

U.S. Department of Energy - Energy Efficiency and Renewable Energy Energy Savers

Solar Water Heaters

Solar water heaters—also called solar domestic hot water systems—can be a [cost-effective way](#) to generate hot water for your home. They can be used in any climate, and the fuel they use—sunshine—is free.

How They Work

Solar water heating systems include storage tanks and solar collectors. There are two types of solar water heating systems: active, which have circulating pumps and controls, and passive, which don't.

Most solar water heaters require a well-insulated storage tank. Solar storage tanks have an additional outlet and inlet connected to and from the collector. In two-tank systems, the solar water heater preheats water before it enters the conventional water heater. In one-tank systems, the back-up heater is combined with the solar storage in one tank.

Three types of solar collectors are used for residential applications:

- **Flat-plate collector**

Glazed flat-plate collectors are insulated, weatherproofed boxes that contain a dark absorber plate under one or more glass or plastic (polymer) covers. Unglazed flat-plate collectors—typically used for [solar pool heating](#)—have a dark absorber plate, made of metal or polymer, without a cover or enclosure.

- **Integral collector-storage systems**

Also known as ICS or *batch* systems, they feature one or more black tanks or tubes in an insulated, glazed box. Cold water first passes through the solar collector, which preheats the water. The water then continues on to the conventional backup water heater, providing a reliable source of hot water. They should be installed only in mild-freeze climates because the outdoor pipes could freeze in severe, cold weather.

- **Evacuated-tube solar collectors**

They feature parallel rows of transparent glass tubes. Each tube contains a glass outer tube and metal absorber tube attached to a fin. The fin's coating absorbs solar energy but inhibits radiative heat loss. These collectors are used more frequently for U.S. commercial applications.

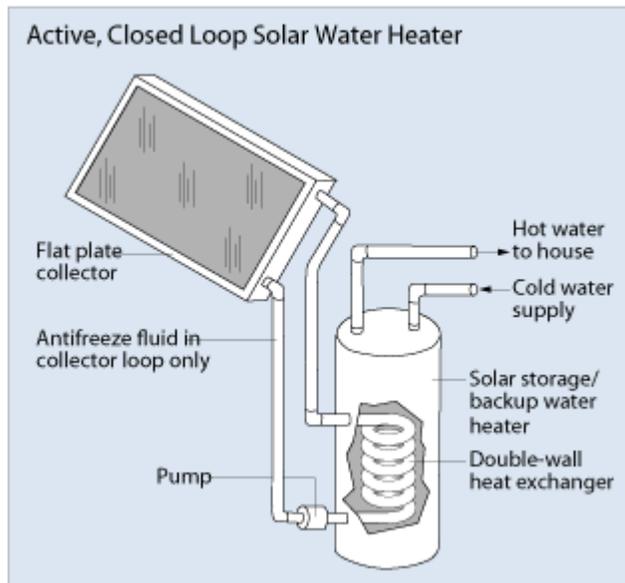
There are two types of active solar water heating systems:

- **Direct circulation systems**

Pumps circulate household water through the collectors and into the home. They work well in climates where it rarely freezes.

- **Indirect circulation systems**

Pumps circulate a non-freezing, [heat-transfer fluid](#) through the collectors and a [heat exchanger](#). This heats the water that then flows into the home. They are popular in climates prone to freezing temperatures.



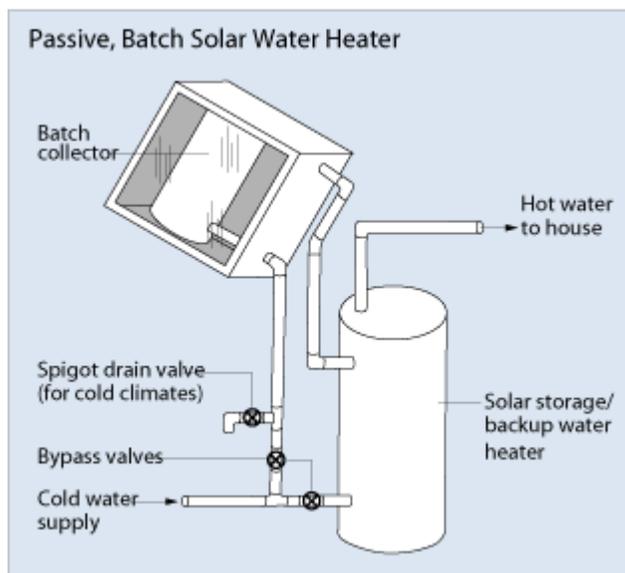
Passive solar water heating systems are typically less expensive than active systems, but they're usually not as efficient. However, passive systems can be more reliable and may last longer. There are two basic types of passive systems:

- **Integral collector-storage passive systems**

These work best in areas where temperatures rarely fall below freezing. They also work well in households with significant daytime and evening hot-water needs.

- **Thermosyphon systems**

Water flows through the system when warm water rises as cooler water sinks. The collector must be installed below the storage tank so that warm water will rise into the tank. These systems are reliable, but contractors must pay careful attention to the roof design because of the heavy storage tank. They are usually more expensive than integral collector-storage passive systems.



Solar water heating systems almost always require a backup system for cloudy days and times of increased demand. [Conventional storage water heaters](#) usually provide backup and may already be part of the solar system package. A backup system may also be part of the solar collector, such as rooftop tanks with thermosyphon systems. Since an integral-collector storage system already stores hot water in addition to collecting solar heat, it may be packaged with a [demand \(tankless or instantaneous\) water heater](#) for backup.

For more information about solar water heating system components, see the following information:

- [Heat Exchangers for Solar Water Heating Systems](#)
- [Heat-Transfer Fluids for Solar Water Heating Systems](#)

Selecting a Solar Water Heater

Before you purchase and install a solar water heating system, you want to do the following:

- [Consider the economics of a solar water heating system](#)
- [Evaluate your site's solar resource](#)
- [Determine the correct system size](#)
- [Determine the system's energy efficiency](#)
- [Estimate and compare system costs](#)
- [Investigate local codes, covenants, and regulations.](#)

For information about specific solar water heater models and systems, see the Product Information resources listed on the right side of this page (or below if you've printed the page).

Installing and Maintaining the System

The proper installation of solar water heaters depends on many factors. These factors include solar resource, climate, local building code requirements, and safety issues; therefore, it's best to have a qualified, solar thermal systems contractor install your system.

After installation, properly maintaining your system will keep it running smoothly. Passive systems don't require much maintenance. For active systems, discuss the maintenance requirements with your system provider, and consult the system's owner's manual. Plumbing and other conventional water heating components require the same maintenance as conventional systems. Glazing may need to be cleaned in dry climates where rainwater doesn't provide a natural rinse.

Regular maintenance on simple systems can be as infrequent as every 3–5 years, preferably by a solar contractor. Systems with electrical components usually require a replacement part after or two after 10 years. For more information about system maintenance, see the following:

- [Solar Water Heating System Maintenance and Repair](#)
- [Solar Water Heating System Freeze Protection](#)
- [Scaling and Corrosion in Solar Water Heating Systems](#)

When screening potential contractors for installation and/or maintenance, ask the following questions:

- *Does your company have experience installing and maintaining solar water heating systems?*
Choose a company that has experience installing the type of system you want and servicing the applications you select.
- *How many years of experience does your company have with solar heating installation and maintenance?*
The more experience the better. Request a list of past customers who can provide references.
- *Is your company licensed or certified?*
Having a valid plumber's and/or solar contractor's license is required in some states. Contact your city and county for more information. Confirm licensing with your state's contractor licensing board. The licensing board can also tell you about any complaints against state-licensed contractors.

For contractor information, see the Professional Services resources listed on the right side of this page (or below if you've printed it out).

Improving Energy Efficiency

After your water heater is properly installed and maintained, try some additional [energy-saving strategies](#) to help lower your water heating bills, especially if you require a back-up system. Some energy-saving devices and systems are more cost-effective to install with the water heater.

Other Water Heater Options

- [Conventional storage water heaters](#)
- [Demand water heaters](#)
- [Heat pump water heaters](#)
- [Tankless coil and indirect water heaters](#)

Learn More

Evaluation Tools

- [Solar Benefits Model](#)
DOE Building Energy Software Tools Directory
- [Solar Water Heating Project Model](#)
RETScreen International

Financing & Incentives

- [Find State and Local Incentives](#)
Database of State Incentives for Renewables and Efficiency
- [Find Federal Tax Credits for Energy Efficiency](#)
ENERGY STAR®

Product Information

- [Solar Thermal Systems](#)
Florida Solar Energy Center
- [Certified Solar Collectors and Systems](#)
Solar Rating and Certification Corporation
- [Find ENERGY STAR® Solar Water Heaters](#)
ENERGY STAR

Professional Services

- [Find a Solar Pro](#)
Solar-Estimate.org
- [Solar Energy Industries Association](#)

State & Local Resources

- [State Chapters](#)
Solar Energy Industries Association

Related Links

- [Solar Hot Water](#)
Florida Solar Energy Center

Reading List

- *The Borrower's Guide to Financing Solar Energy Systems: A Federal Overview* ([PDF 501 KB](#)). (September 1998). U.S. Department of Energy. This booklet provides an extensive overview of government-authorized special financing programs available to consumers interested in installing solar energy systems for heat and electricity.
- *Heat Your Water with the Sun* ([PDF 603 KB](#)). (December 2003). DOE/GO-102003-1824. U.S. Department of Energy.

Content Last Updated: March 24, 2009