

Implementing sustainability initiatives - learning from the experience of the National Trust

The National Trust (www.nationaltrust.org.uk) can claim that they own and manage some of the most 'difficult to heat' buildings in the country. Five years ago the annual electricity bill for some of these properties would have made most business managers eyes water! However, in the last five years the organisation has embarked on an ambitious programme of investment of time and money into reducing their fuel consumption.

Ambitious targets

The National Trust has pledged to reduce their use of fossil fuels by 50 per cent by 2020. This move should cut their carbon emissions from energy use for heat and electricity by 45 per cent. The target will be met by reducing energy use for electricity and heating by 20 per cent and introducing 'grow your own' micro and small scale energy schemes using wood fuel, solar, heat pumps, hydro and wind.

The initiative involves the NT's entire in-hand building stock, which includes 300 major historic houses, office buildings, visitor centres and 360 holiday cottages.

They also plan to install more than 50 new wood fuel boilers into their mansions and larger buildings over the next five years. The fuel will be sourced either from their own estates or from local suppliers, with replanting and maintenance benefiting woodland and wildlife habitats.

Sharing their experience

Obviously the scale and nature of the National Trust's business model differs from that of most tourism businesses in Wales. However, there are still many lessons that can be learnt from their experience.

- **New technologies such as renewable energy systems can be successfully integrated into traditional, vernacular buildings**
- **Investment in energy efficiency must make good business sense:** The National Trust expect payback on the majority of their schemes within 7 years, even allowing for the huge variability in the price of energy and uncertainty over the future of grants and subsidies.
- **Buy-in from staff is essential to implementing a successful project:** By involving staff in the design and development of energy efficiency projects you can ensure they have the knowledge required to operate and manage the equipment in the future, to ensure the maximum savings of money and carbon are achieved.
- **Don't put renewables on an inefficient property: sort out the small stuff first:** Fitting automatic closers on doors, draught proofing windows and lagging hot water pipes, can save you an amazing amount of money for very little outlay.

A case study in the restoration of a derelict, listed building, incorporating renewable energy systems: Penbrenmydyr Cottage, Llanerchaeron

Pontbrenmydyr is a mud and thatch cottage, typical of those once found in the Dyffryn Aeron. It is thought to date from 1750 and is Grade II listed. Prior to restoration Pontbrenmydyr had been uninhabited for approximately fifty years and was urgently in need of careful restoration and conservation.



Penbrenmydyr Cottage before restoration

Prior to work commencing a full historic building survey was carried out, the results of which informed the design and management of the project. A full bat survey was also undertaken, which confirmed that no significant bat mitigation measures were required.

Design Approach

The project brief required the building work to be as sustainable as possible, this meant re-using materials, maintaining original features, reducing future energy consumption and installing equipment which reduced the building's dependence on fossil fuels.

All service runs to the buildings were buried to ensure that the external appearance of the building was altered as little as possible.

Key Features

250 mm of wool insulation was installed in the loft. Tri Iso 9 (multi foil, multi layer) insulation was trialed in areas of restricted head height.

All doors and windows were made as draught proof as possible.

A biomass pellet boiler was installed to provide the primary source of heating and hot water, combined with a solar thermal system. This decision was made following a comparison with the installation and running costs of an oil-fired boiler and a cost-benefit analysis. The solar thermal panels are predicted to produce around 1,770 kWh of heat a year, making a saving of around 566.4 kg of wood pellets per annum. The total expected heat energy consumption of the cottage is predicted at 2,308 kWh per year. There have been no problems with the installation or use of the combined biomass-solar heating system. The estate manager has been very satisfied with the operation, efficiency and maintenance requirements of the biomass boiler, which is expected to use around three to four tonnes of pellets per year.

A rainwater harvesting system was installed in the cottage to supply grey water to the toilet and garden tap. A water storage tank was buried under the lawn: this was fed by water from the gutters. The water is filtered at a number of stages before it reaches the toilet cistern, ensuring that the plumbing does not get fouled. The system has worked well although there have been occasional problems with the filters becoming blocked with silt.

An improved, preventative maintenance programme should stop this from occurring in the future.

Lessons Learnt

- The benefit of having a locally qualified and experienced service engineer was invaluable to the project.
- Placing solar panels on the ground in an adjacent field was the only option due to the cottage's roof being constructed of thatch. However, this positioning helped to preserve the aesthetic of the cottage and would be highly recommended for similar projects
- The solar hot water system has been very low maintenance, only requiring one annual maintenance check
- Maintenance of the biomass boiler has been minimal. This requires one annual service and two annual ash removals. The burner requires vacuuming once every 500 hours.
- The combined biomass and solar thermal system suits isolated holiday cottages and historic buildings. The key requirements are to have the space to store the fuel, a good quality supply of fuel and staff with the knowledge to operate and maintain the system.
- The rainwater collection system has performed efficiently, is low maintenance and is highly recommended for similar projects. Rainwater collection is significantly cheaper and simpler to install during a renovation project compared with retrofitting to an occupied dwelling.



Penbrenmydyr Cottage before restoration

A case study in improving heating controls to reduce energy wastage in holiday cottages: [Braich Melyn](#), [Fron Dirion](#), [Nant Las](#) and the [Siloam cottages](#)

As a group, the holiday cottages account for the highest electricity consumption of National Trust properties in Wales. Heating holiday cottages efficiently can be problematic for a number of reasons:

- They are often traditional buildings that can be difficult to insulate and draught-proof.
- Guests like to be able to control the temperature, but are unfamiliar with the



Siloam Cottages, nr Betws-Y-Coed, Conwy

heating system, or the thermal efficiency of the property.

- Properties can be empty for considerable periods and then be rented at short notice.

With 360 holiday cottages on their books the National Trust were keen to see if they could address some of these issues.

The 5 holiday cottages in this case study are all traditionally built, with solid wall construction and high levels of sheep wool insulation in the loft space. A mixture of storage heaters, oil panel heaters and fan heaters formerly provided heating in the cottages. Storage radiators tended to be left on to provide background 'welcoming heat' and frost/damp protection. This occurred even if the cottages were not due for occupancy, due to the possibility that they could be rented at very short notice. When occupied the existing storage heaters were often switched to their maximum output and could then be left on for days or weeks, especially if there were no follow-on bookings.

Design Approach

The National Trust wanted to reduce the energy wasted through unnecessary heating of the properties whilst maintaining the holidaymakers ability to heat the cottages as and when they required. The solutions had to be simple to understand, easy to fit and easy to use. In addition, the systems installed had to be capable to returning to a default setting after a pre-set period of time, when settings are overridden.

The solutions identified by the Trust were as follows:

- Installation of electrical panel heaters operated via a controller, which works in very much the same way as a boiler controller. The period of time that the heaters are on is timed and there is also the option of a one, two or three hour boost so that guests can over ride the system for a limited period. Frost protection is built in.
- Replacement of the towel rail/combined electric radiator with a lower wattage towel rail (60watt). The towel rail is controlled by a manual boost control that is operated by the guests 'as and when' required.
- Installation of a manual boost control to the wall mounted fan heater to prevent the guests from leaving it running. The boost control 'times out' after a pre-determined period.
- Installation of additional controls to the hot water heating. The systems are now timed with an additional boost button should further hot water be required.
- Installation of a water heating boost control in place of the existing controls to allow the hot water to be easily switched off when the cottages are not occupied. The simplicity of the system was important for the guests.



Operation and Maintenance

The equipment installed is operating well and offers increased management and control for both staff and guests. The panel heaters and their controls were easy to install and retro fit. In most cases storage heaters or oil-filled radiators were being replaced, so much of the hard wiring already existed. All of the equipment is hard wired in to the electrical supply and distribution board - therefore the only maintenance element is as part of the properties 5 yearly fixed wiring tests, which the original storage heaters also required.

Improved Energy Efficiency

Monitoring of energy consumption before and after any energy efficiency work is essential to enable the payback times to be calculated and benefits evaluated. Baseline 12 month monitoring for the meter at one of the Siloam cottages enabled an evaluation of the impact of the changes. Prior to the work the annual electricity consumption was 32,231 kWh, the consumption for the 12-month period after the changes was 18,193 kWh. Measured at a cost of 8 pence per kWh this meant an energy efficiency saving of £1,123 per annum, plus a carbon reduction of 6,036 kg. The cost of the equipment and installation fell well within the expected budgets and the payback time for the investment was 18 months.

Lessons Learnt

- Ongoing, regular monitoring of energy consumption via meter readings is essential if projects are to be planned, commissioned and operated in a way that delivers maximum savings.
- Improvements to heating controls deliver maximum savings if combined with improvements to insulation and draught proofing.
- Involvement of staff in the design and implementation of energy efficiency measures is a key part of ensuring the systems are operated efficiently post-installation.
- The use of 'Green Plugs' provide a simple and easy to install means of ensuring heaters are not left on whilst cottages are unoccupied. They operate on a 'push and go' system, the plug is pushed to start an in-built timer that after a set time switches off the power for an allotted duration.