Solar Collectors

Solar collectors are the key component of active solar-heating systems. Solar collectors gather the sun's energy, transform its radiation into heat, then transfer that heat to water, solar fluid, or air. The solar thermal energy can be used in solar water-heating systems, solar pool heaters, and solar space-heating systems. There are several types of solar collectors:

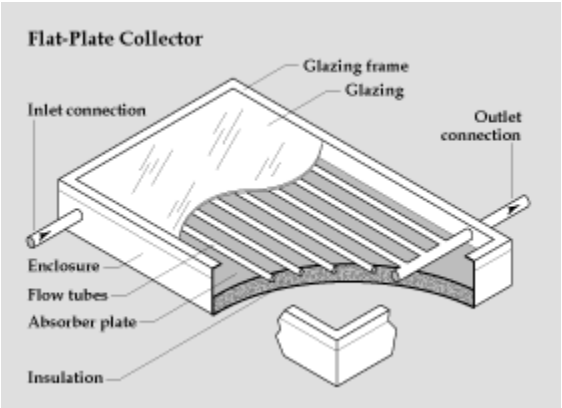
- Flat-plate collectors
- Evacuated-tube collectors
- Integral collector-storage systems

This home in Nevada has an integral collector storage (ICS) system to provide hot water.

Residential and commercial building applications that require temperatures below 200°F typically use flat-plate collectors, whereas those requiring temperatures higher than 200°F use evacuated-tube collectors.

Flat-plate collectors

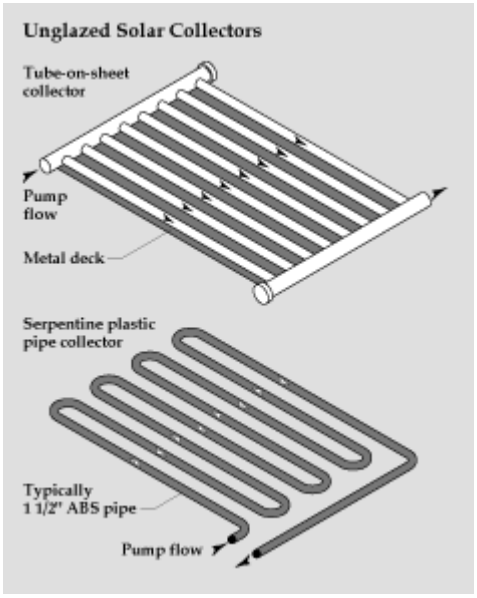
Flat-plate collectors are the most common solar collector for solar water-heating systems in homes and solar space heating. A typical flat-plate collector is an insulated metal box with a glass or plastic cover (called the glazing) and a dark-colored absorber plate. These collectors heat liquid or air at temperatures less than 180°F.



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

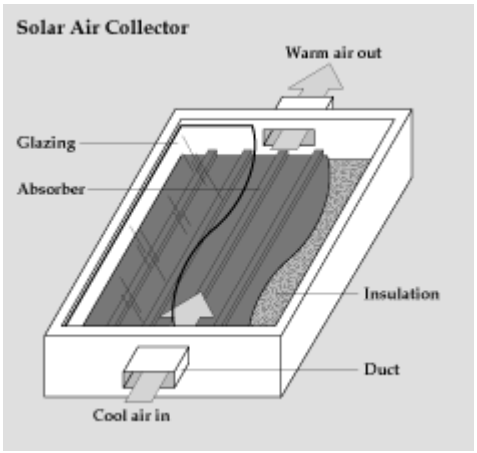
Liquid flat-plate collectors heat liquid as it flows through tubes in or adjacent to the absorber plate. The simplest liquid systems use potable household water, which is heated as it passes directly through the collector and then flows to the house. Solar pool heating

also uses liquid flat-plate collector technology, but the collectors are typically unglazed as in figure below.



Unglazed solar collectors typically used for swimming pool heating.

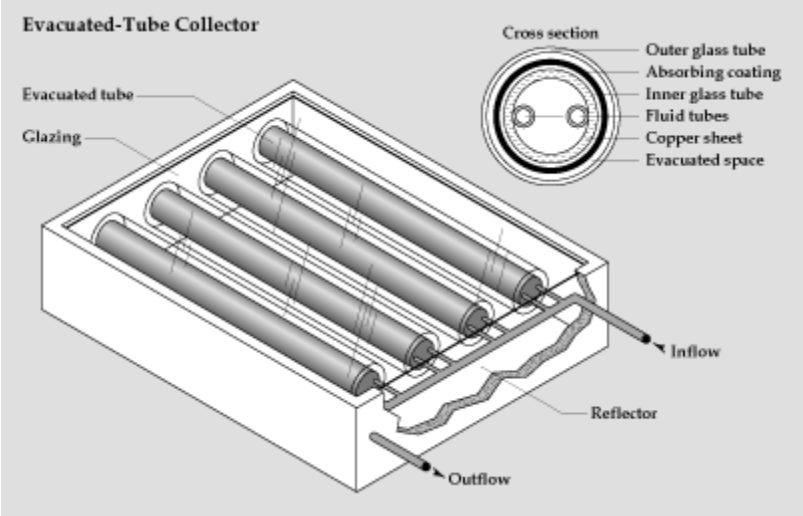
Air flat-plate collectors are used primarily for solar space heating. The absorber plates in air collectors can be metal sheets, layers of screen, or non-metallic materials. The air flows past the absorber by using natural convection or a fan. Because air conducts heat much less readily than liquid does, less heat is transferred from an air collector's absorber than from a liquid collector's absorber, and air collectors are typically less efficient than liquid collectors.



Air flat-plate collectors are used for space heating.

Evacuated-tube collectors

Evacuated-tube collectors can achieve extremely high temperatures (170°F to 350°F), making them more appropriate for cooling applications and commercial and industrial application. However, evacuated-tube collectors are more expensive than flat-plate collectors, with unit area costs about twice that of flat-plate collectors.



Evacuated-tube collectors are efficient at high temperatures.

The collectors are usually made of parallel rows of transparent glass tubes. Each tube contains a glass outer tube and metal absorber tube attached to a fin. The fin is covered with a coating that absorbs solar energy well, but which inhibits radiative heat loss. Air is removed, or evacuated, from the space between the two glass tubes to form a vacuum, which eliminates conductive and convective heat loss.

A new evacuated-tube design is available from the Chinese manufacturers, such as: Beijing Sunda Solar Energy Technology Co. Ltd. The "dewar" design features a vacuum contained between two concentric glass tubes, with the absorber selective coating on the inside tube. Water is typically allowed to thermosyphon down and back out the inner cavity to transfer the heat to the storage tank. There are no glass-to-metal seals. This type of evacuated tube has the potential to become cost-competitive with flat plates.

Integral collector-storage systems

Integral collector-storage systems, also known as ICS or "batch" systems, are made of one or more black tanks or tubes in an insulated glazed box. Cold water first passes through the solar collector, which preheats the water, and then continues to the conventional backup water heater.

ICS systems are simple, reliable solar water heaters. However, they should be installed only in climates with mild freezing because the collector itself or the outdoor pipes could freeze in severely cold weather. Some recent work indicates that the problem with freezing pipes can be overcome in some cases by using freeze-tolerant piping in conjunction with a freeze-protection method.