SOLAR WATER HEATING SYSTEMS

WHAT ARE SOLAR WATER HEATING SYSTEMS?

Solar water heating systems (SWHS) use the sun's energy to provide hot water, space heating, and even air conditioning. Multiple configurations are available at various price ranges, providing a possible solution for a variety of climates and geographies. SWHS are widely used for residential purposes, as well as some industrial applications. The most common type is solar thermal collectors.

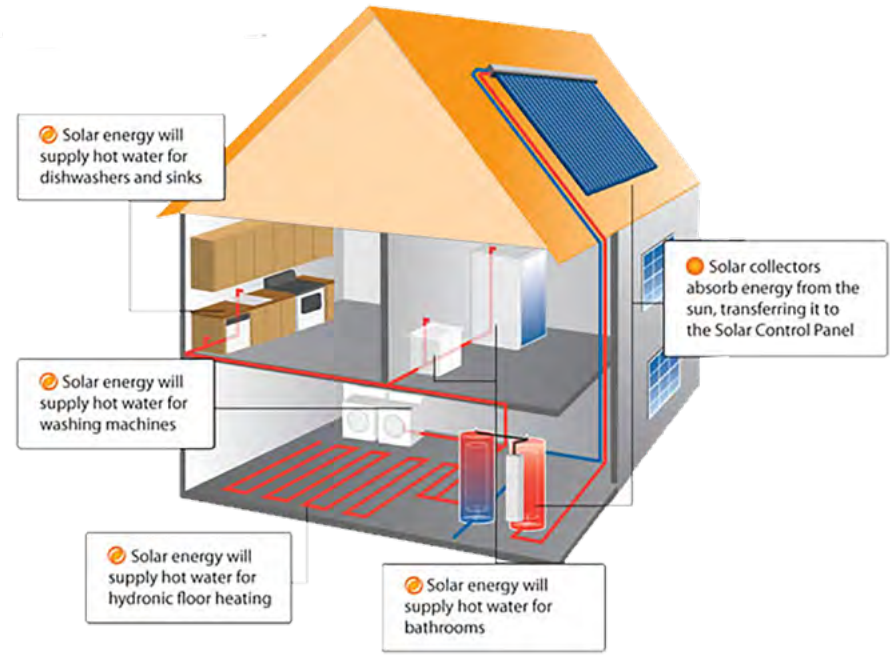


Figure 1: Working Principle of Solar Thermal System

A CLOSER LOOK AT SWHS

Solar water heating systems have two major components: a solar collector and a storage tank. The solar collector, usually a thin, black plate, is mounted on a building's roof. Water or antifreeze runs through small tubes under this plate and is heated by the sun. The hot water or antifreeze then flows into a well-insulated storage tank.

DIFFERENT OPERATION MODES OF SWH SYSTEMS

Direct and indirect systems

Direct systems heat water under the solar collector. If temperatures drop below freezing, the water must be drained from the collector to avoid damaging the system. These systems are used where freezing temperatures occur at most once or twice per year, because draining the water more frequently is expensive and wastes energy. In indirect systems, often used in cold climates, the solar collector heats liquid antifreeze, which then runs through tubes inside a water storage tank to heat water indirectly.

Passive and active systems

Passive systems, known as thermosiphons, circulate water or antifreeze from the solar collector to the storage tank using the warm liquid's natural tendency to rise. Active systems use electric pumps to increase the efficiency of the water circulation.

KEY FACTS

A 100 LPD* SHW system, on average would be able to deliver **100 liters of water at 60°C** on a given day.

100 liters

A single solar FPC of 1.85–2.8 m^2 **COULD HEAT ABOUT 300 LITERS OF WATER A DAY,** which is about the size of a standard hot water storage tank.

An ETC type SWHS would generally require close to 1.4 m^2 of clean rooftop space per 100 LPD of installed system. A 300 LPD system would require about 3.7–4.2 m^2 of roof space whereas a 4000 LPD system would require roughly 140 m^2.

A 100 LPD solar water heater can replace an electric geyser and **save 1500 UNITS OF ELECTRICITY** per year.

Over a 20-year period, one SWH system can **prevent over 50 TONS OF CARBON DIOXIDE** emissions that would have been emitted by an electric or natural gas water heater.

Liters per day (LPD)

TYPES OF SOLAR WATER HEATER COLLECTORS

The 3 main types of solar water heater collectors are:

- Flat-plate collectors (FPC)
- Evacuated tube collectors (ETC)
- Integrated collector-storage (ICS)

FPC and ETC are the ones most commonly used.

Flat-plate collectors are waterproof boxes fitted with dark absorber plates. Flow tubes positioned over the plates carry tap water over the heated plates and out to household plumbing lines.

Evacuated tube solar collectors use special glass tubes, metal tubes, and fins to absorb solar energy and reduce heat loss. The evacuated tube collector system relies on the vacuum created between the glass and metal tubes to retain heat.

Figure 2: Solar flat plate collectors (FPC)

Figure 3: Evacuated tube collector (ETC)

EFFICIENT MODERN SWHS

Modern SWHS can provide hot water even during cloudy winter days as they work on absorbed heat, and not on direct sunlight, unlike solar photo-voltaic (PV) cells. FPC has better performance when they are installed facing the equator with optimum angle of latitude +5 degrees.

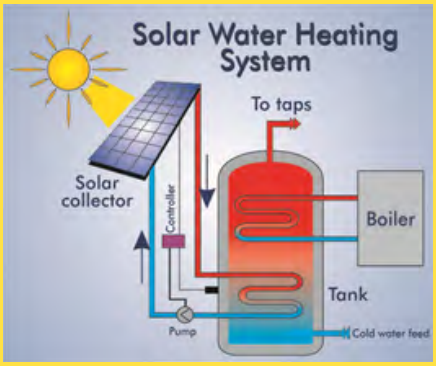
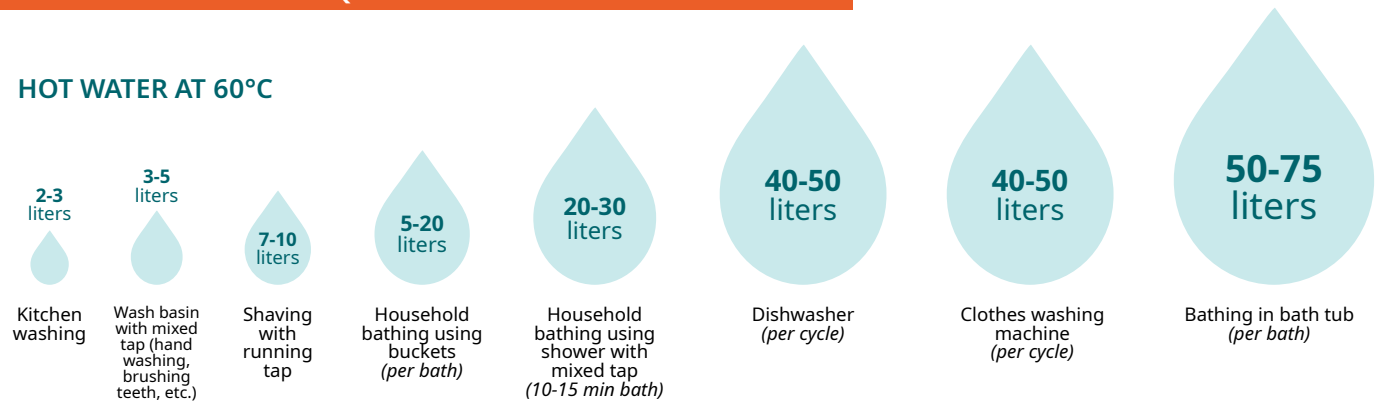


Figure 4: Typical solar water heating system

For collectors, approximately 1.8 m^2 of space is required for a 2-member household; for each additional member, this comes down to 1.1 m^2. For hot water storage, a small tank (150–200 liters) is usually sufficient for 1–3 people; for 3–6 people, around 300–350 liters is enough.

AVERAGE HOT WATER REQUIREMENT PER PERSON PER DAY

HOT WATER AT 60°C



FINANCIAL FACTS

Residential solar water heating systems initially cost between $1,500 and $3,500, compared to $150 to $450 for electric and natural gas water heaters. SWHS have extremely low operation costs, as the fuel cost is zero. Solar water heaters cost between $2,000 and $6,000, including installation cost. This can save money on electricity bills up to 50%-80% on the cost for heating water. Hence, $80-105 can be saved by switching to FPC annually [1].

For a site with clear roof access and ready inlet and outlet piping, the installation time of a SWHS can be less than 5 days. They have a lifespan of 15-40 years, similar to conventional water heating systems. With savings in electricity or natural gas, SWHS have a payback period of about 3-6 years [2].

REFERENCES

1. Emily Rivers. 'Solar Flat Plate Collectors'. Quotatis [Online]. Available: https://www.quotatis.co.uk/advice/projects/solar-panels/flat-plate-collectors/

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