Office of the
Deputy Prime Minister
Creating sustainable communities

The Building Regulations 2000

LOW OR ZERO CARBON ENERGY SOURCES:
STRATEGIC GUIDE

First edition May 2006

Summary of Comments on LZC.indd

Page: 1

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 16:21

February 07. This document is being published because the use of the Low and Zero Carbon Strategic Guide in UK means that Solar Twin Ltd faces what it sees as significant and apparently unjustified market limitation. This has happened because it appears that this current (May 2006) edition has been written with too narrow a technological scope for the proprietary technology which we use. We have had productive discussions with DCLG concerning the content of documents relating to building regulations on solar thermal, however a timetable for action concerning updates is uncertain. Therefore it is important that designers, engineers, building control officers and regulators, among others, know about our concerns, which follow. Portions of this document have been copied for fair comment because they contain material which may be inaccurate, misleading, or market limiting. if read from the perspective of new solar water heating technology such as, but not exclusively, Solartwin.

8. Solar hot water

8.1 Introduction

Solar thermal and, especially, active Solar Domestic Hot Water (SDHW) heating is a well-established renewable energy system in many countries outside the UK. It can be one of the most cost-effective renewable energy systems available.

It is appropriate for both residential and non-residential applications. For a single typical house, for instance, a suitable water heating system would occupy 2.5–4m² of roof space. The cost would be £1,500–£5,000 for a flat plate system that will provide around 50% of the typical hot water demand, and up to £5,000 for an evacuated tube system that will provide around 60%.

Solar hot water can be applied cost-effectively in a number of non-domestic building types, such as hospitals, nursing homes and leisure facilities, which have high demands for domestic hot water. SDHW systems are not so cost-effective in commercial buildings, where the demand for hot water is lower.

Technical and market research has been undertaken in the UK, the main conclusions being that most systems are technically proven and will provide a significant contribution to hot water demand if correctly installed. Installer training and accreditation schemes supported by the DTI have helped allay fears of poor quality installations, and this is on-going.

Solar thermal systems in the UK normally operate with a back-up source of heat, such as gas or electricity. The solar system pre-heats the incoming cold water, which is topped up by the back-up heat source when there is insufficient solar energy to reach the chosen target temperature.

Solar collectors are best mounted at an incline with a southerly orientation, although orientations between south-east and south-west are acceptable. With increased collector area, orientations between east and west are also acceptable. Collectors can also be mounted on south-facing vertical walls or horizontally, so that a large proportion of the building stock is suitable for solar thermal systems.

There are four main types of solar collector that can be used in SDHW systems. These are:

a. Evacuated tubes.
b. Glazed selective surfaced flat plate.
c. Glazed non-selective surfaced flat plate.
d. Unglazed plastic collectors (mostly used for swimming pool heating).

There are several design features of systems that can affect performance, including drainback or antifreeze systems, twin coil or preheat cylinder, and control systems.

The following standards are available for SDHW systems and components:

a. BS 6785:1986. Code of practice for solar heating systems for swimming pools.

b. BS 6757:1986. Methods of test for thermal performance of solar collectors.

c. EN 12975-1:2005. Thermal solar systems and components – Solar collectors – Part 1: General requirements.

d. EN 12975-2:2001. Thermal solar systems and components – Solar collectors – Part 2: Test methods.

e. EN 12976-1:2000. Thermal solar systems and components – Factory made systems – Part 1: General requirements.

f. EN 12976-2:2000. Thermal solar systems and components – Factory made systems – Part 2: Test methods.

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Page: 2

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 16:28

This claim is over optimistic. On a simple payback calculation you can rarely claim that solar thermal is cost-effective. It almost always has a payback of over 15 years. To get a payback under 10 years your system would need to be at least 50% grant aided (or stolen). This claim damages consumer confidence by raising false expectations. They may cause wrong decisions to install solar in inappropriate situations. User dissatisfaction with payback may result. Please tell the truth. Maybe say "there is little evidence that simple payback can be less than fifteen years when mains gas is a fuel. However if solar thermal were found to be as adding significantly to the value of a home, then payback of the residual capital cost of a system could be shortened dramatically".

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 16:41

Several issues here. First, repetition: why not just say up to £5k for a system? Second: only 50-60% solar fraction. True in most cases but it can be higher. Latitude and pitch are the main influences on solar fraction. Panel type, as in plates vs tubes, has less influence. This document lacks good science. Third: 50% vs 60% solar fraction ibias n favour of evacuated tubes. This is commercial bias by an unsupportable claim. Plenty of published research shows that solar thermal systems in Europe can produce 30-70% solar fraction. The higher levels can be achieved by one or more of the following: moving towards the equator (!), or installing steep wall mounted S facing panels (an important issue which is

Comments from page 2 continued on next page

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unfortunately ignored by SAP 2005) , or oversized systems with redundant summer capability. Any flat plate vs evacuated tube debate is marginal compared to these measures. This unsupportable myth that evacuated tubes are in effect 20% better (60% vs 50% means 20% of 50% better) should not be perpetuated by government. It biases the market against flat plate technology.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 16:42

Repetition of the payback myth. Indeed, institutions usually pay even less per kWh for their energy than homes.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 17:06

Rather a garbled sentence. What does "not proven" mean? In our experience this is the term sometimes used by some members of the solar thermal industry to justify the exclusion of our technology from a number of documents, even though it has been operating successfully for seven years. If some technologies are concluded to be not proven they should be identified, with valid reasons. Certain senior regulators in UK have come up with ludicrous reasons to criticisise our technology, eg it acks a solar controller, must prevent freezing (instead of accommodate it) etc.. Regulators, including authors of documents like this would do well to speak with innovators face to face before publishing the, not after, as has happened with this document. They would also do well to look at science rather than majority led industry votes against patented innovations on questions of science or technology.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 17:52

The state funded installer training scheme which we are aware of is the

Comments from page 2 continued on next page

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Carbon Trust / IT Power / BPEC / STA / Filsol / Laughton solar thermal training manual. The names show, as far I am aware the parties involved. Production of this material was supported by £86k of state funds. Regrettably it is a commercially damaging document with respect to our technology, despite us repeatedly offering detailed technical input. Over 1000 installer have been trained using this material. We would not want them to use them to install our technology without us retraining them ourselves because the material is of such poor quality with respect to our technology. Unfortunately many of these installers would not want to install Solartwin anyway because of the inaccurate, misleading and scaremongering approach which the manual takes to Solartwin. It is regrettable that this paragraph refers to this flawed and market limiting material.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 17:54
Add here, either during the day or at the end of th eday, depending on the technology uses.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 19:22
For best solar fractions aout 40% larger than normal panels are best mounted due south, attached to walls. It is a myth to say that panels are best mounted at an incline.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 19:19
If they need to be bigger at all, then roof mounted collectors at 30 degrees pitch only need to be about 10% bigger than SW or SE facing panels.

Author: barryjohnston
Subject: Highlight

Comments from page 2 continued on next page

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Date: 02/02/2007 18:09

Limited scope. In fact there are at least six. Solartwin's double glazed matt black or semi selective freeze tolerant collectors also have a significant presence in UK. They are also missed out as a category from SAP 2005. A sixth category are collectors which are single glazed and which use air as the heat transfer medium. The document should warn that the standards apply primarily to old technology and say that some solar standards need review. (Regulation is supposed to allow a plurality of approaches even if this means thinking outside the box.)

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 18:03

It should be clearly stated that these standards do not encompass very well the range of viable solar thermal systems available. Their over zealous application can function to limit the market. Solar thermal technology linked to these standards is likely to be based on design principles which are 15, or more, years old. Many new designs and ways of working solar thermal systems and increases is sustainability of approach have developed since then.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 18:05

This standard does not fit our technology properly but has been used to limit the market in UK and Ireland (Does the year on this need updating? Should it not be 2005?)

i. ENV 12977-3:2001. Thermal solar systems and components – Custom built systems – Part 3: Performance characterisation of stores for solar heating systems.

8.2 Performance calculation method

For the purpose of calculating the potential of solar hot water systems to contribute towards lowering the carbon emissions of a building in order for it to meet the compliance requirements of Part L of the Building Regulations, the factors to be considered are:

Symbol	Units	Description	Value
Q_{hwtot}	kWh	Annual hot water demand	
I_{av}	kWh/m^2 per year	Average annual irradiation at the specific location	
K_E	%	SDHW system conversion efficiency	See EN 12975 for collector
K_P	%	Positioning factor based on system's tilt and orientation	
K_u	%	Utilisation factor	
U	kWh/m^2	Output per functional unit installed	$I_{max} \times K_E \times K_P \times K_u$
M	%	Percentage of hot water demand met by SDHW system	Maximum 50% (less if collector area constrained)
Q_{hw}	kWh	Annual hot water supplied by SDHW system	$Q_{hwtot} \times M$
A	m^2	Net area of the SDHW collector to meet desired target M%	Q_{hw}/U
Q_{pump}	kWh	Energy input for circulating water in the SDHW system (circulating pump)	
$Q_{control}$	kWh	Energy loss without thermostatic control	75kWh per year from DTI side-by-side testing
Cf_e	$kgCO_2/kWh$	Carbon dioxide factor for used electricity	Grid-supplied electricity = 0.422 PV electricity = 0.0
C_{shw}	kg	Resulting carbon dioxide emissions due to the operation of the SDHW system	$(Q_{pump} - Q_{control}) \times Cf_e$
Cf_{con}	$kgCO_2/kWh$	Carbon dioxide factor for fuel supply to a conventional boiler	Natural gas = 0.194 Grid-supplied electricity = 0.422
C_{be}	%	Conventional boiler efficiency during intermittent operation	
C_{con}	kg	Resulting carbon dioxide emissions due to the operation of a conventional boiler for an equivalent output of the SDHW system	$Q_{hw} \times Cf_{con}/C_{be}$

The carbon dioxide emissions saving resulting from a solar hot water system can be derived as follows:

$$C_s = C_{con} - C_{shw}$$

Increasingly, the circulation pump carbon dioxide burden is being reduced to zero as PV panels are installed in parallel with an SDHW system to power, or offset, their electricity demand. However, these benefits can be fully realised only in combination with differential thermostatic control from the collector to the storage.

Solar hot water systems are most economically designed to meet only a proportion of the hot water demand for the building. As solar irradiation is greatest in the summer when demand is lowest, it is not possible to meet the entire annual demand by increasing the size of the system. For both residential and non-residential buildings, a maximum of 50% of the DHW may be recommended.

Page: 3

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 18:34

Annual or instantaneous efficiency? On what area basis - aperture or footprint? This is not defined? In any case, EN 12975, referred to here, does not state a system conversion efficiency. It simply gives a mathematical formula from which one can derive a panel efficiency (not system) which will be lower than the panel efficiency.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 19:12

Six months ago we asked ODPM / DCLG for a justification of this figure, but have seen no answer yet. (This was a freedom if information request which in law is meant to be complied with in a month). This is a selective market bias of about 8% against the performance of our technology. If such biases are to be applied, then they should not ignore the shortcomings of old solar. This 75 kWh pa penalty against Solartwin is not balanced by penalties which relate to conventional solar's several shortcomings such as fat pipes and stop-start pumping and the use of heat exchangers which reduce stratification and therefore also reduce pump-on time. Either remove this penalty or play fair. Fair could mean penalising old solar by say 0.5% energy per 5 metre for pipes of 15mm diameter and 1.5% for 22mm. Penalise heat exchangers, penalise start stop control since they all introduces loss or inefficiencies.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 18:31

Optimising system performance at all cost may not be cost effective. We

Comments from page 3 continued on next page

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found that making our panel 40% bigger was a much more cost effectiv ething to do than to squeeze a single figure percentage performance out of a smaller one. Thi sblack box input/output approach needs to be permitted and not distorted by too many individual component related tweakings.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 19:14
Inconsistency. 50% or 60% or something else. The front page says 60% is possible. In fact 70% is possible with steep S facing panels. Positional approaches must be mentioned.

8.3 Additional guidance

Design guidance

For solar DHW system design guidance, refer to the following publications:

a. Planning and installing solar thermal systems – a guide for installers, architects and engineers. German Solar Energy Society, 2005.

b. Solar thermal heating – design guide. CIBSE Domestic Heating Group, 2006.

Installation, commissioning and maintenance issues

For guidance on installation and commissioning of SDHW systems, refer to the following publications:

a. Solar thermal systems – successful planning and construction. Dr. Felix A. Peuser, Karl-Heinz Remmers and Martin Schnauss, 2002.

b. Solar water heating – a guide for installers. BRE/EST Energy Efficiency Best Practice, 2005.

User guidance

General user guidance on SDHW systems is available in the following publications:

a. Heating water by the sun: a layman's guide to the use of flat plate solar collectors for domestic water heating and for heating swimming pools. Solar Energy Society, 2001.

b. Tapping the sun – a guide to solar water heating. Chris Laughton, 2004.

Page: 4

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 19:15

Of these six documents, two take a traditional solar, German approach. Three of the four English Language ones appear to be at least partly written by the same plumber and are quite similar in content and. The first is still not yet in print. The second does not cover our technology at all yet it manages to mailign it in several places. The third is a cheery amateur's guide. The fourth one which is in English is independently written but rather out of date.

There appears to be an issue of limited technical scoping as well as a limited range of authors when it comes to most of the regulatory documents in UK, several of which ignore or misrepresent our technology. There is also an worrying issue of cross-referral of one flawed document to another. This appears to consolidate certain myths quite effectively.

Such limited scope of documentation may mean limited choice of technology and limitations on sustainability in buildings in the long term. Where is the guide to zero carbon soar thermal technology?

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 18:36

Not in publication, even in 2007. Is it wise to refer to documents before they are printed? What if they are anticompetitive, like the BPEC training manual?

Author: barryjohnston

Comments from page 4 continued on next page

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b. Tapping the sun – a guide to solar water heating. Chris Laughton, 2004.

Subject: Highlight
Date: 02/02/2007 18:38
This document contains numerous errors and omissions related to our product. We pointed several of them of them out at the draft stage and offered to help to write it better. Instead of our comments and offer being taken on board the scope of the document was reduced to exclude our technology.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 18:52
Parts of this are out of date.

Author: barryjohnston
Subject: Highlight
Date: 02/02/2007 19:06
This quaint introduction to the myths of solar heating makes interesting reading. Its author is a highly regarded solar expert and plumber. He chairs the BSI committee on Solar thermal, was past chair of the STA, and was involved in setting grants criteria (which initially excluded Solartwin). As a consultant to BRE once told us to remove our panel altogether and replace it with traditional solar technology. BRE agreed with us that he had made a mistake. He also wrote the technical content of the flawed BPEC manual and appears to have had an input to the CIBSE and BRE/EST material as well. He also teaches solar heating at CAT in Wales.