CARBON TRUST

Solar thermal technology

A guide to equipment eligible for Enhanced Capital Allowances

Contents

Front cover image courtesy of Wessex Water

Introduction

ECAs are a straightforward way for a business to improve its cash flow through accelerated tax relief. The scheme encourages businesses to invest in energy saving plant or machinery specified in the ETL to help reduce carbon emissions, which contribute to climate change.

The Energy Technology List (ETL) is a register of products that may be eligible for 100% tax relief under the Enhanced Capital Allowance (ECA) scheme for energy saving technologies[1]. The Carbon Trust manages the list and promotes the ECA scheme on behalf of government.

This leaflet gives an overview of solar thermal equipment specified on the ETL and illustrates the reductions in energy bills that can be realised by investing in qualifying ETL energy saving equipment over non-qualifying equipment.

Background

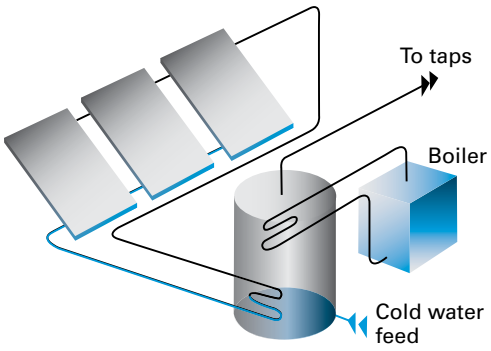
The ETL comprises two lists: the Energy Technology Criteria List (ETCL) and the Energy Technology Product List (ETPL). The ETCL defines the performance criteria that equipment must meet to qualify for ECA scheme support; whereas the ETPL is the list of products that have been assessed as being compliant with ETCL criteria.

Setting the scene

Solar thermal systems use energy from the sun to heat water. This replaces other energy sources such as natural gas and electricity as a means of providing hot water to buildings.

The most important part of a solar thermal system is the 'collector'. The collector's role is to absorb the sun's energy and efficiently convert it to heat for transfer to the hot water system. The collector is normally mounted on the roof of a building. There are a number of different types of solar thermal system; a typical system is shown in Figure 1.

***Figure 1** Typical twin coil solar thermal system*



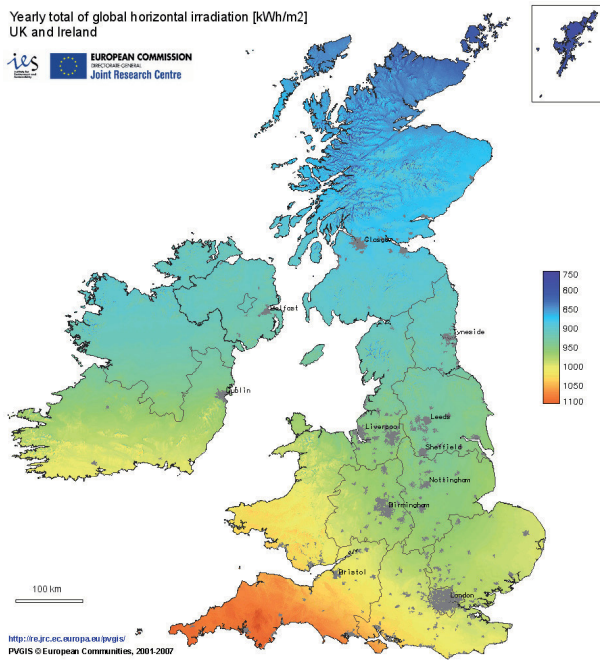
Hot water is supplied to the building by transferring the heat (energy) absorbed by the collector and pumping it down to the cylinder tank.

[1] Eligibility for ECAs is based on a number of factors. Visit www.etl.decc.gov.uk/etl to find out more.

A well designed system, incorporating a collector from the ETL, can be expected to collect useful energy greater than 450 kilowatt hours per year per square metre (kWh/y/m^2)[2]. However, performance is dependant on the location and orientation of the collector.

The available solar energy across the UK is shown in the solar irradiation chart below. This shows that the South West receives the highest level of solar radiation falling on the horizontal plan per square metre, making it an ideal location for the use of a solar thermal system. However, a wide range of other locations in the UK will also be suitable.

***Figure 2** Solar irradiation chart[3]*



There is a common misconception that solar thermal systems do not operate when it is cloudy. In the UK there is a relatively high percentage of cloudy days compared to clear days. When the sun's radiation passes through clouds, it is dispersed and is known as diffused radiation. On clear days, with no dispersion effect, it is known as direct radiation. Solar thermal systems are able to operate in both conditions. Figure 3 shows the average daily values for both diffused and direct irradiation for the London area.

***Figure 3** Average daily light energy for London[4]*

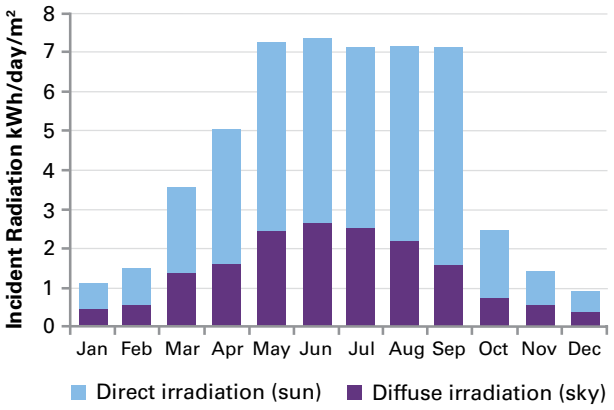


Figure 3 shows that solar thermal systems will provide more hot water during the summer than during the winter. This means that an auxiliary heat source will still be required to heat the water during the winter months. However, solar thermal systems are still able to save between 40% and 60% of the energy that would have been required annually to heat up the hot water using conventional energy sources, such as gas[5].

2 ETL Technology Review – Solar Thermal Systems (August 2006).
3 PVGIS, European Communities.
4 Solar Irradiance Database.
5 CIBSE (2007) Solar Heating Design & Installation Guide.

Benefits of purchasing ETL listed products

The solar thermal products listed on the ETL are highly energy efficient, particularly when compared to non-ETL listed products, and can potentially achieve energy savings of between 40% and 60%[5] for hot water heating when installed in a well designed system.

When replacing equipment, businesses are often tempted to opt for equipment with the lowest capital cost; however, such immediate cost savings can prove to be a false economy. Considering the life cycle cost before investing in equipment can help enhance the cash flow benefits still further.

The ECA scheme provides businesses with 100% first year tax relief on their qualifying capital expenditure, and the ETL specifies the energy saving technologies that are supported by the ECA scheme. This means that businesses can write off the whole cost of the equipment against taxable profits in the year of purchase. This can provide a cash flow boost and an incentive to invest in energy saving equipment that normally carries a price premium when compared to less efficient alternatives.

This leaflet also illustrates the reductions in energy consumption, carbon emissions and energy bills that can be realised by investing in qualifying ETL energy saving equipment over non-qualifying equipment.

Important

Businesses purchasing equipment must check the ETL at the time of purchase in order to verify that the named product they intend to purchase is designated as energy saving equipment. Solar thermal equipment that meets the ETL eligibility criteria but is not listed on the Energy Technology Product List (ETPL) at the time of purchase is not eligible for an ECA.

Types of solar thermal collector eligible under the ECA scheme

The ECA Scheme covers solar thermal systems incorporating two main types of solar collector:

- Glazed flat plate collectors.
- Evacuated tube collectors, including:
  - Direct flow collectors.
  - Heat pipe collectors.

All collectors listed under the ECA Scheme have to meet strict criteria in terms of testing and efficiency.

Using the baseline scenario below, the potential financial (£), energy (kWh) and carbon savings (kg CO_2) have been calculated for comparison unless otherwise indicated:

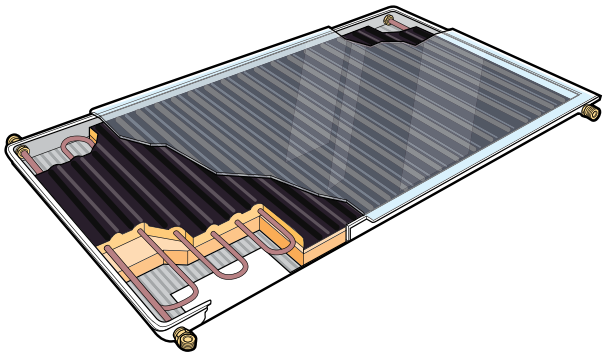
- Gas cost 3.79p/kWh and electricity cost 13.19p/kWh.
- Annual solar energy delivered to hot water system: 1340kWh for a collector that does not meet the ECA criteria[6].
- Carbon dioxide emissions factors of 0.1836kgCO_{2e}/kWh (gas) and 0.524kgCO_{2e}/kWh (electricity)[7].

5 CIBSE (2007) Solar Heating Design & Installation Guide.
6 ETL Technology Review – Solar Thermal Systems (August 2006).
7 Guidelines to Defra's GHG conversion factors for company reporting.

Glazed flat plate solar collector

Glazed flat plates are constructed with insulation on their back and sides and are covered by a transparent cover. This reduces the heat loss to the surrounding area and therefore improves the performance of the collector compared to an unglazed version. These collectors can be integrated with the roof, mounted on the roof or façade mounted. Figure 4 shows a glazed flat plate collector.

***Figure 4** Schematic of a glazed flat plate collector*



Flat plate collectors are generally cheaper than evacuated tube collectors with a good cost-to-performance ratio.

Did you know?

A glazed flat plate collector will collect approximately 450kWh/m^2 per year[8]. This is equivalent to 4,500 100W light bulbs being turned on for one hour.

Installing an ETL listed glazed flat plate collector with an annual solar yield of 1,800kWh could result in the following annual savings when compared to an equivalent non-ETL listed product.

	ETL	Non ETL
Fuel savings	£237	£176
Energy saving	1,800kWh	1,340kWh
Carbon dioxide savings	943kg CO_{2e}	702kg CO_{2e}

Evacuated tube solar collectors

Evacuated tubes are highly efficient even with low solar radiation, as well as in circumstances where there is a large temperature difference between the absorber and ambient temperatures. In general, evacuated tubes are more expensive than glazed flat plate collectors and cannot be installed integral to the roof.

Evacuated tube collectors use glass tubes in which a vacuum is created. This acts as a source of insulation, reducing heat losses from the collector and making the product very efficient. There are two types of evacuated tube collectors: direct flow and heat pipe collectors.

Direct flow collectors

Direct flow evacuated tube collectors use an evacuated tube inside a U-shaped tube. There are three different designs of direct flow evacuated tubes for the U-shaped tube. These are: concentric fluid inlet and outlet, two separate tubes for inlet and outlet and the Sydney tube. The fluid in the solar system is used as the heat transfer medium and the fluid runs through a concentric tube-in-tube or a U-shaped tube to the base of the glass bulb and then returns to the header. The Sydney tube is an example that incorporates a vacuum double glass tube sealed together at one end.

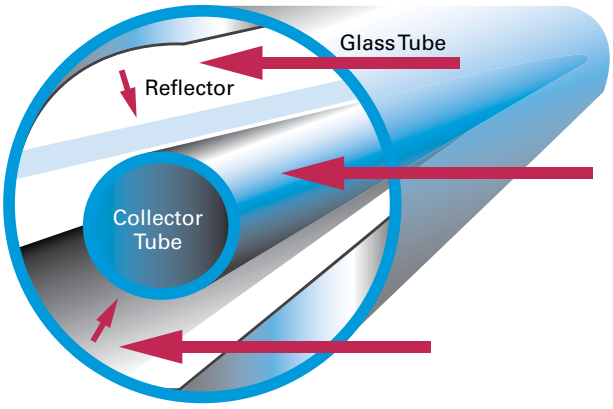
[8] German Solar Society (2005) Planning and Installing Solar Thermal Systems.

Heat pipe collectors

A heat pipe evacuated tube collector uses alcohol or water in a vacuum which is used to absorb the sun's energy. Due to the vacuum, the alcohol or water will evaporate at a low temperature of 25°C to form a vapour. This vapour then rises up the collector tube to the heat exchanger where heat transfer to the solar fluid takes place. Following heat transfer, the vapour condenses back to a liquid and flows back down the collector tube. It should be noted that heat pipe evacuated tubes must be installed with a tilt of at least 25°C degrees.

There are two types of heat pipe evacuated tube collector: a dry connection and wet connection. In a dry connection collector, the condenser completely surrounds the collector tube. This provides good heat transfer between the tube and the heat exchanger and allows for tubes to be replaced without the need to drain the solar fluid. In a wet connection collector, the tube is submersed in the heat transfer fluid. Therefore, if a tube needs to be replaced then the system must be drained.

Figure 5 Schematic of heat pipe evacuated tube collector



Did you know?

An evacuated tube collector will collect approximately 450-550kWh/m^2 per year 9. Therefore, a typical 4m^2 system could provide an annual solar yield of 2,200kWh.

Installing an ETL listed evacuated tube collector with an annual solar yield of 2,200kWh/m^2 could result in the following annual savings when compared to an equivalent non-ETL listed product.

	ETL	Non ETL
Fuel savings	£290	£176
Energy saving	2,200kWh	1,340kWh
Carbon dioxide savings	1,153kg CO_{2e}	702kg CO_{2e}

Conclusion

When considering ETL solar thermal equipment compared to non ETL listed equipment it can be seen that ETL solar thermal equipment will save you between 115kWh/m^2 and 215kWh/m^2 of energy. This means a financial saving of between £15 to £28 and an environmental saving of up to 450kg of carbon dioxide per square meter of collector. These savings are dependent whether a flat plate collector or an evacuated tube collector is purchased.

Information for purchasers

For further information about the ECA scheme, the Energy Technology List (ETL) and other Technology Information Leaflets in the series please visit www.carbontrust.co.uk/eca, contact the Carbon Trust on 0800 085 2005 or email customercentre@carbontrust.co.uk

9 German Solar Society (2005) Planning and Installing Solar Thermal Systems.

Go online to get more

The Carbon Trust provides a range of tools, services and information to help you implement energy and carbon saving measures, no matter what your level of experience.

Carbon Footprint Calculator

Our online calculator will help you calculate your organisation's carbon emissions.
www.carbontrust.co.uk/carboncalculator

Energy Efficiency Financing

Offers leases, loans and other financing options to all types of organisations seeking to reduce their energy use. For more information see: **www.energyefficiencyfinancing.co.uk**

Carbon Surveys

We provide surveys to organisations in Scotland, Northern Ireland and Wales with annual energy bills of more than £50,000*. Our carbon experts will visit your premises to identify energy saving opportunities and offer practical advice on how to achieve them. **www.carbontrust.co.uk/surveys**

Action Plans

Create action plans to implement carbon and energy saving measures. **www.carbontrust.co.uk/apt**

Case Studies

Our case studies show that it's often easier and less expensive than you might think to bring about real change.
www.carbontrust.co.uk/casestudies

Events and Workshops

The Carbon Trust offers a variety of events and workshops ranging from introductions to our services, to technical energy efficiency training, most of which are free. **www.carbontrust.co.uk/events**

Publications

We have a library of free publications detailing energy saving techniques for a range of sectors and technologies
www.carbontrust.co.uk/publications

Need further help?

Call our Customer Centre on 0800 085 2005
Our Customer Centre provides free advice on what your organisation can do to save energy and save money. Our team handles questions ranging from straightforward requests for information, to in-depth technical queries about particular technologies.

* Subject to terms and conditions.

The Carbon Trust is a not-for-profit company with the mission to accelerate the move to a low carbon economy. We provide specialist support to business and the public sector to help cut carbon emissions, save energy and commercialise low carbon technologies. By stimulating low carbon action we contribute to key UK goals of lower carbon emissions, the development of low carbon businesses, increased energy security and associated jobs.

We help to cut carbon emissions now by:

- providing specialist advice and finance to help organisations cut carbon
- setting standards for carbon reduction.

We reduce potential future carbon emissions by:

- opening markets for low carbon technologies
- leading industry collaborations to commercialise technologies
- investing in early-stage low carbon companies.

www.carbontrust.co.uk

0800 085 2005

The Carbon Trust receives funding from Government including the Department of Energy and Climate Change, the Department for Transport, the Scottish Government, the Welsh Assembly Government and Invest Northern Ireland.

The Carbon Trust is a company limited by guarantee and registered in England and Wales under Company number 4190230 with its Registered Office at: 6th Floor, 5 New Street Square, London EC4A 3BF.

Published in the UK: February 2012.

CARBON TRUST