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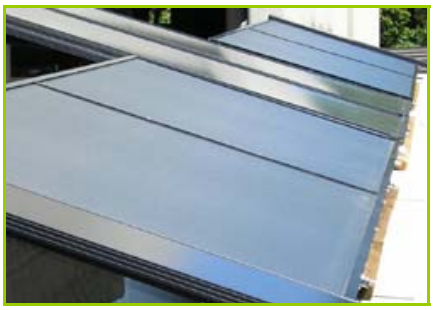
Solar Water Heating

Prepared For:
The Los Angeles Community College District



DESCRIPTION OF TECHNOLOGY

Solar thermal systems, unlike Photovoltaics (PV) are comparatively low-technology systems that rely on absorbing radiant solar energy through collectors to heat water for domestic use. These collectors usually consist of:

- A highly conductive material such as copper with a coating designed to maximize the collection of sunlight,
- A glazing system covering the collecting surface and designed to minimize heat loss by radiating energy to the environment, and
- Casings designed to reduce loss of heat with traditional insulating materials or a vacuum.

Transporting the heat collected is typically done using water or a glycol mix to move the energy from the collector to a point of use.

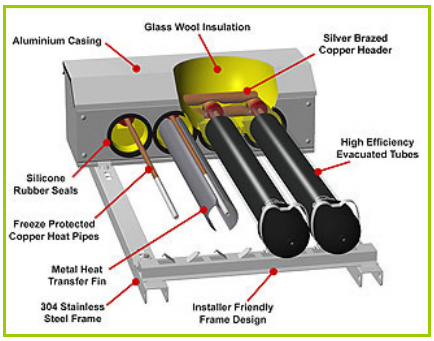
For the buildings on the Los Angeles Community College Districts' campuses, the most cost effective candidates for receiving solar hot water are domestic hot water systems in physical education buildings with showers, high temperature domestic hot water systems in food service buildings, and buildings with pools.

Collector Types

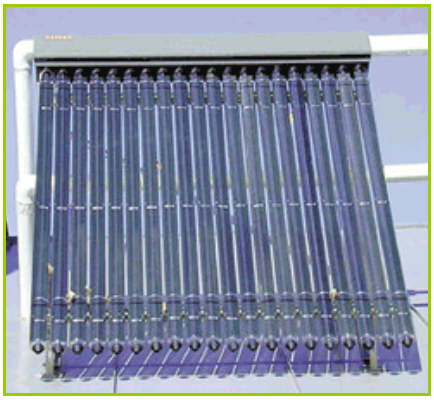
Unglazed liquid flat-plate collectors. Unglazed liquid flat-plate collectors are usually made of a black polymer and simply laid on a roof or on a simple support. These low-cost collectors are good at capturing solar energy, but thermal losses to the environment are very high, particularly in windy conditions. Additionally these collectors do not last as long as other types of collectors because they do not have protective casings. As a result, unglazed collectors are not recommended for use on LACCD campuses.

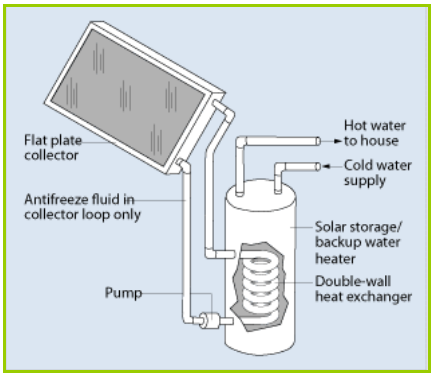
Glazed liquid flat-plate collectors. A flat-plate absorber , which often has a selective coating, is fixed in a frame between a single or double layer of glass and an insulation panel at the back. Much of the absorbed solar energy is prevented from escaping due to the glazing (the "greenhouse effect"). These collectors are commonly used in low to moderate temperature applications, such as domestic hot water systems and pools.

Evacuated/vacuum tube solar collectors. Evacuated or vacuum tube solar collectors have an absorber with a selective coating enclosed in a sealed glass vacuum tube. This technology captures solar energy well, and thermal losses to the environment are extremely low. Systems presently on the market use a sealed heat-pipe on each tube to extract heat from the absorber. The liquid is vaporized while in contact with the heated absorber, heat is recovered at the top of the tube where the vapor condenses, and condensate then returns by gravity to the absorber.



Detail of Evacuated Tube Collector

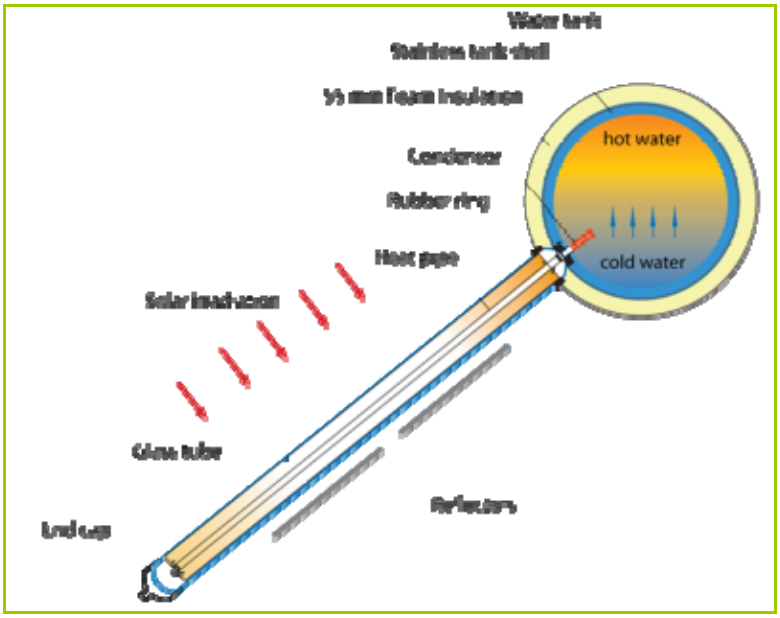

Evacuated Tube Collector



Indirect System with Storage Tank


Glazed Flat Plate Collector Installation

Evacuated collectors are good for applications requiring energy delivery at moderate to high temperatures, such as food preparation and dishwashing applications. Temperatures of 140°F to 175°F can be achieved, depending on outside temperature. This system can also be used for low to moderate temperature applications.



Evacuated Tube Cutaway

System Components

System components will vary depending on system design, but the typical major elements are described below.

Storage Tanks. To take advantage of the available solar insolation when demand for heated water is low, a storage tank is used to store energy for later use. The storage tank should be located as close to the collectors as practical in a thermally protected space; otherwise its location should be as close to the hot water demand as possible.

The size of the storage tank will depend on the type of system and the demands of the facility, but will typically be in the range of 1.5 to 2.5 gallons per square foot of collector plate.

A storage tank is not required for a solar water heating system for a pool, since the pool attacks as a large heat reservoir.

Heat Exchanger. Indirect systems require a heat exchanger to transfer heat from the collector fluid (typically water mixed with glycol) to the heated water which will be used at the plumbing fixture or pool. Normally the heat exchanger is mounted in the storage tank, but it can be installed in-line with the piping if the system does not have a storage tank, as in a pool heating system.


Glazed Flat Plate Collectors


Glazed Flat Plate Collectors


Evacuated Tube Collectors


Evacuated Tube Collectors

Glycol Mixture. The glycol mixture to be used in an indirect system should be based on propylene glycol, a non-toxic fluid that will help prevent freezing. Freezing is a consideration even in Los Angeles, since the collectors may freeze by radiating heat to a clear nighttime sky, even when ambient temperatures are above the freezing point.

Piping Systems. Based on California plumbing requirements, piping should be done using conventional copper piping systems.

Pumps. To move fluid between tanks, heat exchangers, and collectors, small pumps are used.

LOS ANGELES FIRE DEPARTMENT REQUIREMENTS

Roof-mounted solar hot water collectors should comply with the same Los Angeles Fire Department requirements that apply to PV arrays to allow adequate firefighter emergency access. The requirements include maximum collector array sizes and adjacent clearances. For more information, contact the LAFD or refer to lafd.org/prevention/pdfforms/solar_pwr_req.pdf.

Energy Production

The Solar Ratings and Certification Corporation provide an independent certification program for solar water heating systems.

"Fchart" is an industry-standard computer program which sizes the collector arrays and calculates the final efficacy of solar water heating systems. Go to fchart.com for additional information.

Additional Resources

The following websites contain additional information on solar water heating systems.

Government websites
- www.consumerenergycenter.org
- www.cpuc.ca.gov
- www.eere.energy.gov
- www.eren.doe.gov
- www.gosolarcalifornia.ca.gov
- www.nrel.gov

Utility websites
- www.socalgas.com

Industry websites
- fchart.com
- www.ases.org
- www.californiasolarcenter.org
- www.fsec.ucf.edu/~thermal/index.htm
- www.seia.org