunlight into electricity. This means that solar panels are only effective during daylight hours because electricity storage is not a particularly efficient process. Heat storage is a far easier and efficient method, which is what makes solar thermal so attractive for large-scale energy production.

Heat can be stored during the day and then converted into electricity at night. Solar thermal plants that have storage capacities can drastically improve both the economics and the dispatchability of solar electricity.

Solar Thermal Technology

A solar thermal power generating system works no different than a conventional steam power plant. However, there is one important difference: no harm is done to the environment by burning coal, oil, natural gas or by splitting uranium to produce steam. It generates power solely from the energy of the sun.

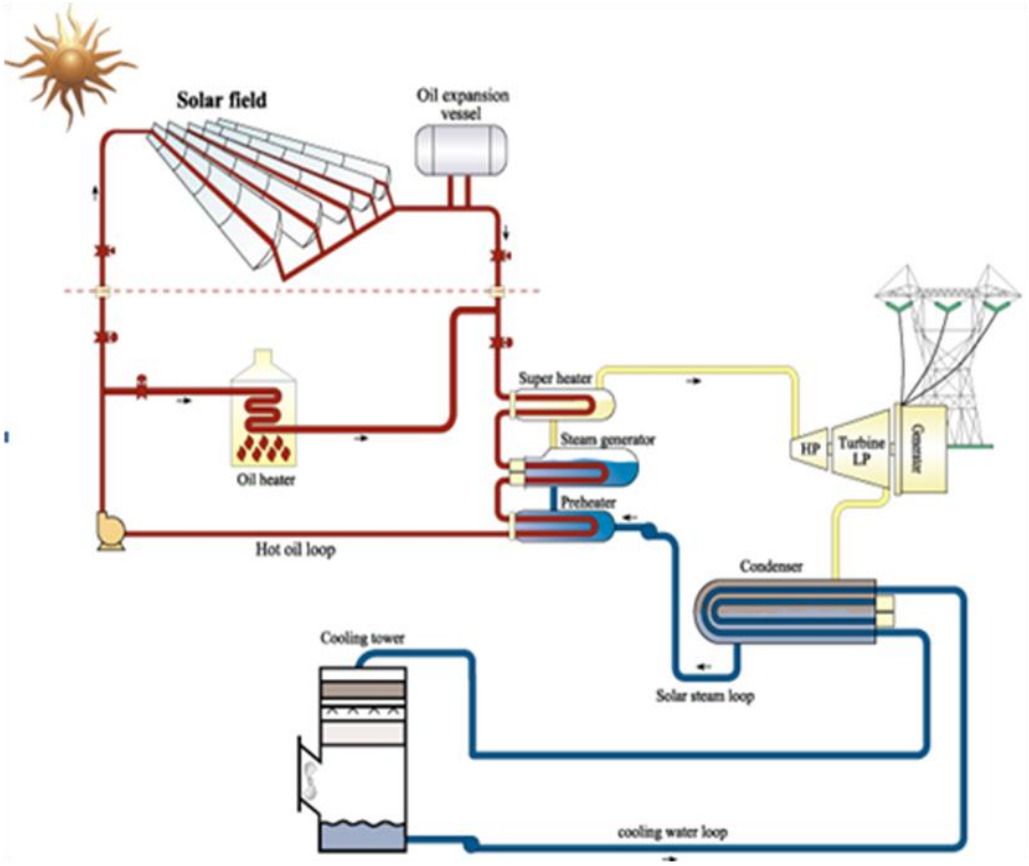
Solar radiation is collected through parabolically shaped mirror segments. The mirror lines track and absorbed through tube receivers. Solar radiation heats up the thermo-oil that is lead to steam generation and power generation through the turbine movement.

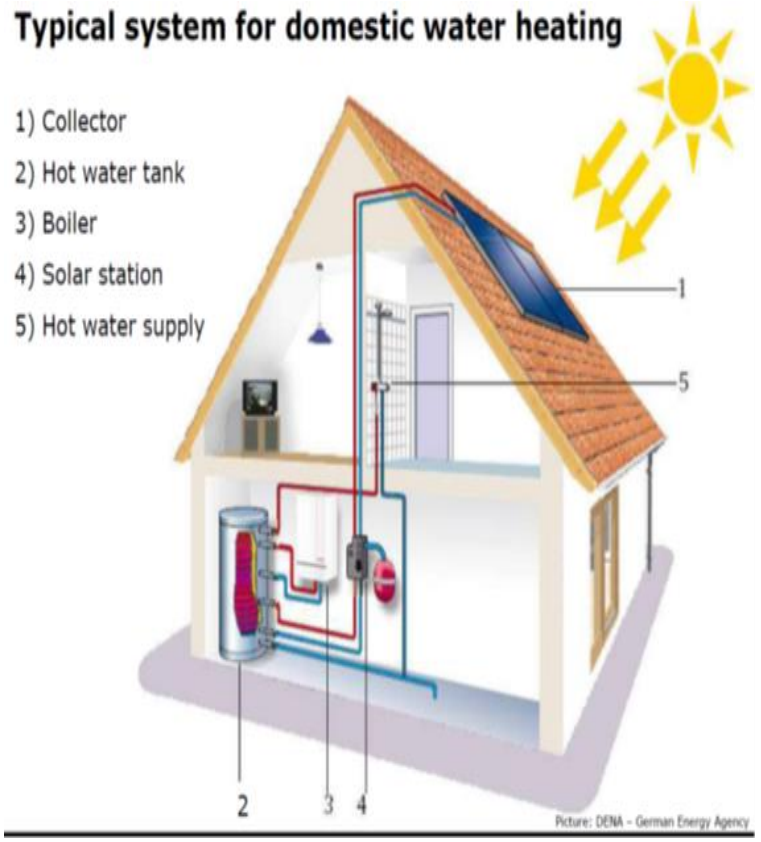
The following figure shows the basic principle of power generation through solar thermal technology.

On a small scale, energy output of solar thermal relates to latitude and levels of direct sunlight. Solar thermal installed on roofs of homes might provide up to 70 percent of the average house's hot water needs, depending on the amount of hot water used and levels of energy efficiency in place. Some combine systems also allow space heating generation.

(Source: U.S. Dept. Of Energy and Climate)

SOLAR THERMAL TECHNOLOGY





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SOLAR PHOTOVOLTIC TECHNOLOGY

The word “photovoltaic” is a combination of two words - “photo”, meaning light, and “voltaic”, meaning electricity. Therefore photovoltaic technology, the scientific term used to describe solar energy, involves the generation of electricity from light.

The secret to this process is the use of a semi-conductor material which can be adapted to release electrons, the negatively charged particles which form the basis of electricity. The most commonly used semi-conductor material used in photovoltaic (PV) cells is silicon, an element most commonly found in sand. All PV cells have at least two layers of such semi-conductors, one positively charged and one negatively charged. When light shines on the semi-conductor, the electric field across the junction between these two layers causes electricity to flow, generating DC current. The greater the intensity of the light, the greater the flow of electricity.

Therefore a photovoltaic system does not need bright sunlight in order to operate. It also generates electricity on cloudy days, with its energy output proportionate to the density of the clouds.

House with Solar PV System (Source: Carlsonsolar, USA)

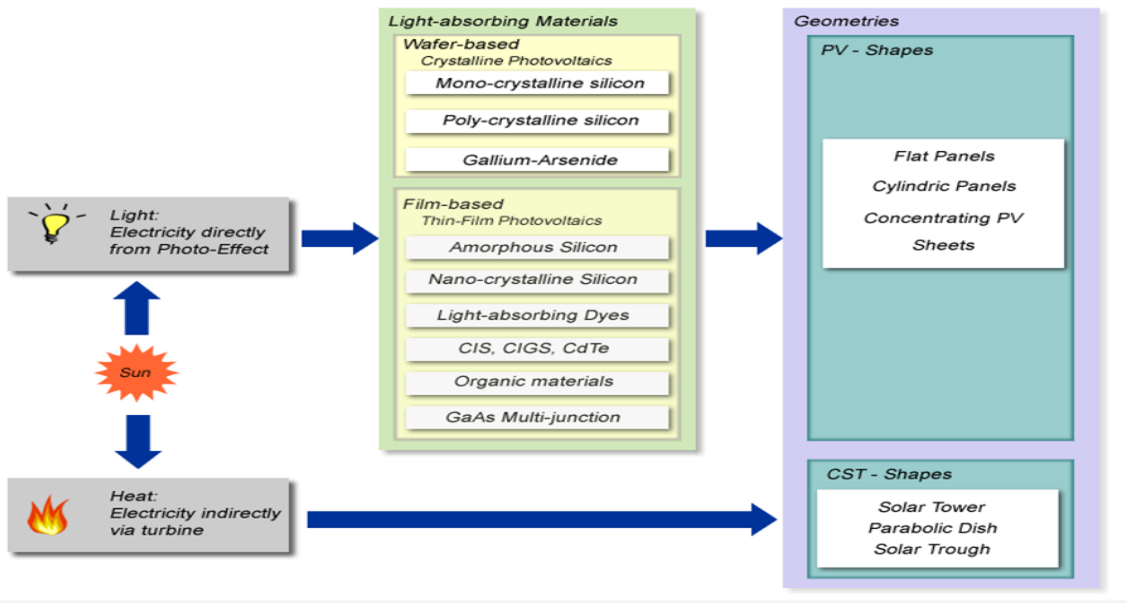
Due to the reflection of sunlight, slightly cloudy days even result in higher energy yields than days with a completely blue sky. Storage batteries are often included in a PV system to provide energy back-up or low-sun power in remote installations.

The performance of a solar cell is measured in terms of efficiency at turning sunlight into electricity. A typical commercial solar module has an efficiency of over 12%. In other words, about one-sixth of the sunlight striking the module is converted into electricity. Improving solar module efficiencies while holding down the cost per cell is an important goal of the PV industry. (Source: European Photovoltaic Industry Association)

DIFFERENCES BETWEEN THERMAL AND PHOTOVOLTAIC

Both photovoltaic and solar thermal are the two established solar power technologies. Photovoltaics use semi-conductor technology to directly convert sunlight into electricity. Photovoltaics, therefore, only operate when the sun is shining, and must be coupled either with other power generation mechanisms to ensure a constant supply of electricity. The most common semiconductor materials are monocrystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride and copper indium sulphide. Solar thermal works by using mirrors to concentrate sunlight. The concentrated sunlight is then used either directly as a source of heat, as in solar water heating, or to drive additionally, since solar thermal only directly produces heat, it can store thermal energy various mediums. Some plants, in fact, can store enough energy for 7.5 hours of generation in lieu of sunlight.

Therefore, solar thermal can potentially generate power 24 hours a day. The following figure demonstrates the differences between the two technologies:



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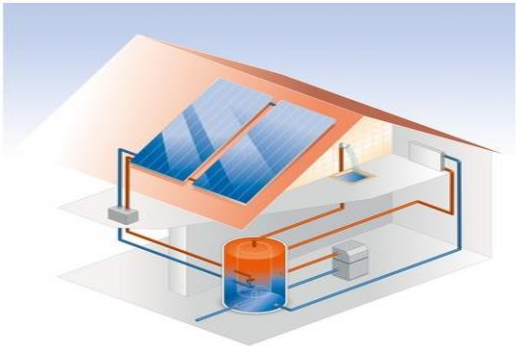
DIFFERENCES BETWEEN THERMAL AND PHOTOVOLTAIC

As photovoltaic cells directly convert solar energy into electricity, these can be fitted to remote objects with no direct power supply. Although photovoltaic cells are also used on mass to generate electricity, they are also fitted to solar powered cars, traffic signs and emergency telephones. They are very rarely used on privet buildings, although some offices use them. (Source: eHow)

As solar thermal cells need a steam turbine they are static energy producers, like a regular power plant.

Solar thermal cells are either used as a power plant to supply direct electricity or on the roofs of homes to heat water. The average cost of a typical home PV system may twice as much as a home solar thermal system. However, the PV system enables a saving of two times more than with the solar system. The decision of which system best suits is dependent of the incentives.



Water Heating solar thermal system

There is a range of federal and local incentives in each country, which should be checked before a decision is made. In some countries, such as in the UK, incentives may be of as much as £300 (around USD 480) for the installation of solar thermal panels. *(Source: Department of Energy & Climate Change, UK)*

In the USA, a Federal Investment Tax Credit enables businesses investing in solar energy equipment and installations to take 30% of the total project cost. *(Source: Sunlight Electric)*

Street Light Application

Solar driven LED streetlights epitomize the advantages offered by solar technology for domestic, respectively public scale standard applications.

Advantages:

- Low-cost installation. No trenching, no heavy cable, quick and easy installation anywhere.

STREET LIGHT APPLICATION

- Have lights in days not months.
- Ultra-low maintenance and long product life. Long warranty on solar panels, LED/Induction lighting fixture.
- Green light source. 40-70% less power consumption than traditional light sources. LED/Induction lights emit no light pollution, provides bright white light which improves color recognition and improves night visibility from 400%-1000% over traditional light sources.
- Flexible configuration. Solar lights can be easily configured to suite your requirements with solar module, wind module and battery of various sizes.
- 3-5 days backup power for rainy, cloudy days.

Ensymm offers high quality street light systems, meeting individual requirements. Our Systems have been successfully tested under various climatic environments, also resisting heavy conditions like sandstorms. And last but not least:

It is made in Germany.

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