

SOLAR HOT WATER AND SPACE HEATING & COOLING

Solar hot water heaters use the sun to heat either water or a heat-transfer fluid in collectors. There are passive systems and active systems. A typical system will reduce the need for conventional water heating by about two-thirds. High-temperature solar water heaters can provide energy-efficient hot water and hot water heat for large commercial and industrial facilities.

SOLAR HOT WATER SYSTEMS

Direct Systems

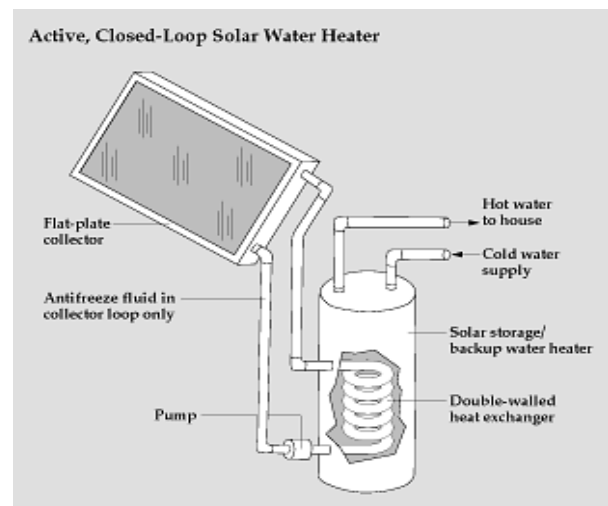
This system uses a pump to circulate potable water from the water storage tank through one or more collectors and back into the tank. An electronic controller, an appliance timer, or a photovoltaic panel regulates the pump.



Integral Collector Storage (ICS) System is passive and direct, the collector and tank are combined. Pumps and controls are not required. Water is heated and stored in a combined heat storage and collection unit.

Indirect Systems

In this system, a heat exchanger heats a fluid that circulates in tubes through the water storage tank, transferring the heat from the fluid to the potable water. Active, indirect systems are often used in freezing climates.

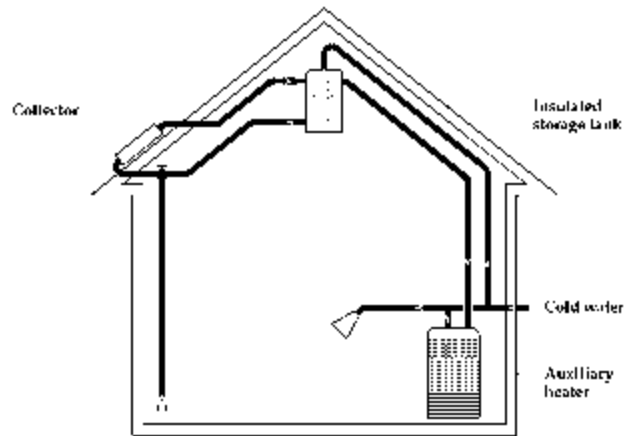


Thermosiphons

A thermosiphon solar water heating system has a tank mounted above the collector. As the collector heats the water, it rises to the storage tank, while heavier cold water sinks down to the collector.



Thermosiphon Solar Water Heater

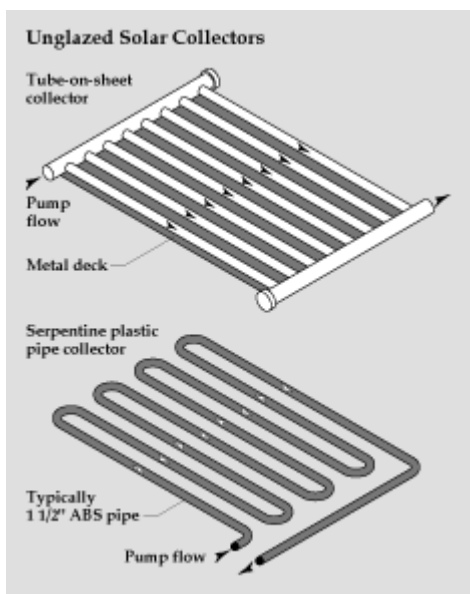


Thermosiphon systems are an economical and reliable choice, especially in new homes.

Drain down Systems

In cold climates, this system prevents water from freezing in the collector by using electric valves that automatically drain the water from the collector when the temperature drops to freezing. "Drain back systems," a variation of this approach, automatically drain the collector whenever the circulating pump stops.

Swimming Pool Systems

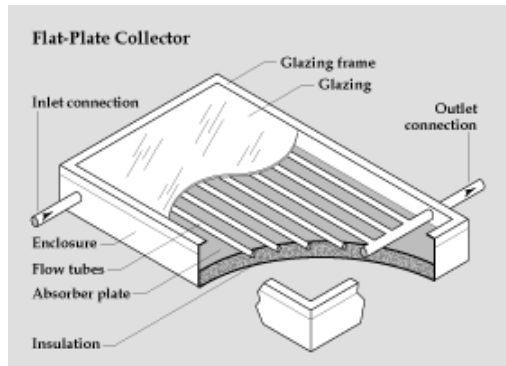


In solar heated swimming pools, the pool's filter pump pumps water through a solar collector, and the pool itself stores the hot water.

Unglazed solar collectors are typically used for swimming pool heating.

SOLAR ENERGY COLLECTORS

Flat Plate Collectors



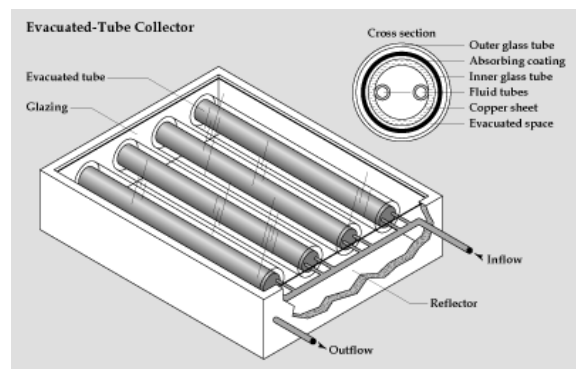
Flat-plate collectors are used for residential water-heating and space-heating installations.

The most common collector for solar hot water is the flat plate collector. It is a rectangular box with a transparent cover, installed on a building's roof. Small tubes run through the box and carry fluid—either water or other fluid, such as an antifreeze solution. The tubes attach to a black absorber plate. As heat builds up in the collector, it heats the fluid passing through the tubes. The hot water or liquid goes to a storage tank. If the fluid is not hot water, water is heated by passing it through a tube inside the storage tank full of hot fluid.



Evacuated Tube Collectors

These collectors consist of rows of parallel transparent glass tubes, each containing an absorber and covered with a selective coating. Sunlight enters the tube, strikes the absorber, and heats the liquid flowing through the absorber. These collectors are manufactured with a vacuum between the tubes, which helps them achieve extremely high temperatures (170-350 degrees F); so they are



appropriate for commercial and industrial uses.

Concentrating Collectors

Parabolic trough-shaped reflectors concentrate sunlight onto an absorber or receiver to provide hot water and steam, usually for industrial and commercial applications.

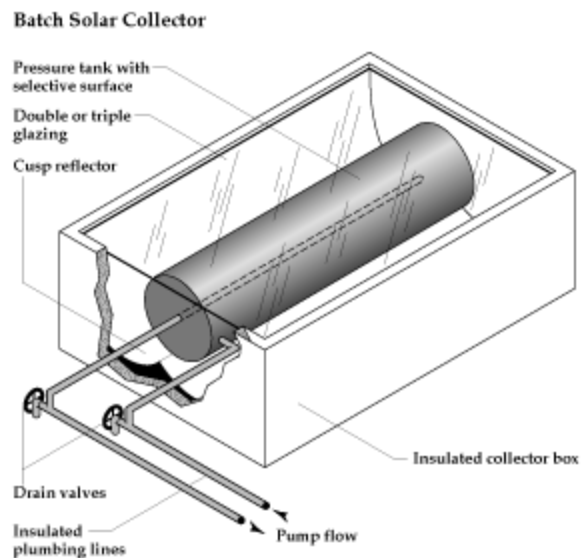
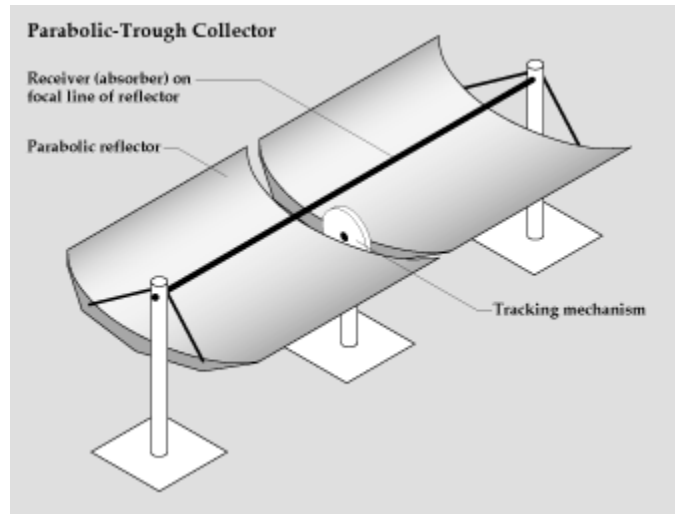
Transpired Solar Collectors

A transpired collector is a south facing outside wall covered by a dark sheet metal collector. The collector heats outside air, which is then sucked into the building's ventilation system through perforations in the collector. They have been used

for pre-heating ventilation air and crop drying. They are inexpensive to make, and commercially, have achieved efficiencies of more than 70 percent.

Batch or Breadbox Heaters

This system is also referred to as a batch heater and a breadbox. It consists of an approximately 40-gallon insulated tank, lined with glass on the inside and painted black on the outside. It is mounted on the roof, or on the ground in the sun. Plumbing from the house supplies the box with cold water through an inlet that extends down to the bottom of the tank. The box itself acts like a collector, absorbing and trapping the sun's heat and heating the water. An outlet supplies the house with heated water from the top of the tank.



Batch solar collectors can be a reliable and economical choice for heating domestic water in mild-freeze climates.

APPLICATIONS

Solar Process Heat

These systems consists of several thousand square feet of ground-mounted collectors, pumps, heat exchangers, controls, and one or more large storage tanks. Typically, they provide hot water and hot water space heating for large institutions such as schools, office buildings, prisons, and military bases.

Active Solar Cooling

As water evaporates, it cools the air. Evaporative cooling systems, usually appropriate for hot dry climates, can be powered with solar technology. In humid climates, desiccant evaporative cooling systems use the same evaporative concept to cool air, but they also include a desiccant wheel to dry incoming air. Waste heat from the building, natural gas, or solar technologies can be used to regenerate the desiccant wheel. Evaporative cooling is a CFC-free and energy-efficient way to cool commercial buildings. In absorption solar cooling, an absorption device uses a heat source, such as natural gas or a large solar collector, to evaporate refrigerant.

ISSUES

Certification of Solar Water Heaters

Solar research facilities have developed testing and certification requirements for solar collectors and design and installation criteria for solar systems. Thermal performance ratings, derived from testing and certification programs, are a useful tool in comparing the efficiency and economics of various flat-plate solar collectors.

Incentives

Builders, utilities, and the Department of Energy have joined together on several occasions to offer tax credits and utility rebates to encourage the use of solar hot water for residential and commercial projects.