DARE
Devon Association for Renewable Energy

FACTSHEET 3: Introduction to Solar Thermal Heating

Introduction

The sun's energy is free and abundant, and can be used to provide green and renewable hot water for a variety of domestic and commercial situations. For Solar Thermal Water Heating systems solar collector panels are installed on roofs facing between South West and South East (the more south facing the better the performance). These collectors absorb the sun's energy and change it into heat, which is then used to heat water. There are two main types of collector plates, and several different ways these can be used to provide hot water.

1. Types of Solar Collector Plates

a) Flat Plate Collectors

The most common panels for solar water heating are flat-plate collectors. These consist of a thin metal box with insulated sides and back, a glass or plastic cover (the glazing), and a dark coloured absorber plate. The glazing allows most of the solar energy into the box whilst preventing much of the heat gained escaping. The insulation on the sides and back minimizes further heat loss to the surroundings. The absorber plate is in the box painted with a selective dark coloured coating, designed to maximize the amount of solar energy absorbed as heat. Running through the absorber plate are many fine tubes (usually made of copper), through which water is pumped. As the water travels through these tubes it 'absorbs' the heat – this heated water is then gathered in a larger collector pipe through which it can be transported into the household's hot water system.

b) Evacuated Tube Collectors

These are a more modern and more efficient design of solar energy collector that can heat water to much higher temperatures and require less area, yet they are also correspondingly more expensive. Instead of an absorber plate, water is pumped though absorber tubes (metal tubes with a selective solar radiation absorbing coating), gaining heat before going into the collector pipe. Each absorber tube is housed inside a glass tube, from which the air has been evacuated, forming a vacuum. The glass tube allows solar radiation through to the absorber tube where it can be turned into heat. The vacuum eliminates convective and conductive heat loss - virtually all heat absorbed is transferred to the water. The circular shape of each evacuated tube means that solar radiation is perpendicular to the collector for a much greater time than with flat plate collectors, further improving efficiency.

The average sized system will cover an area of between 4 and 6 metres squared

FIGURE 1: INSTALLATION OF EVACUATED TUBES (SOURCE – SOLAR FLAIR)

2. System Requirements

There are several necessary features that each system must have. Systems must have freeze protection - if the water in a system freezes it can damage the solar collector, so this needs to be guarded against.

Systems using evacuated tube collectors should also have boil protection to prevent water becoming too hot, as they can heat the water to much higher temperatures.

Any system will also require an electric pump to push the water around the system. This pump can be run by electricity provided by a solar PV panel incorporated in the roof installation – this saves on mains electricity, reduces CO_2 emissions further, and in some systems helps to regulate the temperature of the water produced. The low power produced by these panels' means a slow pump speed, which makes it a more suitable solution for flat-plate installations that require a slower water speed. Evacuated tube systems require more energy to pump the water around, and so generally will need a pump run off mains power. If solar PV is not provided, or is not suitable, then the pump will have to be run off the mains – this will incur slight running costs and offset the environmental benefits (reducing CO_2 abatement by as much as 20 percent in some evacuated tube systems).

3. System set-up

Each solar hot water system will require a solar collector, plumbing to join it to the existing system, a pump to circulate water around the system (either mains electricity or solar PV), and either modification

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to your existing hot water storage cylinder or a new cylinder.

Each system can be put into one of two generalized categories, 'open' or 'closed'. Again depending on the situation (space, cost, needs) systems can either be single or dual cylinder – the solar water can be stored in a large cylinder along with conventionally heated water, or it can be stored in its own separate solar hot water cylinder.

An open system heats the water that will actually be used as the household's domestic hot water – this means that the hot water travelling through the solar collector is the water that will come out of the taps. Such systems are especially suitable if you already have a low-pressure vented hot water system – usually identifiable by a cold storage tank in the attic.

A closed system will heat water that is passed though a heat exchanger in a hot water storage cylinder, thus heating the water coming out of your taps indirectly. Such systems can be used if your hot water is kept at mains or high pressure, usually identifiable if your system provides pressurized hot water for things like showers without the need for separate pumps.

4. Costs

A small-scale solar hot water heater installation will cost from between £3,500 and £6,500 including panels, pumps, accumulator vessel and plumbing (but excludes a hot water tank),

To ensure that a system is as economically beneficial as possible it is important that the system's size is calculated in relation to current hot water needs. A good solar water heater installation should have a running capacity producing around 50-70% of non-space heating hot water needs – the bigger the running capacity the greater the savings but there will be a limit to how much energy a system can provide.

For these systems anything too small is unlikely to provide significant benefit, anything too large and it is unlikely that the greater investment will be justified by any additional energy savings. Any quote should provide a detailed breakdown of the specification and cost of the proposed system, and be able to explain how they have calculated the size of the system to be appropriate for specific hot water needs.

For each situation there are many factors influencing which system will be best to install – considering these factors will help you choose the best system for your needs. The cheapest short-term option may not be the best or cheapest in the longer term.

- Type and efficiency of solar collector – flat-plate collectors may be of lower efficiency and so require a larger area, but can still work out cheaper.
- New and additional hot water cylinders – will a system need new hot water cylinders for twin tank systems, or a new bigger cylinder for a single tank system, and will this be included in the price? Is the hot water system being changed or upgraded anyway?
- Size of cylinder and its performance – the larger the cylinder generally the greater the amount of solar energy that can be stored. They will cost more though, and require more space.
- Installation costs – installing the system requires roof working, plumbing and often electrical skills, and the more of such work required the more expensive the installation. Simple but less efficient systems are generally cheaper to install, more complex and efficient systems cost more to install but can produce more heat. Self-installing a system will reduce costs dramatically, but requires the relevant practical skills.
- Planning permission – most panels are governed by the same guidelines as roof light windows, generally not requiring permission. It is worth checking with your council, especially if you live in a listed building or conservation area.
- Hard water – many systems will not function if the water is too hard, so check with the installer and your water company.

There are now government incentives to support renewable heat production and use. The RHI was launched in November 2011, and is the first financial support scheme for renewable heat of its kind in the world.

In the first phase, long term tariff support has been made available to non-domestic, industrial, business and public sectors . The second phase of the RHI scheme will see it expanded to include support for household installations. The timing of this introduction is expected to be in the Spring of 2014.

For more information please visit:
https://www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies/supporting-pages/renewable-heat-incentive-rhi