Case Study

008

Solar House 80/50
Low Carbon Refurbishment

client

places for people

solar thermal
3.2kWth (4.5 m^2)

thermal system
Pre-heat to heat pump

solar energy saving
3,016 kWh/year

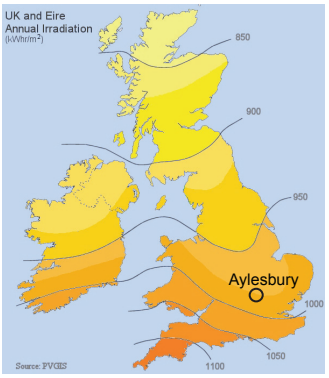
solar pv
1.35kWp (9.0 m^2)

number of dwellings
1

solar carbon dioxide saving
1,060 $kgCO_2$/year

Retrofit for the Future

Eighty six refurbishment projects across the UK, all with the common goal of refurbishing homes to reduce the energy consumption by 80% compared to an average house built in 1990.



The Technology Strategy Board (TSB) launched the project in 2009 with the aim of providing a kick-start to the retrofitting of the UK housing stock. Over 300 applications were whittled down in a two stage process. The successful applicants received a grant of £150,000 for their project which should deliver standard solutions that can be widely applied into mass retrofit programmes. The energy performance of the houses will be monitored over a two year period.

Solar House 80/50

Places for People selected a three storey terraced house in Aylesbury for the refurbishment. The house was built in the mid 1990s, a peak time for social house building, and representing a highly typical construction type.

The discreet roof-integrated Clearline solar panels are the only outward indication that this house is 80% more energy efficient than its neighbours.

The mid-terrace location of the property made achieving the required energy improvements especially challenging due to the lack of exposed flank walls to improve and the high proportion of windows and doors relative to the masonry walls.

Viridian Solar was a key member of the design team right from the beginning of the project, working alongside Willmott Dixon, Rickaby Thompson Associates and MEPK Architects.

Design teams were encouraged by the TSB to trial new technologies, and the project provided an ideal opportunity for Viridian Solar to demonstrate the real-life performance of its new Clearline PV photovoltaic panels. These had been designed to install harmoniously alongside the company's successful range of solar heating panels.

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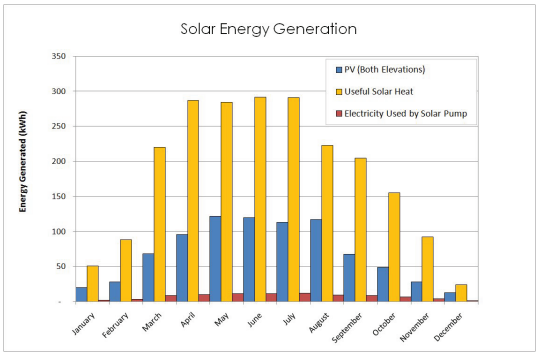
The team developed a whole-house solution based on the following key strategies:

- reduce heat losses to a level which could be largely satisfied by internal heat gains
- supply hot water from solar panels, supplemented by an exhaust air heat pump
- whole house ventilation with heat recovery from extract air
- solar PV to make up any shortfall

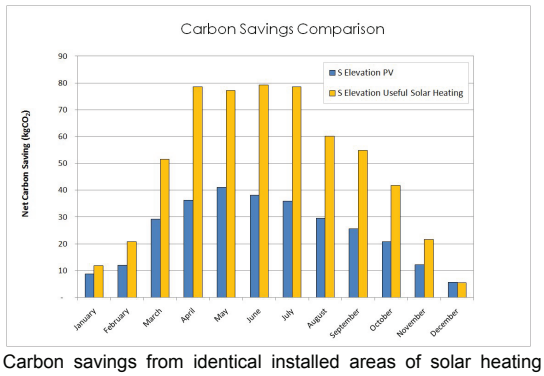
The solar water heating was implemented as a 4.5m^2 array of panels on the south elevation heating a cylinder on the top floor. Solar-heated water is fed from here to an exhaust air heat pump on the ground floor. The heat pump has its own integral hot water cylinder under thermostatic control. If the solar-heated water is sufficiently hot, the heat pump will not need to add any further energy to the water. On days with less solar energy, the heat pump may need to top up the solar heated water to the working temperature.

View of the front (South) elevation showing harmonious aesthetic from a row of three Clearline PV panels (top row) and three Clearline solar heating panels (lower row).

The PV array was sized to make up the difference between the limit of improvements achieved by other measures and the target performance. As a result, the array was larger than the south elevation could accommodate and was split between the south and north elevations, with 4.5m^2 (0.675kWp) of monocrystalline silicon panels to each roof.



Monthly useful energy output from solar heating (yellow), solar pump electricity use (red) and solar pv panels (blue).



Carbon savings from identical installed areas of solar heating (yellow), and solar pv panels (blue).

Monitoring Results

The results illustrate some key points about solar technology.

1. *Solar heating produces significantly higher energy yields per area of roof than solar PV.* The south elevation PV outputs only 23% of the useful energy output from the same area of solar heating panels. The higher carbon intensity of electricity compared to gas would change this figure to 52% in terms of carbon dioxide in a gas heated property.

2. *Solar heating is limited by demand.* It can be seen from the graph that the useful solar heat is capped at a peak output of around 300kWh/month. This suggests an average usage of 35 litres/day of hot water for each of the five occupants. The PV panels export their excess to the grid, so solar yields continue to rise from April to mid-summer.

3. *The solar heating outperforms the government's SAP prediction by two-fold*- this is due to the occupancy of the house (5 people) being well above the SAP occupancy of 2.8 which is fixed by floor area.

4. *The solar pump energy consumption is a tiny fraction of the benefit.* The electrical energy used by the solar system was only 3.9% of the heat energy collected.

client: places for people

main contractor: WILLMOTT DIXON

architect: MEPK ARCHITECTS

energy consultant: RICKABY THOMPSON ASSOCIATES ARCHITECTS+ ENERGY CONSULTANTS

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