

Residential Solar Thermal System

Overview

Sample solar thermal project designed, engineered and installed by Southern Energy Management

NC Family of Four Residence – Raleigh, NC

In the summer of 2008, an NC family of four invested in a solar thermal system for their home in Raleigh. Their 2-collector solar water heater supplies the family of four with the majority of their domestic hot water needs.

Applications and Uses

Residential solar thermal systems are typically designed to provide a majority - 60-70% - of a home's hot water needs. Solar thermal systems can also be used for heating pools. In general these installations are less expensive- because no storage is required- and they offer a similar return on investment.

Installation Costs

The residential system at the family's residence cost \$7,100 to install. After adjusting for current state and federal tax credits, the initial price falls by approximately 42% - bringing their total out-of-pocket cost to about \$4,092.

Residential systems are typically mounted flat to the roof. For low-slope or flat roofs, the collectors may have to be tipped up. Other cost factors include system type and number of collectors. Typical residential solar thermal systems include two collectors, but systems may use as few as one to as many as four, depending on a household's hot water demand.

Energy Produced

The NC family's residential solar water heater will produce about 12.5 MMBTUs (million BTUs) of usable heat energy per year. Their system is made up of two 4'x8' collectors and an 80-gallon storage tank. A typical 4'x8' collector will collect 24,000 BTUs per day. However, consumption patterns and amount of storage can impact how much of this energy can be used. Solar panels produce the most energy from 10a.m. to 4 p.m. The energy produced is stored in a hot water tank until it is needed. While water is the best thermal storage medium, an average size residential water tank (50 gal) will lose one degree in temperature each hour. A qualified solar installer will take all of these variables into account when designing and properly sizing a system to meet hot water usage patterns for optimum performance.

Tax Benefits and Investment Return

While energy savings, monthly utility savings and long-term value of a solar system are important, the attractive financial payback on solar thermal is primarily driven by state and federal tax incentives. Assuming the owners have the tax liability to take advantage of these incentives, they can anticipate recovering the total system cost within 7 to 10 years. From that point forward, they will incur net savings each year, accumulating approximately \$7,200 by the 20th year. Optimum water usage patterns or utility incentive programs can decrease the payback further. Factoring in the tax credits, the family reduced the total cost of their system by 42% and eliminated the cost of heating about 60-70% of the hot water they consume.

Breakdown of Costs and Benefits for Residential Solar Thermal System in NC

Cost of System (eligible for tax incentives)	\$7,100	100%
35% NC tax credit (\$1,400 maximum)	- \$1,400	20%
30% Federal tax credit (\$2,000 maximum)	- \$2,000	28%
Impact of state credit on federal taxes	+ \$392	6%
Estimated Net Cost of System	\$4,092	58%

For more information on solar tax incentives see www.dsireusa.org.

Energy and Cost Savings

The solar water heater installed at the family's residence was designed to be a pre-heat system for the primary gas water heater. This is a typical residential set up, which utilizes a gas water heater as a back-up resource if needed. By significantly reducing the operation of the gas water heater and producing a majority of their hot water with their new solar water heater, the savings for this family of four can be estimated at \$400 per year.

Example: 2-collector system	Electric	Natural Gas
System cost	\$7,100	\$7,100
Utility rate	\$.11/kWh	\$1.48/therm
Efficiency of existing system:*	90%	60%
Solar energy produced:	3,664 kWh/yr	125 therms
Actual energy saved (solar energy / efficiency of system):	4,071 kWh/yr	208 therms
Total \$ savings (year 1):	\$448	\$308
Net tax benefits:	\$3,008	\$3,008
Payback:**	Year 9	Year 10

* based on ACEEE data- <http://www.aceee.org/consumerguide/waterheating.htm>

**using a 4% utility escalation rate for electricity and a 9% rate for natural gas

Project Feasibility Variables

To begin the process, a professional solar installer should perform a solar site visit to evaluate the home. Sun-tracking tools should be used to determine the feasibility and capacity of solar thermal and ensure the family receives optimum benefit from a solar water heater. Below are some of the key variables for solar thermal in a residential application.

Use of hot water:

- Ideal project has predictable, regular hot water consumption

Ideal installation site conditions:

- At least 4 full hours of sun on the collectors.
- Little shading from trees, adjacent structures or roof features such as gables.
- Ability to face collectors to within 30 to 45 degrees west or east of due south.
- Fairly new (4-5 years maximum age); the roof needs to last the age of the system.
- Roof with a pitch between 4:12 and 6:12. Steeply-pitched roofs make staging difficult and can increase installation costs. Low-pitched roofs (1-2:12) will require tilt-up hardware to maximize output, which will raise installation costs.

Expected Life

Solar thermal systems have a design life of 20-25 years, and sometimes higher in the case of several manufacturers. This is a mature technology that has been deployed, refined and improved for close to a century.

Maintenance Costs

Solar thermal system owners should consider a maintenance check every 3 to 5 years. Maintenance costs are minimal and don't impact ROI, but are critical to ensuring the long-term optimum performance of a solar system. Residential solar thermal systems simply require a quick pH check-up. The process is easy and requires no tools, just a pH testing strip.

Warranty

Most solar collectors carry a 10-year warranty. Other components vary by manufacturer. The specific warranties associated with the system highlighted in this case study are as follows: solar collectors (10 years); water storage tank (lifetime warranty); heat exchanger, pump and controls (5-year warranty). Make sure your solar installer warranties labor.

Technical Overview

Major components

Collectors: two flat-plate glass collectors installed on South-facing, shingled 10/12 pitched roof; collectors use a glycol solution flowing through copper tubes attached to fins to collect heat energy from the sun.

Storage tank: after the energy is collected, it is stored until needed in an 80-gallon solar hot water storage tank.

Pumps: this system has two pumps- one to circulate glycol solution through the collectors, and another to circulate hot water from the storage tank(s) to the family's existing water heater.

Controls: a digital controller with sensors determines when the pumps run. It is programmed to activate the pumps when the collectors are hot and the tank is cold.

Freeze and over-temperature protection: properly installed systems have insulation on all piping, and the system will also be designed for freeze protection. For pressurized systems, this means using more glycol fluid. For drain-back systems, this is accomplished by storing the fluid in the drainback tank when the collector temperature is too cold or too hot.

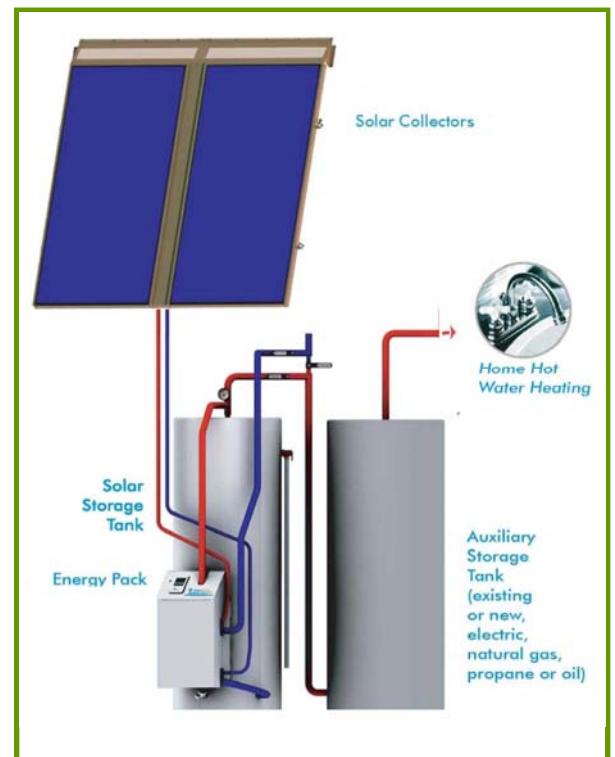
Industry Certifications

Equipment:

The Solar Rating Certification Council (SRCC) provides third party, ANSI-approved testing for solar thermal collectors. These ratings are the industry's best guarantee that a collector's performance has been reviewed and verified. SRCC certification is required for NC solar tax credit eligibility.

Solar Installer:

NC Building Code requires that all solar thermal installations be performed by a licensed plumber. The North American Board of Certified Energy Practitioners also offers a nationally recognized solar thermal certification program. (More info: www.nclicensing.org)



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