SOLAR RADIATION

in·so·la·tion

[2] [in-soh-**ley**-sh*uh* n]

noun *Meteorology* .
solar radiation received at the earth's surface.

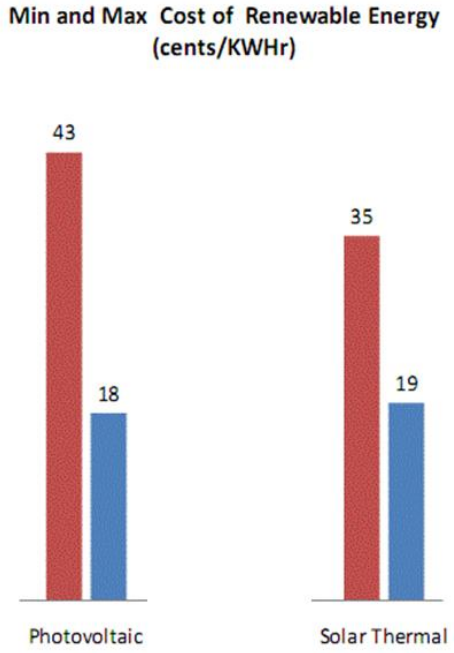
Insolation is a measure of **solar radiaton** energy received on a given surface area and recorded during a given time. It is also called solar irradiation.

Solar power is the conversion of **sunlight into electricity,** either directly **using photovoltaics (PV),** or **indirectly using concentrated solar power(CSP).** Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. **Photovoltaics convert light into electric current using the photoelectric effect. Solar thermal collectors** instead use solar power to **heat up a liquid**, generally water, in order to gain **thermal energy.**

PHOTOVOLTAICS (PV)

Photovoltaics is a method of generating electrical power by converting solar radiation **into direct current electricity** using semiconductors that exhibit the photovoltaic effect. For best performance, terrestrial PV systems aim to maximize the time they face the sun. Solar trackers achieve this by moving PV panels to follow the sun.

WHAT'S THE DIFFERENCE BETWEEN PV AND SOLAR THERMAL?



Both types of solar use solar collectors to **harness the energy from the sun.**

Solar PV is a technology that uses the power of the sun to create electricity. Solar thermal is a technology that uses the power of the sun to heat water.

Unlike solar PV, solar **thermal systems only require daylight to operate and properly installed system works all year round** - even when it's cloudy. In fact, the system will provide you with hot water for approx 70-80% of the year (Reduced amount of daylight hours during the winter reduces production of heat energy).

SOLAR THERMAL ENERGY (STE)

Solar thermal energy (STE) is a technology for harnessing solar energy for thermal energy (heat).

Solar thermal collectors are a technology that can directly convert **stored solar energy** into **thermal energy**.

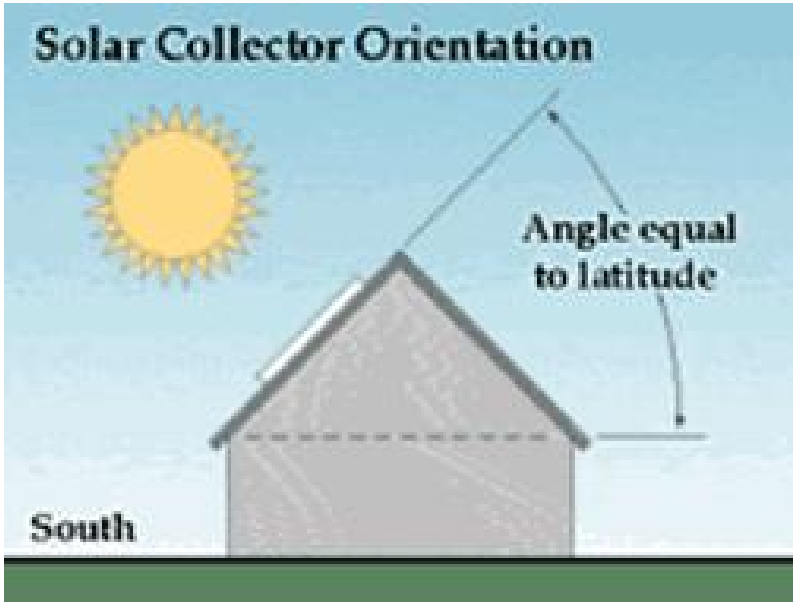
This type of plant is used to produce **hot water** for domestic use or for **heating** using the sun rays.

Specific uses are:
Åheating water for sanitary and domestic use;

Åspace heating;
Åheating water for showers (camping, bathing establishments);
Ådrying of food and agricultural products;
Åcooling environments.

The solar panel systems are connected **in series** and **parallel**, in order to realize and **produce large quantities of hot water at temperatures ranging from 50 to 80 ° C.**

The realization of a good system allows to cover more than **82% of the requirements** of annual hot water, thereby reducing energy costs and placing in harmful agents in the environment.



Italy, from the meteorological point of view, lends itself to the use of solar panel systems and the exploitation of solar energy.

The **maximum radiation** is obtained by **orienting the surface of the panel towards South** and with an **angle of inclination of 30°**, angle that varies according to the ideal type of use established and with the latitude.

STRUCTURE

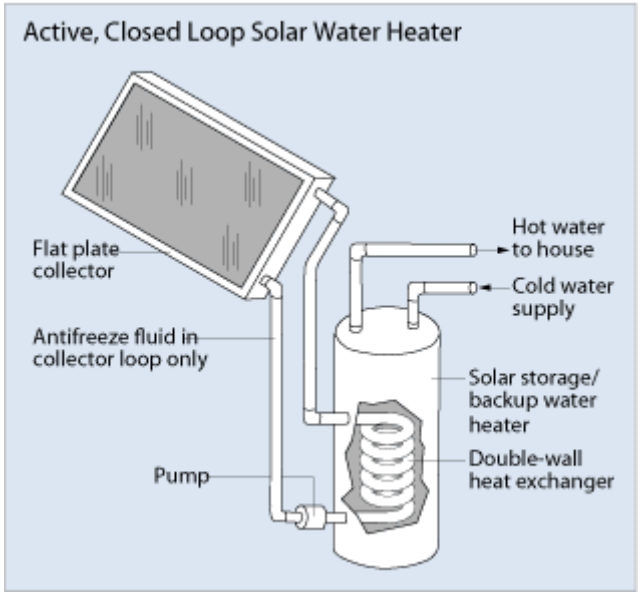
The basic parts of a solar panel system are:

- Panel or collector

- Storage tank

- Pump

- Electronic control



Panel or collector

Panels or collectors can be divided into two categories: **flat solar plates** and **evacuated tube collectors.**

Storage tank

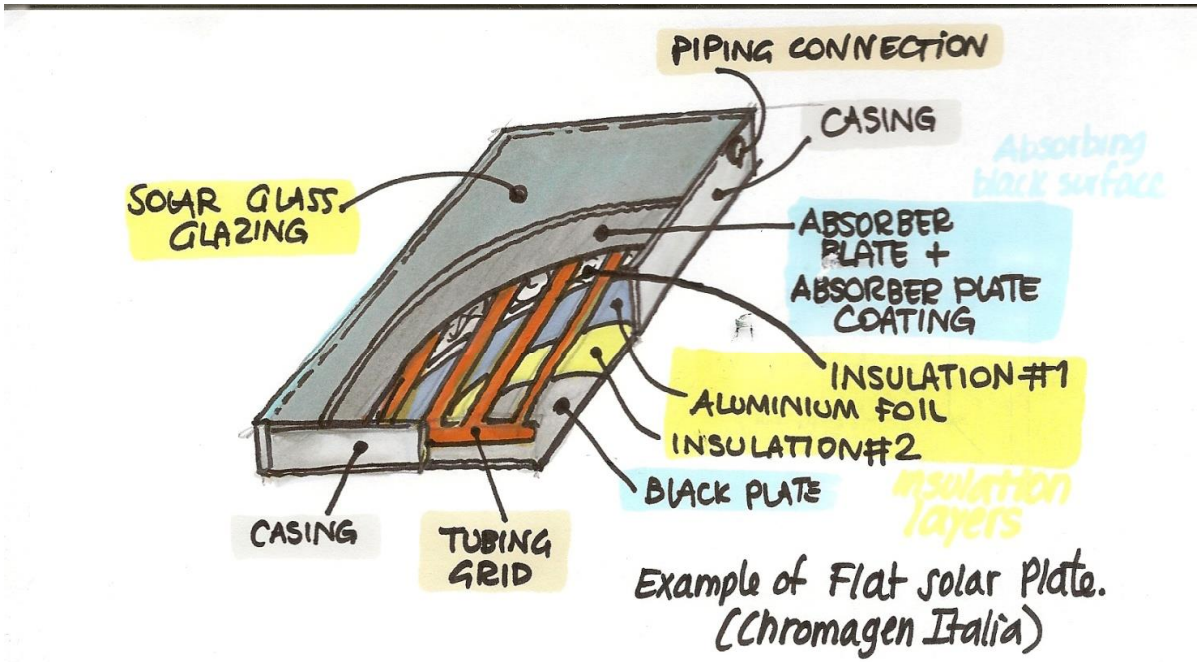
The water tank is needed to store the hot water produced by the panels, keeping it warm for several days. The higher the insulation of the tank, the higher the efficiency of the solar plant. Its dimensions vary on the quantity of water needed and thus on the number of users.

Pump

The pump is a hydraulic device capable of ensuring the circulation of water.

Electronic control

The electronic control unit has the task of controlling the temperature of the system and the kettle and start the pump.



Flat solar plates

Flat solar plates, the most used ones, have the shape of a **box** with a side of transparent glass or plastic. Inside this box there is a **black slab** able to absorb solar energy, which is transmitted to the fluid that will carry the heat. The glass above and the insulation placed under the slab allow to reduce the energy losses and, therefore, heat losses. These panels are capable of producing temperatures up to 70 ° C above the ambient temperature.

*There is another type of flat plate collectors: those **with hot air inside**. The difference consists in the heat-transport fluid: instead of being water, in this case we have air circulating between the glass, the absorber and the bottom of the panel.*

Evacuated tube collectors

Evacuated tube collectors are composed of a series of **evacuated glass tubes**, which allow very high reception of the solar radiation, avoiding also the dispersions with the external environment. They work by using the **heat pipe technology** which allows you to get the best result in terms of efficiency because of the direct contact between radiation, transport and release of heat. The heat losses are very small and you can have temperatures that exceed of 100 ° C the room temperature. They are very efficient in floor heating. Moreover, they ensure good performance even when occurring phenomena of low irradiation. Economically, however, they are more expensive than the flat ones.

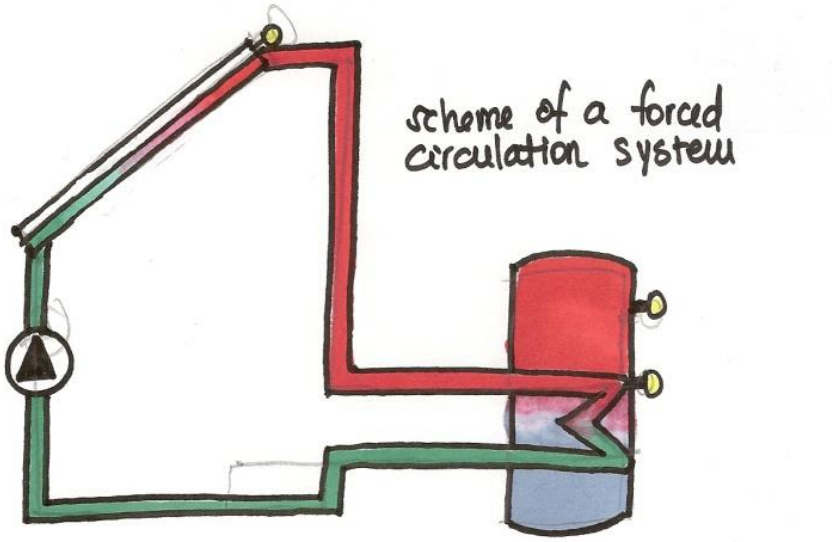
TYPES OF SYSTEMS

The connection between **collector** and **storage tank** in general is referred to as **solar circuit**. It can be:
Å***open,*** if the fluid circulating in the collectors is the same circulating in the circuit for use;
Å***closed*****,** if the fluid circulating in the collectors transfers heat to the fluid for use through the heat exchanger.

The circulation of the fluid within the circuit can be:
Å***natural,*** for convection process;
Å***forced*****,** if for example aided by a pump to transfer the fluid from the collectors to the storage tank.

A natural circulation

Natural circulation systems **do not use pumps**, but exploit the principle that the hot water tends to rise upwards, being able to circulate the hot water inside of the solar panels, and then it flows into the tank where it is stored hot water.
The only negative aspect is the **need for the tank to be positioned higher than the solar panels** with "aesthetic" problems for the buildings, unless the tank is not installed under the roof. The natural circulation system, therefore, is composed of **one or two solar collectors** and a **horizontal boiler with heat exchanger cavity.**



A forced circulation

The circulation in these installations takes place **within the solar circuit**, thanks to an **electric pump** controlled by an electronic control unit. The hot water inside the collector is pushed inside the tank which can be installed or placed in any part of the building. The fact that the tank can be installed in any location is to the advantage of aesthetics, while the panels, of course, are arranged on the roof. In summer, the device is able to cope with the energy needed for the water heating, in winter and in the days of low solar radiation it is used to preheat the water. The auxiliary heating is controlled by a thermostat, which is activated when the ready available water in the tank falls below the temperature desired.