

# Transpired Solar Collector Installations in Wales and England

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## Abstract

Transpired Solar Collectors (TSCs) are a relatively new solar energy technology to the UK building-integrated renewable energy market. Since the first UK TSC was integrated with a profiling mill in County Durham in 2005, a further 19 commercial installations have ensued and have a combined absorber area totaling over 12,500m<sup>2</sup>. Wales and England are home to some architecturally and technically innovative TSC designs. These include one of the world's largest TSCs, a Cassette-Panel TSC array with special high-absorptivity selective coating and a TSC integrated with diurnal thermal storage. To accelerate the development of TSCs in Wales, the Welsh European Funding Office (WEFO) funded Sustainable Building Envelope Demonstration (SBED) project will monitor eight full-scale TSCs over two years to generate robust data on the feasibility of the technology.

## Background

A transpired solar collector (TSC) is a solar thermal system which can be used to preheat the ventilation air supply to buildings using solar radiation as its energy source. Figure 1 illustrates the simple principle upon which it is based. External air is drawn into a plenum or cavity through thousands of evenly spaced perforations in a solar absorbing sheet. As the air passes over the front surface of the perforated sheet, heat is transferred from the sheet to the air. This heated air can then be distributed directly into the building as ventilation or ducted into the main heating system to reduce the fossil fuel load. Although this technology has been used extensively in Canada and the USA since the early 1990s, it is a relatively new technology to the UK.

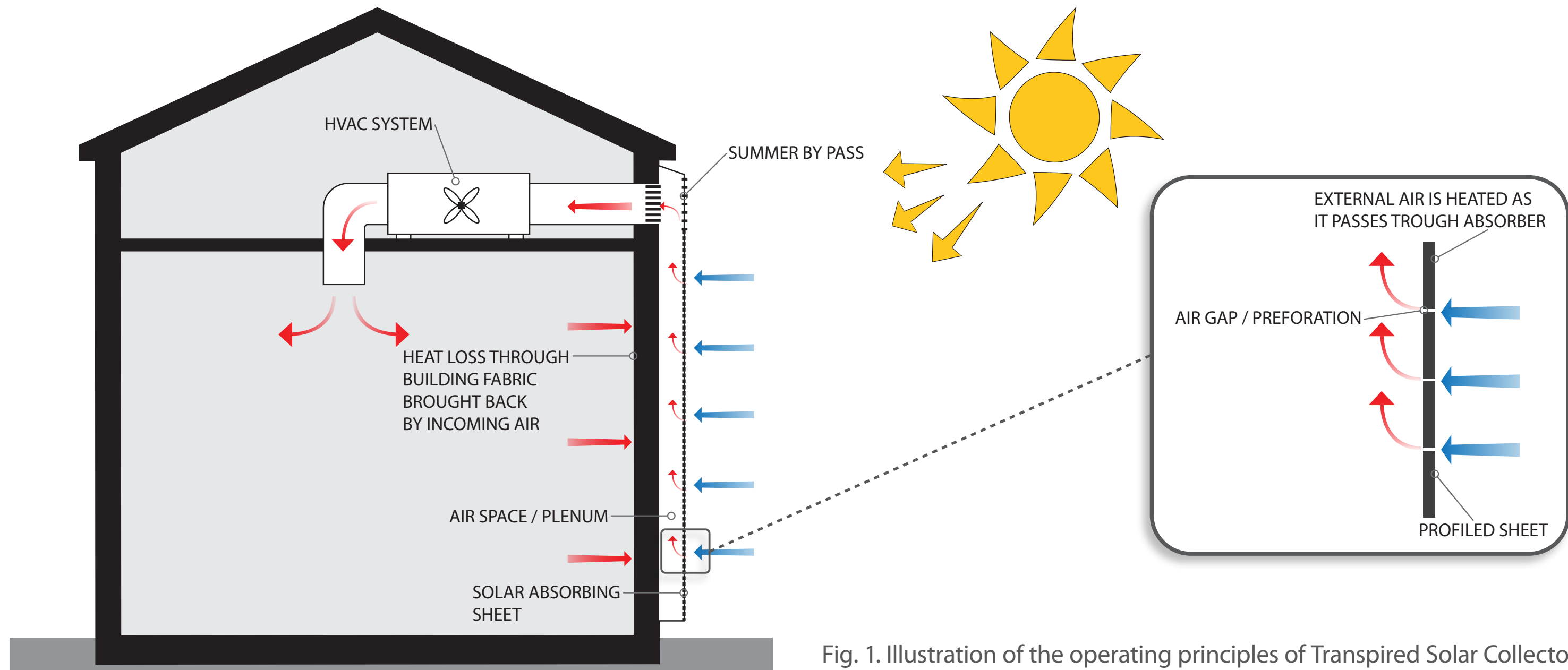


Fig. 1. Illustration of the operating principles of Transpired Solar Collector

## Overview of Transpired Solar Collectors in the UK

The first UK TSC installation took place in 2005 at the profiling mill in Evenwood, County Durham, and consisted of a 410m<sup>2</sup> TSC to the South East Façade. This is one of 15 installations now active in England, with another 5 in Wales. The location of each TSC is illustrated in Figure 2. Table 1 lists details of these installations chronologically, and reveals a great variety in terms of size, location and building type. The total combined TSC absorber area exceeds 12,500m<sup>2</sup> and include some architecturally and technically innovative TSC designs. These include one of the world's largest TSCs, a Cassette-Panel TSC array with special high-absorptivity selective coating and a TSC integrated with diurnal thermal storage.

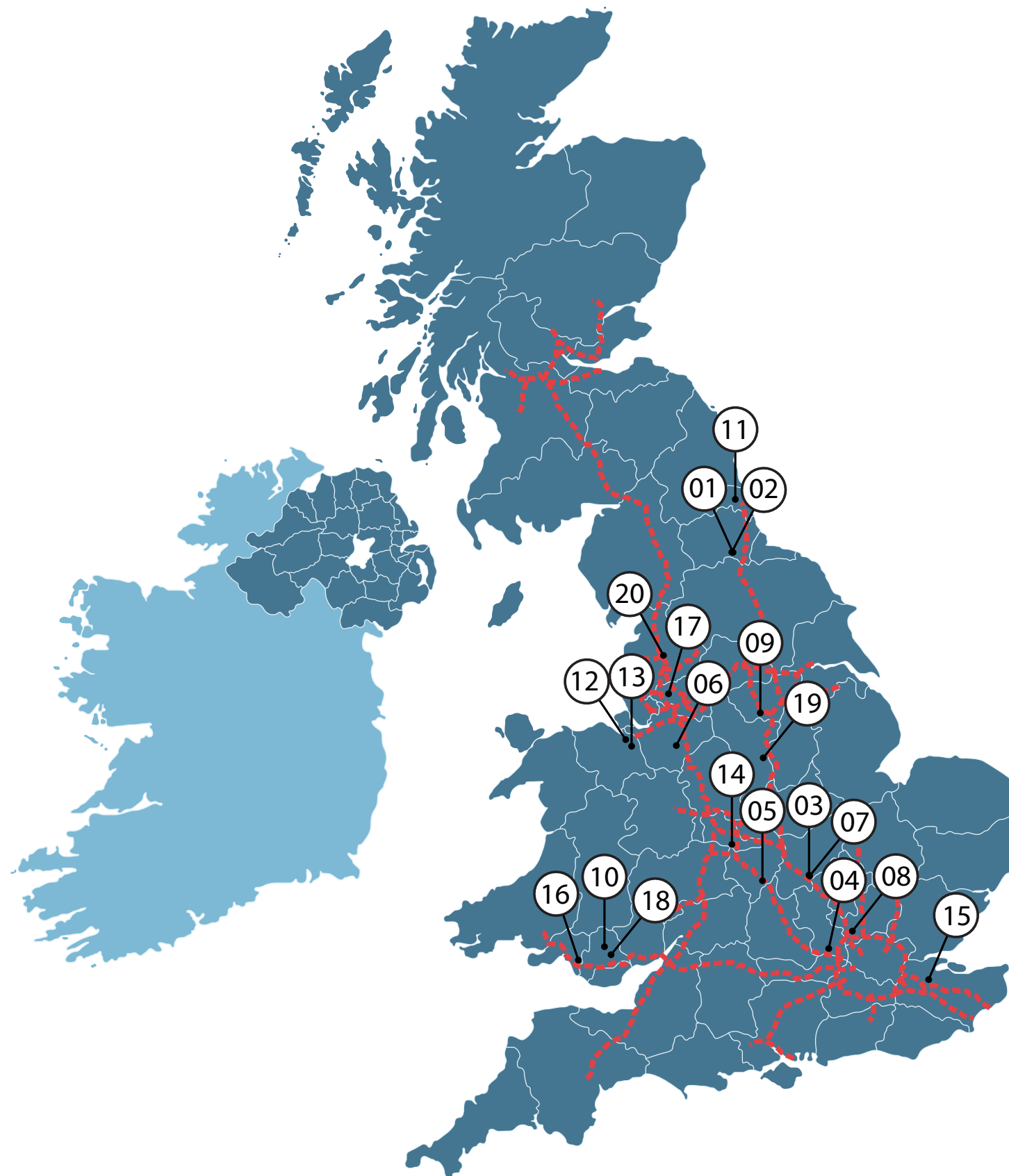


Fig. 2. Map illustrating location of UK TSC installations

## Orientation and Inclination

Most of the TSC installations in the UK have an un-shaded orientation within 20 degrees of South. However, there are exceptions such as the Rhondda Cynon Taff (RCT) Homes dwelling in Aberdare which compensates for its imperfect orientation by splitting the TSC installation between the South West (Front) and South East (Side) façades. In the UK TSCs are generally installed vertically on the façade and to date roof mounted systems do not exist commercially. The only non-vertical example is the TSC at the Technical Training Academy of Jaguar Land Rover which is inclined on the façade at a 69° angle.

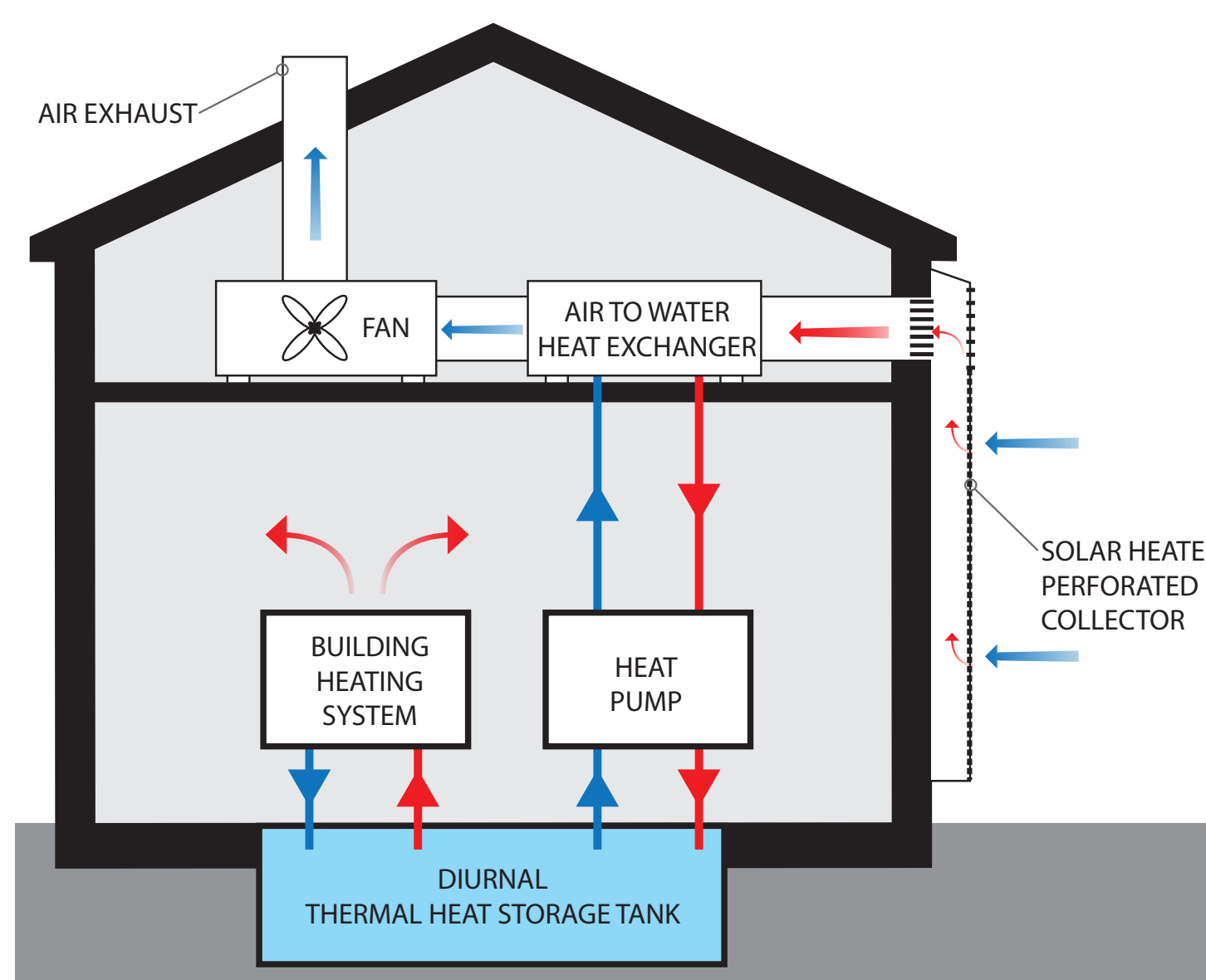


Fig. 3. Illustration of Transpired Solar Collector with Diurnal Heat Storage

## Building Type

The most common application of TSC in the UK is heating Industrial and warehouse buildings which generally comprise of the largest collector areas. Less common applications include heating leisure facility, healthcare, commercial and residential buildings. The majority of TSCs in the UK have been integrated into new buildings. However, there are many examples of installations being carried out as part of an existing building refurbishment.

## Type of Metal Cladding

Led by the availability within the façade metal cladding market, the TSC installations in the UK employ three different types of metal cladding. These are Profiled Metal Sheeting, Cassette Panels and Tongue and Groove Planks and examples of each is illustrated in Figure 4. The vast majority of TSC installations in the UK utilise Profiled Metal Sheeting as the collector surface, although at least one example exists for each of the other two options.



Fig. 4. Examples of the three different types of metal cladding available for Transpired Solar Collectors

Table 1. Transpired Solar Collectors in Wales and England.

Ref.	Project	Location	Year	Absorber Projected Area (m <sup>2</sup> )	Colour	Form of TSC Absorber
01	CA Group Mill Building A (Renovation)*	Evenwood, County Durham	2005	410	Merlin Grey	Profiled Steel Sheet
02	CA Group Mill Building B (New Build) *	Evenwood, County Durham	2006	1211	Merlin Grey	Profiled Steel Sheet
03	Sainsbury's Distribution Centre*	Pineham Park, Northampton	2006	947	Alaska Grey	Profiled Steel Sheet
04	Beaconsfield Motorway Services*	Beaconsfield, Buckinghamshire	2008	255	Alaska Grey	Profiled Steel Sheet
05	Jaguar Land Rover Material Planning & Logistics Centre*	Leamington Spa, Warwickshire	2009	268	Ariadne	Profiled Steel Sheet
06	Premier Park 33*	Winsford, Cheshire	2009	580	Sargasso	Profiled Steel Sheet
07	Royal Mail*	Swan Valley, Northampton	2009	800	Zeus	Profiled Steel Sheet
08	Willmott Dixon Healthcare Campus (Full Scale Showcase) *	Bre Innovation Park, Watford	2009	24	Grey Aluminium	Profiled Steel Sheet
09	Firth Park Community Arts College*	Sheffield, South Yorkshire	2010	218	Anthracite	Profiled Steel Sheet
10	RCT Homes Dwelling	Cwmbach, Aberdare	2010	9	Chocolate Brown	Steel Plank
11	Chartek International Paints*	Felling, Gateshead	2010	100	Merlin Grey	Profiled Steel Sheet
12a	Sustainable Building Envelope Centre (SBEC)	Deeside, Flintshire	2011	62(sum of 3 units)	High Absorptivity Linden Green	Steel Cassette Panel
12b	Sustainable Building Envelope Centre (SBEC)	Deeside, Flintshire	2011	200	Anthracite	Profiled Steel Sheet
13	Deeside Leisure Centre	West Queensferry, Deeside	2011	260	Slate Grey	Profiled Steel Sheet
14	Jaguar Land Rover Deck 92	Solihull, West Midlands	2011	565	Slate Grey	Profiled Steel Sheet
15	Royal Mail*	Strood, Kent	2011	700	Pure Grey & Anthracite	Profiled Steel Sheet
16	TWI Technology Centre	Port Talbot, Neath Port Talbot	2012	486	Slate Grey	Profiled Steel Sheet
17	Armstrong Point Business Park*	Wigan, Greater Manchester	2012	390(sum of 9 units)	Sargasso & Anthracite	Profiled Steel Sheet
18	SSE	Treforest, Rhondda Cynon Taf	2012	210	Anthracite	Profiled Steel Sheet
19	Marks & Spencer*	Castle Donington, Leicestershire	2012	4334	Alaska Grey, M&S Green, Anthracite Grey.	Profiled Steel Sheet
20	Royal Mail*	Chorley, Lancashire	2013	495	Anthracite	Profiled Steel Sheet

## Colour

The colour of the collector is a good indicator of the absorber's ability to convert solar radiation to heat. As dark colours absorb more sunlight, black is the obvious choice in terms of solar thermal performance. Recently, a new range of steel coatings with improved solar absorption including light colours has been introduced. Despite the extended range available, grey is the dominant colour used throughout. At least eight different shades of grey have been used. The only four other colours used currently comprise of linden green, sargasso, chocolate brown and M&S green.

## Size

TSCs are generally sized to match the fresh air requirement of the building. The average area of installation in the UK is 596m<sup>2</sup>. The area of TSC collector ranges from 9m<sup>2</sup> of the Rhondda Cynon Taff (RCT) Homes Dwelling in Aberdare up to 4334m<sup>2</sup> at the Marks & Spencer distribution centre at Castle Donington, which is one of the largest TSCs in the world. Figure 5 illustrates the increase in the operational collector Area of TSC in the UK annually.

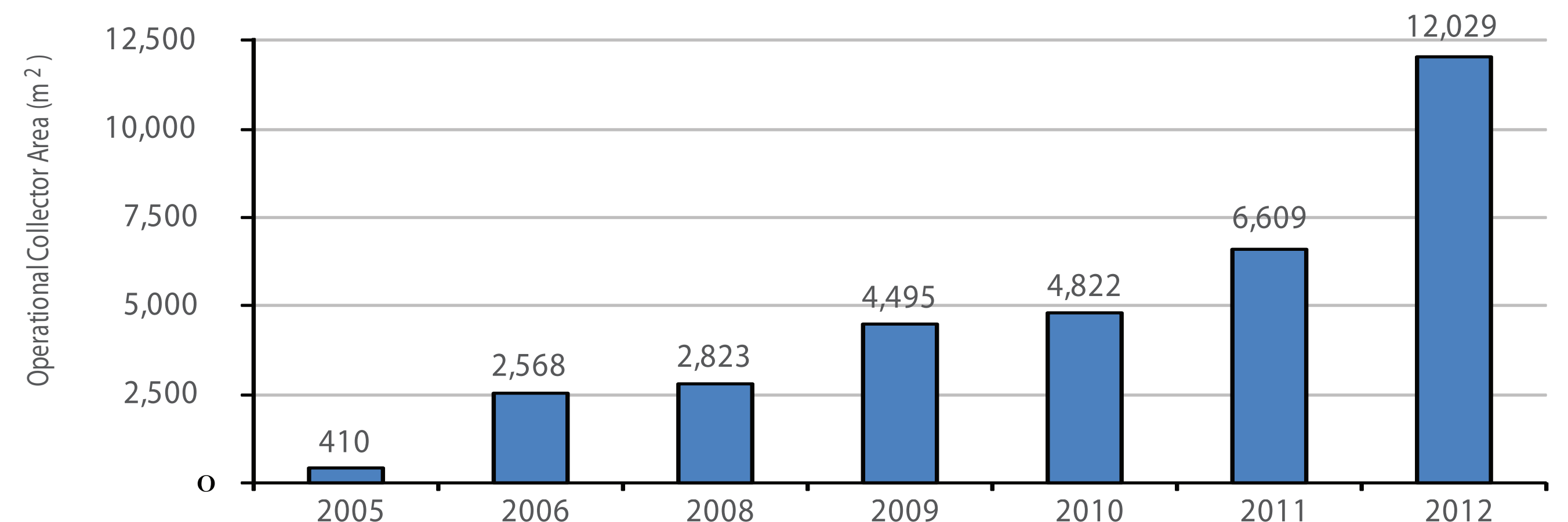


Fig. 5. Graph illustrating Annual Operational Collector Area of Transpired Solar Collector in the UK

## Sustainable Building Envelope Demonstration (SBED) Project

The Sustainable Building Envelope Demonstration (SBED) project is a matched funded project with £1.8 million from the European Regional Development Fund through the Welsh Government. The project was secured by the Welsh School of Architecture, Cardiff University and is delivered in partnership with Tata Steel. The principle aim of this project is to design, model, test, prototype and monitor low carbon building systems incorporating TSCs in eight 'buildings in use in Wales. The full process of design, installation & operation, will be independently monitored along with investigation of public perception. Installations will include new build and retrofit as well as vertical and inclined installations on a variety of building types. This will provide data on the real life performance of the technology and allow dissemination of best practice in terms of installation, integration and maintenance.



## Acknowledgements

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