47 to 74: bringing a Victorian terrace house up to an energy efficient standard

Pett Projects

Case Study 01/2007

Key points

- Victorian terrace house
- Full loft insulation (top-up)
- Gas condensing boiler fitted
- Solar pv array
- Location: Essex, (Epping)

Contents

Summary

In terms of improving a building's energy efficiency, most Victorian houses can be described as 'hard to heat' (or hard to treat). Hard to heat homes either have solid wall construction or are not connected to the gas network. This means that the most cost-effective measures for saving energy and fuel bills like cavity wall insulation can't be applied to them. The alternatives are more expensive to fit, and meanwhile the homes cost more to run because they use more fuel. Hard to heat should really be 'expensive to heat and expensive to solve' but the snappy phrase is easier on the tongue! The basic problem is that the easiest ways to improve a house's energy efficiency cannot be applied to them.

This case study describes how a Victorian terrace house with gas central heating (typical SAP rating 47 for an unimproved property) was brought up to a respectable SAP 74.

The main improvements were, in addition to double glazing:

- Full loft insulation
- Gas condensing combi boiler
- Solar photovoltaic panels

As the house faced south-west at the back, with the typical arranged of two roofs at right angles, and the owner could commit to a large outlay, a larger than standard pv array was fitted. The resulting electricity produced would exceed all the owner's electricity needs over the year—but not at the time needed, so export to the grid is included.

Terraced house at Epping, Essex (pictured in June)

Solar pv roof fitted on both main roof and back addition (April)

Background

The house is a mid-terrace house built in 1889. In common with most of its neighbours, various internal improvements had taken place such as gas central heating installed in about 1975, at about the same time that the interior walls were removed to make a through lounge-diner. The toilet was moved from outdoor to indoor within the downstairs bathroom somewhat earlier. The kitchen and bathroom form a single storey back addition (the term used for the bit sticking out, and NOT an extension but an original part of the building).

The roof had been renovated with recycled slates in 1990. At that stage the loft insulation was stated as 'around 50mm' which is typical of the loft insulation installed n the mid-70s.

The owner, a single professional person, bought the house in 1985 and had gradually replaced the wooden windows with double glazed units. (mainly metal with wood surrounds).

The owner was keen on both energy conservation and promoting new technology.

Internal work included damp proofing, rewiring and loft top-up insulation

The owner had already minimised electricity consumption before fitting the solar panels

The solar pv panels arrive

Energy conservation work

The first issues were to consider heat disappearing out of the roof and cold coming in from the ground. A damp proofing 'skim' had been applied in 1988, and consideration could have been given to floor insulation, however carpeting throughout with a thick underfelt was considered a reasonable option. The walls had a metre of plaster removed, a membrane inserted and were replastered to inhibit damp.

The loft was insulated to a total of 350 mm with standard mineral fibre insulation. In order to maintain use of the roof space for storage, the rafters were built up by putting another batten above the existing rafters. On top of these the boards were put across for three metres across the centre of the loft area, leaving room for air circulation at the side.

The gas boiler had previously been a back boiler in the chimney space, heating a water tank situated on the landing, which supplied water to the back addition through a long run of pipes. Not only did it take at least two minutes for the water to run hot, there had been problems in the past of freezing pipes overnight in winter. There had previously been some concern by the gas engineers as to whether there was technically sufficient ventilation available to this back boiler.

In two stages of work over three years, the gas boiler was changed to a condensing combi situated in the lobby between the kitchen and bathroom, vented direct to the outside. This gave almost instant response in terms of hot water, reduced pipe lengths and repositioned pipes to reduce risk of freezing.

After consideration it was decided that internal or external wall insulation on the front or back wall would lead to insignificant energy savings.

Renewable Energy options

The options considered were solar water heating, solar photovoltaic and microCHP.

For a single person who uses a shower daily and very little hot water otherwise, solar HW did not present an attractive option. This led to the decision to switch to a gas condensing combi boiler for efficient production of hot water on demand.

MicroCHP was still in its early stage of deployment, and the lifestyle of the owner did not qualify for any of the testing programmes.

Solar pv to provide electricity was attractive to the owner as it provided a demonstration of distributed generation.

The owner had already minimised household electricity use with a total of 12 energy efficient light bulbs (including candles for wall lights and cooker). The fridge was A rated, freezer A*, washing machine A*. Computers and other electrical devices were turned off at the wall when not in use except the video recorder (on 1 watt setting) and the clock-radio. No other stand-by modes were used.

Because the back roofs faced SE and SW, both could be used for panels. These were fitted in April 2006.

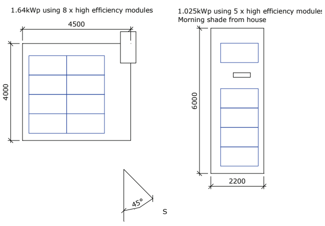
Solar panels — details

The contractor selected were Chelsfield Solar, of Kent.

The panels selected were Sony high efficiency panels rated 0.205 kWp each. The arrangement was for 5 on the back addition, facing SE, and 8 on the main roof, facing SW. This gives an installed rating of 2.665 kWp.

The cables from the back addition were run on the exterior wall into the roof to a DC-AC convertor, the cables from the main roof into a second converter, from whence the electricity was fed into a Landis & Gyr meter in the front corner of the living room adjacent to the main fuse box.

The electricity then exited the property onto the grid. The owner signed up to the Good Energy Home Generation scheme, obtaining 4.5p per



kWh generated.

The installation was made under the DTI Major Photovoltaic Demonstration Programme—Stream 1, which gave a grant of 50% of the eligible costs.

Energy Performance

A hand held monitor gave a spot reading for the amount of energy generated at any one time, a running total (less distribution losses—the meter was the final arbiter of this) and total CO2 saved to date.

The maximum spot generation noticed in the period April to September was 2576 Wp (impressively close to the total rated performance).

A number of attempts to monitor generation over a day were made, the results shown in the graph, where the black line shows the line of best fit for 11th June (the most complete set, a sunny day with some light cloud at times).

The SAP rating of the house was calculated using Builder™ software. The estimated rating before the loft top up, with the older gas boiler and with double glazing was 54. Before the solar panels were fitted, the house rated 63, and afterwards 74.

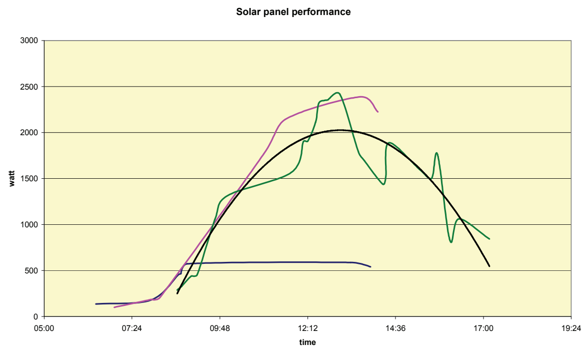
Because of the small wall area involved, external or internal wall insulation would have only added c 1 SAP point.

The total energy generated in the 47 weeks to 01/03/2007 was 2492 kWh, saving approx 1500 kg CO2.

The pattern of electricity use of the owner was 1250kWh a year, so the amount generated is around twice the annual usage, but of course, not at the times needed.

The amount of gas used went up 5% from 2004 to 2005, but dropped to 12% below 2004 in 2006.

Fixing the panels on the back addition roof



Difficulties encountered & Lessons learned

There were some delays to the start of the project as the available contractors in the area had waiting lists, and the grant programme experienced a rush of applications as it was nearing the end of its life. The new programme is now in place.

There were no problems with the installation, the scaffolding was put in place the day before and removed two days later without the need for the owner to be present.

The main difficulty is that the meter into the house from the grid started to run backwards and had to be replaced. It was some time before the owner or the supplier recognised this, which caused a problem in billing. The paperwork for the Home Generation scheme went astray but the company backdated the application to the start of the installation.

Issues relating to registration of generation were handled by Chelsfield Solar, who guided the owner through any paperwork necessary and the owner felt confident with them.

Lesson to be applied in future installations; check incoming meter regularly as well as outgoing meter to ensure both are working properly and make sense!

The total energy generated in the 47 weeks to 1st March 2007 was 2492 kWh, saving approx 1500 kg CO_2.

Comfort and ease of use

The home definitely felt warmer with the newly insulated loft and the new boiler, but the distribution of heat changed. The suggested reason is that the hot water pipes that had been under the upstairs floor, and the hot water cylinder ,had previously making a substantial (and expensive) contribution to the upstairs warmth.

The panels were a talking point and gave no trouble at all—self cleaning as the manufacturers said; no glare or reflections, no noise, and functioned well.

Billing caused a few problems as a result of the meter problems and because the owner had a prolonged period of absence , so use was overestimated.

The grant money came through without any problems, and the whole arrangement for the solar panels was excellent.

Some residual problems remained with the damp prevention, but consistent with the age of the house. There were no problems with storage in the well-insulated loft.

Completing the installation of the panels

Pett Projects

Mill House
Lenwade Mill
Lenwade
Norfolk NR9 5QA

Phone: 01603 879890
Mobile: 07963 189314
E-mail: pett.projects@btinternet.com
www.pett-projects.org.uk

sustainable energy and buildings research

Pett Projects carries out research projects and related services to promote and remove the barriers to implementation of sustainable energy and sustainable building in the community.

Sustainable energy implies:

- **Use low and zero carbon sources of power**
- **Use less fuel for the services needed**
- **Use efficiently generated power in the most efficient manner possible.**

Sustainable building implies developing new buildings and refurbishing old ones that:

- **Reduce their impact on the environment,**
- **Minimise resource use and waste,**
- **Make places that promote sustainable lifestyles.**

www.pett-projects.org.uk

Key contacts

Chelsfield Solar
66 The Highway
Chelsfield, Kent BR6 9DJ
Tel: 01442 211766

info@chelsfieldsolar.co.uk

www.chelsfieldsolar.co.uk

Energy Saving Trust
21 Dartmouth Street
London, SW1H 9BP
Tel: 020 7222 0101

www.est.org.uk
www.saveenergy.co.uk

Good Energy
Monkton Park Offices,
Chippenham, Wiltshire
SN15 1ER
Tel: 0845 456 1640
generation@good-energy.co.uk

www.good-energy.co.uk/renewable_generation.asp

Before and after: the completed solar pv panels on the back roofs