

Introduction to Domestic Solar Hot Water Systems

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Consumer Series | **Energy**

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Solar hot water systems collect energy from the sun in panels or tubes. Hot water produced for use in a home or building is stored on site in tanks. A domestic solar hot water system can be a cost-effective way to reduce energy costs from gas, electric, or propane sources.

Considerations before Installing a Domestic Solar Hot Water System

Before considering the installation of a solar hot water system, steps should be taken to decrease consumption, increase efficiency, and reduce loss of hot water; a few simple changes can make a big difference. Turning down the hot water heater thermostat to 120°F, insulating hot water pipes and the water heater, repairing leaky hot water faucets, and replacing an inefficient hot water heater and/or plumbing will reduce hot water consumption and increase efficiency of an already existing domestic hot water system. And because typically the shower is the largest consumption of hot water in the average residence, replacing a showerhead with a low-flow model can help reduce hot water usage.

With over 300 days of sunshine per year in Colorado, most locations are good choices when considering solar installation. The location of your home will help determine whether solar is a good choice. Data is available from the U.S. Department of Energy National Renewable Energy Laboratory (NREL) for many locations in Colorado and elsewhere. Online at www.energysavers.gov/pdfs/208.pdf. A fundamental requirement for a solar system is to have a sunny location where solar collectors can function properly. Locations where the sun is blocked from the collectors by the slope or aspect of the

land, trees, neighboring buildings, or other obstructions will reduce efficiency. Solar collectors need to be placed where plenty of sunshine strikes the surface of the collectors, year round.

Prior to making the decision to install a solar system, determine if there are restrictions to placing solar collection panels on your home, by checking with your homeowner's association, local building codes and zoning ordinances. Colorado law prohibits homeowners associations from preventing the use of solar energy devices, including solar hot water systems, in a way that would significantly increase the purchase price or operating costs of the system to the homeowner, or decrease performance.

Cost of a System

A solar hot water system will cost more than a conventional water heating system. The overall cost is determined by its size and complexity. Cost can be estimated by the homeowner or a licensed solar contractor. An online tool is located at www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12780.

Tax incentives and rebates may be available. Check with your local government and utility company to determine what incentives or rebates they may offer, as well. Long term cash flow analysis should be considered before a decision is made. A basic system will cost several thousands of dollars per collector to install, and there are some ongoing maintenance costs to consider. It is very important to have your system properly maintained to optimize its performance and to avoid maintenance problems. A database of incentives in Colorado for renewables and efficiency is found online at www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=CO.



Quick Facts

- Solar hot water systems collect energy from the sun in panels or tubes to produce domestic hot water used in a home or building.
- A fundamental requirement for a solar system is to have a sunny location where solar collectors can function properly.
- Tax incentives and rebates may be available. Check with your local government and utility company to determine what incentives or rebates they may offer, as well.
- A basic system will cost several thousands of dollars per collector to install, and there are some ongoing maintenance costs to consider.
- Discussion with a certified solar installer will aid in clarifying issues around your property and your needs, and can be helpful prior to making the decision to have a solar hot water system placed in your home.

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Sizing of a System

The size of your system will depend on household hot water consumption and storage capacity. It is important to calculate the needs for your home to determine the correct solar hot water system. As a general rule, you will need about 10 to 18 sq. ft. of collector area per person in your household. You will want approximately 1.5 to 2.0 gallons of storage per sq. ft. of collector area. For example, a family of four would need 40 to 72 sq. ft. of collector area and 60 to 140 gallons of storage.

Types of Systems

Systems can become very complex depending upon size and system design. More complex systems are more often used in extremely large homes or businesses.

There are two general types of solar hot water systems used in the United States—closed loop and drainback systems. The system should be designed according to your needs and budget. The goal is to make it as simple as possible, resulting in lower operation costs, lower maintenance costs, fewer site visits, and lower energy consumption. Both closed loop and drainback hot water systems use pumps and valves to control the circulation of the fluid throughout the system. They allow the system to run year round, without the threat of freezing. Protecting the system from freezing is critical to the proper operation of any system.

The most common domestic hot water system is the closed loop glycol system. This is a sealed unit where a propylene glycol mixture transports the heat within

the system. The heat transfer fluid is a mixture of antifreeze and water, which can be protected from freezing to -50°F. If overheated or stagnated, the fluid can go bad.

The second most widely used system is the drainback system. Fluid fills the collectors when the pump starts and drains the collectors when the pump stops. The benefits of a drainback system are it is protected from freezing down to -20°F, it is protected from overheating during a period of time with no power, and water is used as a heat transfer fluid.

Basic Components

Collectors

Solar collectors are one of the key components of an active solar hot water system. They collect the sun's energy and transfer that energy to the heat transfer fluid.

Flat-plate collectors are the most common collector type used in domestic water heating systems. A typical flat-plate collector is an insulated weatherproof metal box with a glass or plastic cover and a dark colored absorber plate. Mounted on the roof or ground, it consists of a thin, flat, rectangular box with a transparent cover that faces the sun. Small tubes run through

the box and carry the fluid, such as water or antifreeze, to be heated. The tubes are attached to an absorber plate, which is painted black to absorb the heat. When the heat builds up in the collector, it heats the fluid passing through the tubes. Active systems rely on controllers and pumps to move the liquid between the collector and the storage tank.

Active, Closed Loop Solar Water Heater

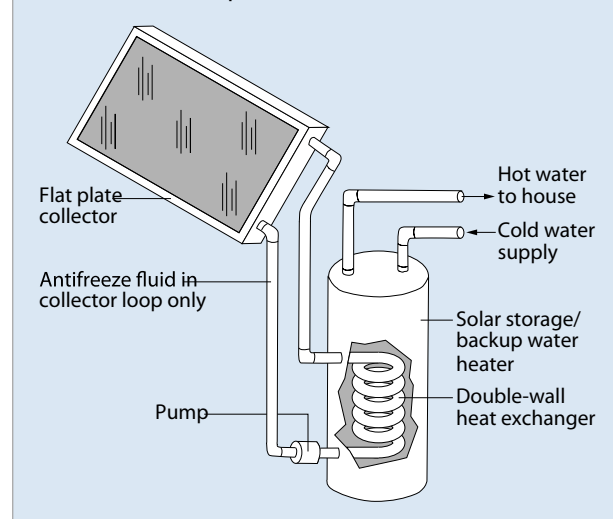


Figure 2. Active, Closed Loop Solar Water Heater. (Photo: U.S. Department of Energy - Office of Energy Efficiency and Renewable Energy)

The second type of collector is an evacuated tube collector which can achieve extremely high temperatures (170°F to 350°F) which makes them more appropriate for industrial and commercial cooling applications. These collectors have rows of transparent glass tubes, each tube containing a glass outer tube and metal absorber tube attached to a fin. The fin's coating absorbs solar energy and reduces heat loss. An evacuated tube collector is sealed in a vacuum that minimizes heat loss and helps absorb solar energy under cloudy conditions. Because of this, there is a concern when snow and ice accumulate on the tubes, causing them to not work properly.

Storage Tanks

The storage tank is an important component of the system. In a one-tank system, solar heated water is stored in a tank with a backup heating element or a side arm boiler. In a two-tank system, solar heated water is stored in a separate tank that feeds into a conventional gas or electric water heater. Whether one or two tanks are used, the household water is heated by solar energy. System efficiency suffers from low storage volumes, so always select an appropriate size tank for extra storage. The sizing volume increases with the amount of collected energy. Pressurized tanks come in multiple standard sizes. Tanks with volumes of 40, 50, 80, and 120 gallons are common and can be installed parallel to increase storage volume.

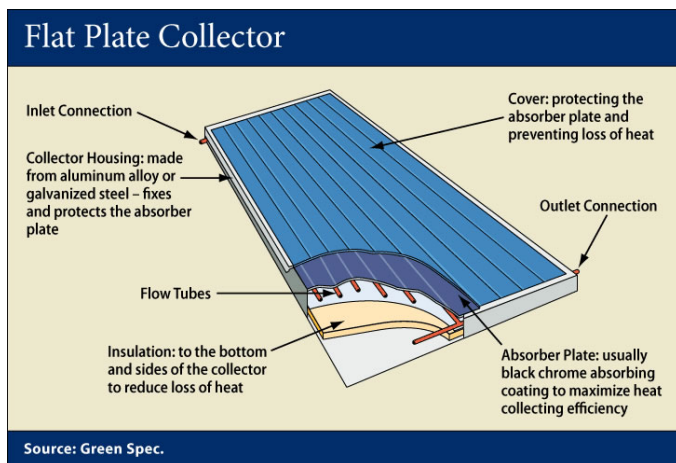


Figure 1. Flat-Plate Collector. (Photo: U.S. Department of Energy)

Certification of Installers

Discussion with a certified solar installer will aid in clarifying issues around your property and your needs, and can be helpful prior to making the decision to have a solar hot water system placed in your home. The North American Board of Certified Energy Practitioners (NABCEP) is the national certification organization for professional installers in the field of renewable energy. To locate a certified installer, visit NABCEP's website : www.nabcep.org.

Resources

American Solar Energy Society: www.ases.org/

Colorado Governor's Energy Office, Recharge Colorado: <http://rechargecolorado.com/>

Colorado Solar Energy Industries Association: www.coseia.org/newsite/home.html

Colorado State University Extension Energy Website: www.ext.colostate.edu/energy

Energy Guide Rating: www1.eere.energy.gov/consumer/tips/energyguide.html

Energy Star Rating: www.energystar.gov

National Renewable Energy Lab–Solar Hot Water for Homeowners: www.nrel.gov/learning/ho_solar_hot_water.html

North American Board of Certified Energy Practitioners: www.nabcep.org

Solar Energy International: www.solarenergy.org/

U.S. Department of Energy: www.energysavers.gov

U.S. Department of Energy–Estimating a Solar Water Heater System's Cost: www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=12760

U.S. Department of Energy–Colorado Financial Incentives and Policies for Renewable Energy: www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=CO