



Dorset Agenda 21

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SOLAR WATER HEATING: A BRIEFING SHEET

BACKGROUND: an old technology.

There are three main ways in which we can take direct advantage of the sun's energy:

1. **Passive solar gain**, as in a conservatory.
2. **Photo-voltaic (PV) panels**, generating electricity from light.
3. **Solar thermal water heating**, usually to provide domestic hot water. This paper is about the third way, which is the most common type of renewable energy technology, in terms of numbers of systems installed.

A long history: the Romans used to bathe in hot water and we re-acquired this habit in the 19th century, following Pasteur's discovery of germs and the importance of hygiene. American inventors used the new technology of plumbing to invent the **solar water heater** e.g the Climax solar water heater of 1892 (the same year that Rudolf Diesel invented the diesel engine!) An early reference in the UK was in 1946, when Dr Harold Heywood of London reported water warm enough for washing up, even on a dull February afternoon, from his solar water panel.

THE PRESENT DAY:

Now, for example, in Cyprus 95% of homes have solar hot water, 80% in Israel and 40% in Australia. The UK figure is 0.003% of homes! Certainly Southern Europe receives about 50% more solar energy than the South of England, over the year, but we still get much more than you might think: e.g Greece gets 1600 kWh/sq.m. per year compared with SW England (the best in the UK!) which gets 1200 kWh/sq.m..

THE POTENTIAL IN BRITAIN: enormous.

It has been estimated that about half of our 24 million homes could easily have solar water heating systems. At present there are around 80,000 (giving the 0.003% above), making this the most popular type of renewable energy. The main barrier is capital cost, with UK systems costing between £2500 and £ 5000. As fossil fuel prices rise steeply and solar system costs fall, in real terms, then more of us will choose to benefit from this free energy, which can save between 12 – 17% of a household's annual fuel bill.

HOW DOES IT WORK ?

A Solar heating system consists of a **collector** and **hot water storage**. The collector is made up of the **absorber** to turn the sun's radiation into heat, a **glass or plastic cover** to trap the heat (using the greenhouse effect) and **insulation** to prevent heat from escaping. Collectors are either:

- **flat plate**, with a black metal absorber, or
- **evacuated tube** type, in which the insulation is in the form of a vacuum. This type is the most efficient and advanced. It consists of a row of 20 – 30 vacuum tubes, which are plugged into a manifold through which water flows. Inside each vacuum tube, there is a metal tube which heats up very rapidly due to the high insulation resulting from the vacuum. The hot metal transfers this heat energy to the water in the manifold, using a liquid as a heat transfer fluid, which gives a quicker response to changing weather. Thus evacuated tubes do provide more hot water and perform better in the changeable weather days of Spring and Autumn; however, most makes (but not all) are more expensive than flat plate absorbers.

In both types, a fluid, usually water with added anti-freeze, transfers heat from absorber to hot water cylinder, in which it flows through a copper coil, thus heating up the water in the cylinder.

In the UK, the hot water storage is inside the house, as part of the general plumbing. The collector/panel/tubes can be mounted at low level, with the hot water cylinder at least a meter higher. This is a **Thermosyphon** system, with hot water circulating by convection and no pump required. The pipework must be large diameter (at least 22mm).

When the collector/panel is above the hot water cylinder, then a **pumped system** is required. This is the most common type and can have small diameter pipe (15mm), Any sort of absorber can be used, it responds efficiently to small bursts of sunshine and high level panels are both safely out the way and have good solar access. However, the pump (~ 50W: a standard central heating pump) and associated thermostatic controller require electricity and maintenance (normally very little)

IS MY HOME SUITABLE FOR A SOLAR WATER HEATING SYSTEM?

If your roof pitch is between 20 and 50 degrees (most in UK) and faces somewhere between East and West, then a solar panel will receive within 20% of the energy received at the optimum position (South). So, South is best, but East to West is nearly as good. Two of our members have such sites – one is due West and the other faces East. Both have had very effective systems for some years. Shading should be avoided, by careful location of the panels.

SIZING, ORIENTATION AND PERFORMANCE

If you are designing your own solar water heating system, refer to the British Standard (BS 5918) which gives much useful information and ways to estimate performance. Regarding this as an energy saving technology, there is an optimum **size of system**: a 10% saving is easy, but a 100% saving would require a huge system. For an average household, an optimum sized system would have:

- 5 sq m of single glazed matt black flat plate collector, or
- 4 sq m of selective-surface absorber flat plate collector, or
- 3 sq m of selective-surface evacuated tube collector.

The best orientation at the UK latitude is slightly west of due south and the optimum tilt angle is 32 degrees. However, with our cloudy climate, the orientation and tilt are not very critical – a collector panel set any where from SW to SE, with a tilt of 10 – 60 degrees, will perform at 90% of the optimum efficiency. Any decrease in performance, due to less favourable orientation and/or tilt, can be offset by a larger panel area.

The performance, in sunny Dorset with between 1100 – 1200 kilowatthours (kWh) of solar radiation per sq metre per year, will be good. About 40-50% of this can be converted to hot water by a solar collector, giving around 1800 kWh of heat, with 4 sq m of panel. This should give 60% of the household's domestic hot water needs, which equates to a saving of 15 % of an average household's annual fuel costs (on average, we use 25% of our annual energy consumption to heat water). You can optimize the system's performance by slight alterations to your life style. For example, use hot water mostly in late afternoon, when you know it has been solar heated. Given that a typical shower temperature is 40 C, you could use hot water at the lowest temperature possible – if your solar panels never had to get hotter than this (40 C), then they would work at much higher efficiencies and thus collect more solar energy. Unfortunately, since the onset of Legionnaires Disease, all hot water is recommended to be stored at a minimum of 55 C.

CAPITAL COSTS AND GRANTS

The system will cost between £ 2500 and £ 5000, depending on size and type of panels/tubes (the main cost), fully installed and including a new twin-coil hot water cylinder. Grants of £ 400 are available to households from the Low Carbon Buildings Programme (LCBP) and 50% grants to community groups, social landlords and local authorities, for installations in social housing or public buildings.

A DIY installation can be done for around £ 1000 - £ 1500, but requires time and some basic plumbing skills: There are practical courses available that will train you to install your own system. No grant is available for DIY and you will have to pay 17.5% VAT, rather than 5% for installation by installer accredited to LCBP ! But it still works out cheaper and you have the satisfaction of having installed your own system.

Some plumbers may work with you, on a part-DIY basis, thus keeping costs down, while ensuring that you have professional support and advice.

Bridport Renewable Energy Group (BREG) have designed and made a DIY system, using old radiators, for less than £1000. It is installed and working at Simondsburry Apple Orchard and can be seen by arrangement – contact DA 21 office.

ARE THERE PLANNING ISSUES?

For listed buildings and in conservation areas, you will probably require planning permission. Flat plate collectors may be more acceptable visually to planners in these situations, since, from a distance, they look quite like Velux windows. In other situations, as long as the collector does not protrude above 100mm from the roof, permission will not be needed.

SOLAR WATER HEATING INSTALLERS

Beware of junk mail and door to door salesmen who promise savings that are too good to be true. Always get several quotes before selecting an installer and ask to see some of their installations. A personal recommendation from a friend or neighbour, who has had a system installed may help you decide. Also check if the installer is either approved by the Low Carbon Buildings Programme (LCBP) or is a member of the Solar Trade Association. However, this membership does not guarantee the quality of their work - ask for guarantees that they themselves provide.

Accredited installers, who are approved by LCBP, in the SW, are:

Absolute Invincible Power (Honiton) www.invinciblepower.co.uk	Tel: 10404 548896
Ace Plumbing and Heating (Shaftesbury)	Tel: 01747 858852
Powertech Solar (Wimborne) www.solar.org.uk	Tel: 01202 590500
Quality Solar Systems (Bournemouth)	Tel: 0800 9750795
Sarum Solar (Salisbury) www.sarumsolar.co.uk	Tel: 0845 4080444
Solar Install (Poole) www.solarinstall.co.uk	Tel: 01202330511

A DA 21 member, who is an installer and who will also work with the householder on part-DIY basis, is Jim Shearman of Bridport, Tel: 01308 425669.

PRACTICAL COURSES are run by:

Powertech Solar (Wimborne): erh@solar.org.uk	Tel: 01202 890234
Low Impact Living Initiative (LILI): www.lowimpact.org	Tel: 01296 714184

OTHER CONTACTS.

Dorset Energy Advice Centre, Poole www.deac.co.uk	Tel: 0800512 0512
Energy Saving Trust case studies: www.est.org.uk/myhome	
Low Carbon Buildings Programme www.lowcarbonbuildings.org.uk	
Solar Trade Association www.greenenergy.org.uk/sta	

John Tomblin, Project Officer, DA 21. 1 September 2006

