



Solar Hot Water Heating

How do solar thermal collectors work?

Solar thermal, or solar hot water, collectors absorb heat from the sun and transfer that energy to a fluid - often water and glycol mixture. The heated fluid is then used to provide space heating or domestic water heating. There are two types of solar thermal panels: flat-plate collectors and evacuated tubes. In residential systems, flat plate collectors are the oldest and most common type of panel. The enclosure for a typical flat plate system looks like a shallow glass-covered box about the size of a sheet of plywood. Inside the box is a thin metal sheet attached to copper tubing with a dark coating that helps absorb the sun's energy. As the fluid circulates through the copper tubing, it collects heat absorbed by the dark layer. The heat is transferred to a storage tank or heat exchanger and the cycle repeats itself.

In the simplest sense, evacuated tube collectors still depend on heat transfer fluid that can absorb the sun's heat, much like the flat plate collector. The difference is that the process takes place inside a series of sealed glass tubes, which surround the absorptive material and the copper tube containing the transfer fluid with a vacuum. Since the heat collection occurs in a vacuum, heat losses back out of the collector tubes are significantly reduced. As evacuated tube collectors lose less heat to the environment, they are more efficient, producing more BTUs during the spring and fall shoulder seasons. What type of collector you choose depends on a variety of factors, such as the volume of heated water needed, the temperature required by the heating system, and of course the price. Solar thermal collectors can also be integrated into a hydronic space heating system if they're producing more heat than you need for domestic hot water.

What's the payback of solar thermal?

A common flat plate residential system used to supplement domestic water heating may cost around \$5,000, though pricing can vary greatly based on the application. That includes the price of installing two panels and an 80-gallon hot water tank for a single-family residence. The two panels will not be sufficient to provide hot water through the dark winter months of Fairbanks, so you would need a back-up water heating



The Northwest house at the University of Alaska Fairbanks Sustainable Village has a solar hydronic system, which produced 5.6 million BTUs (or the equivalent of 42 gallons of heating oil) during the first year of operation.

system. For many households, the oil-fired boiler can provide hot water during the winter, and a solar thermal water heating system allows you to turn off the boiler during the summer. You could also heat water with an electric tank or a wood-fired boiler.

The two-panel solar thermal systems can produce 9 million BTUs of heat a year, which is equivalent to either 70 gallons of oil or 2,640 kWh of electricity. Homeowners using solar thermal collectors to offset electric water heating stand to save roughly \$527 annually, based on the current cost of electricity in Fairbanks (\$0.22/kWh). At this rate, the payback for solar thermal to replace electric hot water is around 9 years.

If you're offsetting oil-heated water, the payback period is roughly double that, around 18 years (or quicker if you have a less efficient boiler). The payback period is reduced by about one-third by a federal renewable energy tax credit, which returns 30% of the installed cost of the



Through 2016, anyone who installs solar PV or thermal systems is eligible for a 30% federal tax credit for the cost of the system—including installation and material costs. (See more info at <http://dsireusa.org>)



system to the homeowner.

Since solar thermal systems can vary so much, a consultation with a solar thermal system designer will provide you with the best design for your intended use. A reputable system designer may suggest a site visit and the design may entail an up-front fee. With the proper information in hand before you start, you can decide for yourself if a solar thermal system is worth your investment.

How do they work in the winter?

CCHRC has three solar thermal collectors mounted on the south-facing roof. During the summer, these panels provide heat (at temperatures up to 200°F) to a domestic hot water tank. During the winter, they continue to produce heated water but at a much lower temperature—around 70°F, which is too cool for the domestic hot water system to use. However, it's possible to design a system that can use low-grade heat and continue to run solar thermal panels during the winter. For instance, heat from solar thermal panels can pre-warm incoming water, which is often around 40°F, before another appliance boosts the water to a final temperature.

How does solar thermal compare to solar PV?

Solar photovoltaic (PV) panels convert sunlight into electricity. They have a silicon sheet that is made up of semiconductors. When light strikes the sheet, part of the energy is transferred to the semiconductors, which knocks electrons loose and allows them to flow freely through connected wires. This flow of electrons is called direct current (or DC). The current then flows into an inverter, which changes it into AC (alternating current), the power used by your appliances. This current can either be used to power appliances (if there is demand), stored in a battery, or returned to the electric grid.

A 1,000 watt PV array will produce about 1,000 kWh a year in the Interior, offsetting \$210 in electricity at today's rates. Solar PV costs approximately \$5-\$6 per installed watt, (or \$10,000-\$12,000 for a standard residential 2kW system). While the actual cost of solar thermal in Interior Alaska is less than PV, PV panels are still more common in Fairbanks largely



A few online resources can help determine whether solar panels will work for your particular location. The National Renewable Energy Laboratory's Renewable Resource Data Center (<http://www.nrel.gov/rredc/>) gives the amount of solar insolation (or sunlight) for any U.S. location at each month of the year. For instance, Fairbanks receives an average of 5.6 sun-hours/day in April 9 (this accounts for cloudy days).

You can take this number and find out the estimated output of different brands of solar panels at the Solar Rating and Certification Program website (<http://solar-rating.org/>).

because they are easier to install and retrofit, don't require plumbing, don't have to be integrated into existing mechanical systems, and have no moving parts (whereas solar thermal systems have fluid and pumps that must be maintained and replaced).

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More information on solar and heating can be found at <http://cchrc.org/yourhouse>

Build It Solar (www.builditsolar.com) contains information and diagrams describing passive solar design.