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Solar Domestic Hot Water Heating Systems

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Homeowners interested in using solar energy to reduce energy bills and help preserve fossil fuel supplies should consider installing a solar domestic hot water heating system. These systems have several advantages over solar space heating systems, namely:

1. They have a reasonable first cost. System prices vary between \$700 and \$2,500 depending on system size and installation costs. A small system installed by a skilled homeowner would be the most inexpensive.

2. They have a short economic return period. Hot water heaters operate year-round rather than only during the heating season and can account for as much as 30% of your heating energy bill. Thus, the initial investment can be recovered in reduced energy bills in four to ten years, depending on initial cost and type of energy being replaced.

3. They can be easily retrofitted on existing houses due to the small collector area (less than 100 square feet), small storage tank size (80 - 120 gallons) and the capacity to be easily plumbed into the existing conventional hot water heating system.

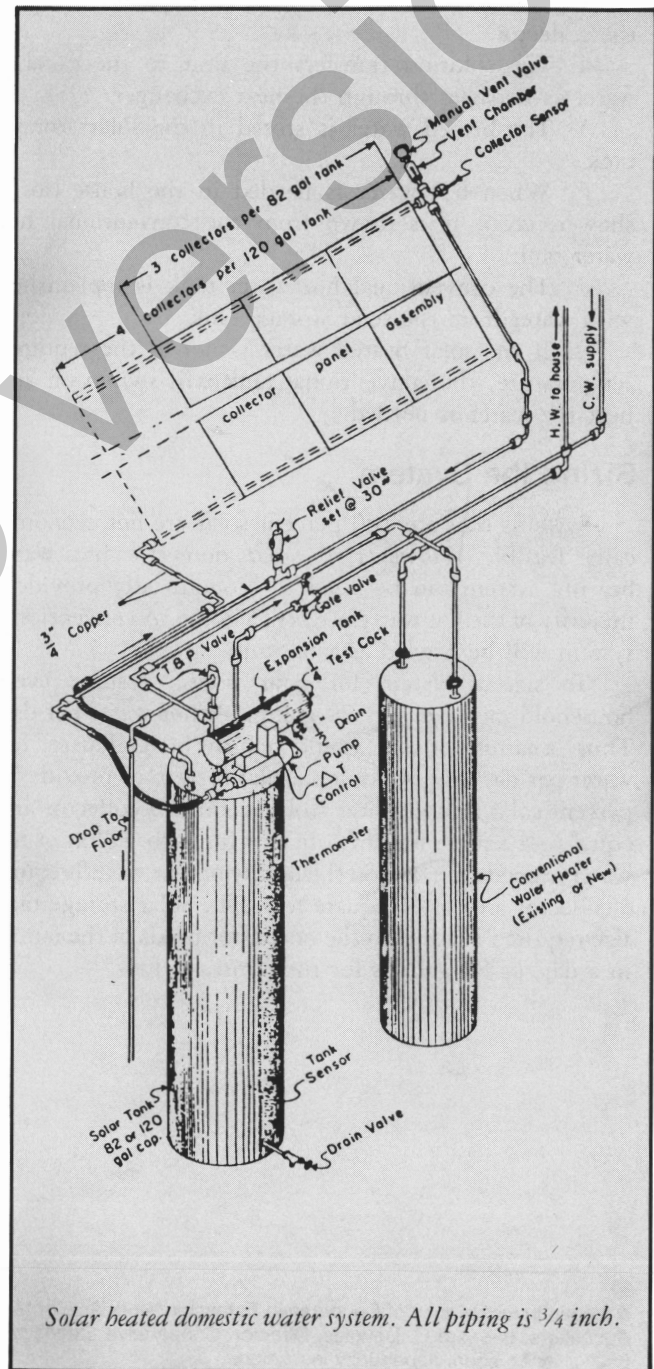
System Components

These are the main components of a solar domestic hot water heating system. See illustration.

1. Solar Collector Panels—these are flat plate, air or liquid collectors. Air collectors heat the air which is circulated through them. This heated air passes over an air to water heat exchanger (the radiator in your car is an example of an air-to-water heat exchanger) thus causing potable water circulating through the heat exchanger to be heated.

Liquid collectors operate as either closed or open systems. A closed system circulates an anti-freeze solution which picks up heat from the collector and transfers the heat to the potable water through a heat exchanger. An open system circulates potable water through the collector. When an open system is not operating, the water drains down into the storage tank to prevent freezing problems.

2. Solar Storage Tank—this is basically a conventional hot water tank without the heating unit, and sized



to meet the family needs (usually 60- to 120-gallon capacity).

3. Associated Plumbing Fixtures—pumps, valves and temperature sensors are necessary to activate the system, circulate the fluid, and safeguard against over-heating or high pressure.

Operating Principles

The solar domestic hot water heating system operates as follows: Assume it is a closed system.

1. Cold water flows into the solar storage tank.
2. When the temperature at the collector sensor is higher than the temperature at the tank sensor, the pump is activated which circulates the anti-freeze solution.
3. The solution absorbs heat as it passes through the collector.
4. The solution transfers the heat to the potable water as it passes through the heat exchanger.
5. The heated water is stored in the solar storage tank.
6. When hot water is needed in the house (for a shower, etc.), it is drawn from the conventional hot water tank.
7. The conventional hot water tank is replenished with water from the solar storage tank.
8. If the solar heated water is not at the required temperature, the conventional tank will switch on and heat the water as needed.

Sizing the System

Systems that are 100 percent solar are not economically feasible. However, a solar domestic hot water heating system can be sized to economically provide a majority of the hot water needs of a home. A conventional system will be needed as a backup.

To size a system for your house, assume every household member uses 20 gallons of hot water per day. Thus, a family of four would require 80 gallons of hot water per day. For example, a solar system to provide 75 percent solar heated water would require a collector area equal to 1 square foot of collector for each gallon of hot water needed each day. So the family of four would require a collector area of 80 square feet. The solar storage tank size required is equal to the hot water needs of the family in a day, or 80 gallons for the family of four.

Conservation Helps

Solar domestic hot water heating systems can be smaller in size and operate more efficiently if conservation measures are also employed. Conservation measures which can reduce energy consumption include:

1. Reducing hot water temperature to 120° - 130°F, (this is an adequate temperature for all household operations except automatic dishwashing).
2. Using warm or cold water cycles in clothes washing.
3. Installing shower head flow restrictors and/or taking more short showers and fewer baths.
4. Repairing leaks.
5. Conscientiously turning off water taps.

Buying and Installing the System

Solar hot water systems can be installed by a homeowner who possesses basic plumbing skills or by knowledgeable plumbing contractors. When buying a system, exercise the same judgment as when making any major purchase. Specifically, use the following criteria:

1. Is the unit reliable and durable? You are purchasing a system that should last 20 years, so examine the materials and construction methods used.
2. Is the contractor or manufacturer reputable? The solar energy industry is very young and there are many unproven businesses flourishing. Examine the company's past record, if possible. Check if warranties are offered. Ask about availability of replacement parts and service.
3. Check with local plumbing codes before purchasing or installing.

Installation of the system is fairly simple due to its small size. The collectors require an area of less than 100 square feet. They must be oriented within 20° of due south and tilted at an angle of 30° to 50°. The solar storage tank is only slightly larger than a conventional tank and should be installed as close to that tank as possible. The use of a liquid system requires only pipes (as compared to ducts in an air system) for connection between collector and tank making a retrofit installation easier.

Because of the relative low initial cost, relative short economic payback period, and compact size, a solar domestic hot water heating system is a very realistic way for a homeowner to make a commitment to solar energy.

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