

Solar Water Heating

Overview

Solar water heating is the most cost effective and environmentally responsible method to heat water for residential, commercial, and industrial needs.

Solar water heating falls under the umbrella term of “solar thermal technologies,”* along with solar pool heating, solar space heating and cooling, and solar industrial process pre-heating. [For more information, see [SEIA fact sheet on solar thermal](#)]. Simply put, a solar water heating system collects the thermal energy of the sun and uses it to heat water for use by a home or business, rather than using electricity or natural gas.

Active solar water heating systems¹ are generally composed of three to five elements:

- a collector;
- insulated heat transport piping;
- heat storage; and sometimes
- electronic controls; and
- in colder climates, a freeze protection system.

The solar collector gathers the heat from solar radiation and then transfers the heat to potable water. This heated water flows out of the collector to a water tank, and is used as necessary. A conventional water heater (using electricity, natural gas, oil, or propane) can provide additional heating if necessary.

In a colder climate where temperatures can drop to 32°F or below, an indirect system is used. (See diagram to the right). An antifreeze solution, such as non-toxic propylene glycol, is heated in the solar collector and circulated from the solar collector through a heat exchanger connected to a storage tank. The potable water in the storage tank is warmed by the hot, antifreeze-filled heat exchanger, and the heated water can then be used as necessary, while the cooled glycol is piped back to the solar collector to be heated again.

Another common type of solar water heating system design for cold climates is called “drainback.” This type of solar energy system typically uses regular water as a heat transfer fluid, and is designed to allow all of the water in the solar collector to “drain back” to a holding tank in a heated portion of the building it is used on. When no sunlight is available for heating, the solar pump turns off and the water flows into the drainback tank by means of gravity.

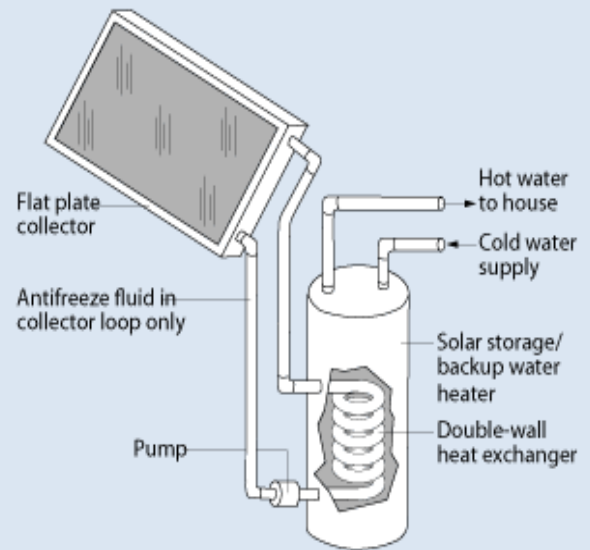
No matter which type of solar energy system your solar professional recommends for you, a properly designed and installed solar water heating system can be expected to provide a significant percentage (40-80%) of a building’s hot water needs.

Example of Flat Plate Collectors



Source: Entech Solar, Inc.

Active, Closed Loop Solar Water Heater



Note: There are many configurations of this idea, including systems with single-wall heat exchangers.

The diagram shows an active, indirect solar water heating system. Source: DOE

* This shouldn't be confused with concentrating solar power technologies that are often referred to as solar thermal electric.

Solar Water Heating Collectors

Solar water heating collectors produce heat, and are different from photovoltaic (PV) modules, which produce electricity. There are several types of collectors: flat plate, evacuated tube, Integral Collector Storage (ICS), Thermosiphon, and Concentrating. Flat plate collectors are the most common type of collector in the US; typically copper pipes create a matrix of risers, or are affixed to an “absorber plate” contained in an insulated “box” covered with a tempered glass or polymer “coverplate.”² Evacuated tube collectors consist of rows of parallel, transparent glass tubes. Each tube encloses an “absorber” assembly, and the entire tube is “evacuated” of air, leaving a vacuum; this vacuum acts as a highly efficient insulator, since air is required to transmit heat from the absorber to the glass. A fluid transfers the heat from the solar collector to a storage tank, where it is distributed for water or space heating purposes³.

Typical Evacuated Tube Water System- Sunda Seido 2 Collectors Shown



Photo courtesy of SEIA.

While both solar water heating systems and solar photovoltaic (PV) systems often involve roof collector panels, they are very different technologies. Solar water heating systems use radiation from the sun to generate heat for water, whereas solar electric systems use solar radiation to directly generate electricity.⁴

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Solar Water Heating Systems...

- Can work in any region of the United States. The solar radiation for the contiguous 48 states and Hawaii is equal to or better than that of Spain, where numerous solar water heaters have been installed. Alaska has a similar solar radiation to that of Germany, one of the world leaders in solar water heating installations.
- Are commonly used in China, where 1 in 10 households has a solar water heating system.⁵
- Last anywhere between 15-40 years, depending on the maintenance given and the climate conditions.
- Can be installed in as little as 2 days.
- Range in price from \$2,000-\$8,000 depending on the size of the residential system and the installation needs. The payback period can be realized in as little as 3-6 years. Larger systems for commercial or industrial purposes have a slightly longer payback.
- Can create thousands of jobs throughout the U.S.
- Are tested and certified by the Solar Rating and Certification Corporation to be reliable and effective.
- Are a rapidly growing sector. In spite of an economic downturn, solar water heating capacity increased 40 percent in 2008 in the U.S., to an estimated 485 MW_{th}.^{**} About 20,500 solar water heating systems were installed in the U.S. in 2008 alone.⁶
- Are proven to increase the value of a home and are therefore a worthwhile investment.⁷
- Can create vast amounts of clean energy. A solar water heating system cost-effectively sized for the climate where it is installed will generate a remarkably consistent 2,800 to 3,200 kWh (9.5 to 11 million Btu) of energy per year.⁸
- Can significantly contribute to emissions reductions. For a typical residential solar hot water system displacing natural gas, about 1,290 lbs of CO₂ can be avoided annually. If the system displaces electricity, the amount of emissions avoided is equal to removing a small car off the road.⁹

About the Solar Energy Industries Association

Established in 1974, SEIA is the national trade association of the solar energy industry. As the voice of the industry, SEIA works to make solar a mainstream and significant energy source by expanding markets, removing market barriers, strengthening the industry and educating the public on the benefits of solar energy.

For a footnoted version of this factsheet and more information, please visit www.seia.org.

^{**} MW_{th} or megawatts-thermal is a unit used to compare solar thermal collector capacity to electric capacity by multiplying the absorber surface area of the solar thermal collector by 0.7 kilowatts/square meter.

¹ Solar water heating systems can be either active (relying on electric pumps to circulate water) or passive (relying on gravity and the property of water to rise when heated). The most common type of system for use in commercial and residential buildings is an active system.

² Efficiencies range between 30-60% for flat plate collectors.

³ An aluminum nitride coating on borosilicate glass gives a 92% efficiency rating of transforming solar radiation into heat.

⁴ Regarding energy metrics: The energy from solar water heating technologies is generally measured in British Thermal Units (BTU), which can be converted to kWh through an industry accepted conversion factor.

⁵ <http://www.martinot.info/china.htm>

⁶ Solar Industry Year in Review 2008, SEIA.

⁷ Ramlow, Bob. *Solar Water Heating: A Comprehensive Guide to Solar Water and Space heating systems*. Canada: New Society Publishing, 2006.

⁸ Wilson, Alex. "Is Solar Still Active? Water Heating and Other Solar Thermal Applications." Environmental Building News. Building Green, LLC. 1 July 1999. <<http://www.buildinggreen.com.proxy-um.researchport.umd.edu/auth/article.cfm/1999/7/1/Is-Solar-Still-Active-Water-Heating-and-Other-Solar-Thermal-Applications/>>.

⁹ Wilson, Alex. "Is Solar Still Active? Water Heating and Other Solar Thermal Applications." Environmental Building News. Building Green, LLC. 1 July 1999. <<http://www.buildinggreen.com.proxy-um.researchport.umd.edu/auth/article.cfm/1999/7/1/Is-Solar-Still-Active-Water-Heating-and-Other-Solar-Thermal-Applications/>>.