

## **SOLAR THERMAL POWER SYSTEM**

### **SOLAR COLLECTOR**

A **solar collector** is a device that collects and/or concentrates solar radiation from the Sun. These devices are primarily used for active solar heating and allow for the heating of water for personal use. These collectors are generally mounted on the roof and must be very sturdy as they are exposed to a variety of different weather conditions.

The use of these solar collectors provides an alternative for traditional domestic water heating using a water heater, potentially reducing energy costs over time. As well as in domestic settings, a large number of these collectors can be combined in an array and used to generate electricity in solar thermal power plants.

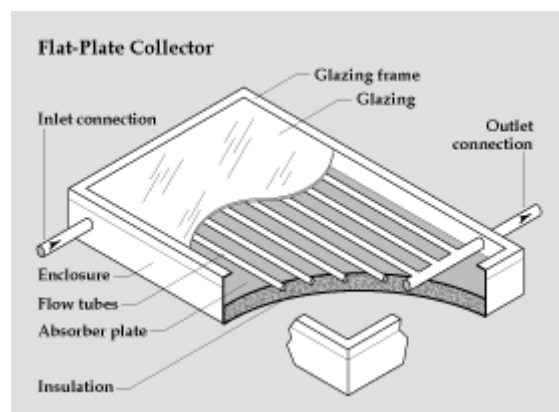
### **TYPES OF SOLAR COLLECTORS**

There are many different types of solar collectors, but all of them are constructed with the same basic premise in mind. In general, there is some material that is used to collect and focus energy from the Sun and use it to heat water. The simplest of these devices uses a black material surrounding pipes that water flows through. The black material absorbs the solar radiation very well, and as the material heats up the water it surrounds. This is a very simple design, but collectors can get very complex. Absorber plates can be used if a high

temperature increase isn't necessary, but generally devices that use reflective materials to focus sunlight result in a greater temperature increase.

## 1. FLAT PLATE COLLECTOR

These collectors are simply metal boxes that have some sort of transparent glazing as a cover on top of a dark-coloured absorber plate. The sides and bottom of the collector are usually covered with insulation to minimize heat losses to other parts of the collector. Solar radiation passes through the transparent glazing material and hits the absorber plate.

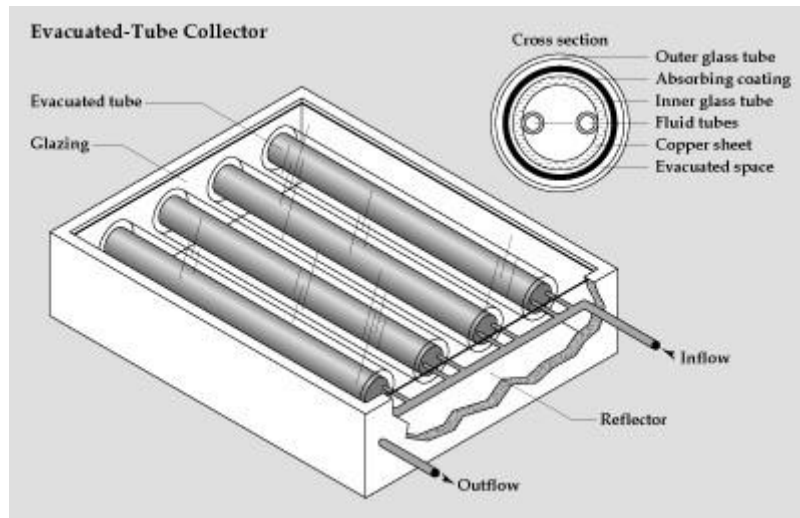


This plate heats up, transferring the heat to either water or air that is held between the glazing and absorber plate. Sometimes these absorber plates are painted with special coatings designed to absorb and retain heat better than traditional black paint. These plates are usually made out of metal that is a good conductor - usually copper or aluminum.

## 2. EVACUATED SOLAR COLLECTOR

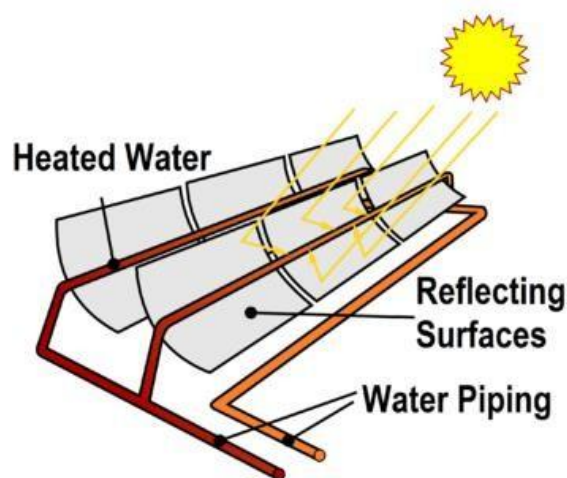
This type of solar collector uses a series of evacuated tubes to heat water for use. These tubes utilize a vacuum, or evacuated space, to capture the sun's energy while minimizing the loss of heat to the surroundings. They have an inner metal tube which acts as the absorber plate, which is connected to a heat pipe to carry the heat collected from the Sun to the water. This heat pipe is essentially a pipe where the fluid contents are under a very particular pressure. At this pressure, the "hot" end of the pipe has boiling liquid in it while the "cold" end has condensing vapour. This allows for thermal energy to move more efficiently from one end of the pipe to the other. Once the heat from the Sun moves from the

hot end of the heat pipe to the condensing end, the thermal energy is transported into the water being heated for use.



### 3. LINE FOCUS SOLAR COLLECTOR

These collectors, sometimes known as parabolic troughs, use highly reflective materials to collect and concentrate the heat energy from solar radiation. These collectors are composed of parabolically shaped reflective sections connected into a long trough. A pipe that carries water is placed in the center of this trough so that sunlight collected by the reflective material is focused onto the pipe, heating the contents. These are very high powered collectors and are thus generally used to generate steam for Solar thermal power plants and are not used in residential applications. These troughs can be extremely effective in generating heat from the Sun, particularly those that can pivot, tracking the Sun in the sky to ensure maximum sunlight collection.



#### **4. POINT FOCUS COLLECTOR**

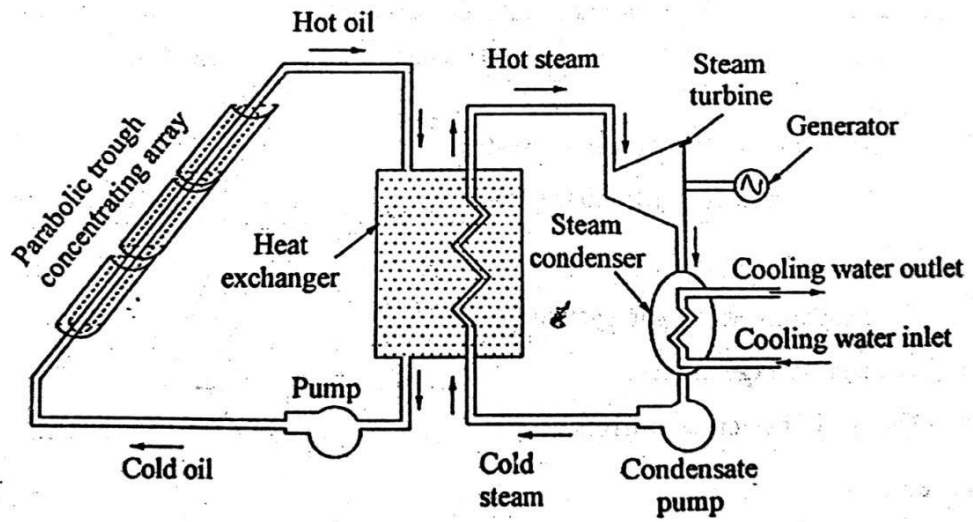
These collectors are large parabolic dishes composed of some reflective material that focus the Sun's energy onto a single point. The heat from these collectors is generally used for driving Stirling engines. Although very effective at collecting sunlight, they must actively track the Sun across the sky to be of any value. These dishes can work alone or be combined into an array to gather even more energy from the Sun.

Point focus collectors and similar apparatuses can also be utilized to concentrate solar energy for use with Concentrated photovoltaics. In this case, instead of producing heat, the Sun's energy is converted directly into electricity with high efficiency photovoltaic cells designed specifically to harness concentrated solar energy.



#### **DISTRIBUTED COLLECTOR SOLAR THERMAL POWER PLANT**

In parabolic trough collector, long, U-curved mirrors focus the rays of the sun into an absorber pipe. The mirrors track the sun on one linear axis from north to south during the day. The pipe is seated above the mirror in the center along the focal line and has a heat-absorbent medium (mineral oil, synthetic oil, molten salt etc.) running in it. The sun's energy heats up the oil, which carries the energy to the water in a boiler heat exchanger, reaching a temperature of about 400°C. The heat is transferred into the water, producing steam to drive turbine. Turbine is the prime mover for the generator and generator produce electrical power.



*Distributed collector solar thermal power plant*