SHELDRAKE PRESS

ENERGY CONSERVATION IN A VICTORIAN HOUSE

A technical advice paper by Denis Meehan, Director of Ecological Heating Ltd, to accompany the UK edition of *The Victorian House Book*

The most important way of reducing energy consumption is to contain the heat in your property. By retro-fitting insulation you can substantially reduce your heat loss. Approximately 25% of heat is lost through the loft, 35% through the exterior walls, 10% through windows, 15% through doors and 15% through floors. U-values are used to indicate the rate of heat loss through a construction element per square metre per degree of temperature difference. The lower the U-value the better. An uninsulated loft has a U-value of 2.6, whilst Building Regulations recommend 0.16. Although not all the values prescribed in the Building Regulations are practical for a Victorian house, some insulation is better than none. It makes sense to start with the areas where the greatest improvement can be obtained and attend to the rest in percentage order.

Lofts
Most unconverted Victorian houses have an open loft with, at best, a basic layer of insulation between the ceiling joists, which is nowhere near enough. To meet Building Regulations, you need either 10½ inches (270 mm) mineral wool, 10½ inches (270 mm) of sheep's wool insulation or 6½ inches (170 mm) of solid foam board. You can install all these yourself with minimum effort. Mineral wool is the cheapest, but airborne fibres can cause irritation while it is being laid. Sheep's wool is more expensive but is an environmentally friendly product and does not contain irritating fibres. Solid foam board is the most expensive of the three, but as it will probably fit flush between the existing ceiling joists, it will allow you to continue using the loft for storage.

Walls
Building Regulations recommend a U-value for external walls of 0.35, which is usually achieved by installing cavity-wall insulation. Victorian houses were built with solid brick external walls, which have a U-value of 2.1, so you cannot retro-fit cavity-wall insulation. If your property has an external finish such as painted render, you may be able to clad the outside walls with a solid insulation board which can be finished in a similar way to the original. Internally, you can clad the walls with an insulated plaster board which can be finished with plaster and decorated. Both methods add significant depth to the wall, so you would need to relocate window reveals, sockets, light switches, cornices, etc. To avoid such a major upheaval, you can use alternative products consisting of a thin layer of insulation. These can be pasted to the wall like wallpaper and then decorated over. They will not reduce the U-value by much, but some insulation is still better than none.

Windows and doors
Traditionally Victorian houses have single-glazed windows in wooden frames which can have a U-value as high as 4.8. Building Regulations recommend a U-value of 2, which can really only be achieved by fitting triple glazing! As just 10% of the building's heat is lost through the windows, however, spending a large amount of money on them will only bring small benefits. The simplest thing to do is to make sure they are draught-proofed, as wind

whistling through your windows can carry heat out of the room very quickly. Secondary glazing will produce a greater improvement. It consists of a second window mounted parallel to the first, which can be fixed or openable and made of acrylic or glass. As a temporary measure, you could use the most basic type of secondary glazing, available from most DIY shops, which consists of a plastic film taped over the windows and sealed with a hair dryer.

If your existing windows are in a poor condition, it may make sense to replace them with double-glazed units. These do not have to be ugly plastic ones as it is possible to manufacture modern Victorian windows with traditional frames. Whatever windows you have, it is always best to hang thick-lined curtains to help with insulation.

Building Regulations recommend a U-value of 2 for new external doors. The quickest and easiest way to approach this value with an old door is to ensure draught proofing is fitted around it. Hanging a large heavy curtain will further reduce the loss of heat. Building a porch is effectively double glazing for doors, as you have two layers with air trapped between, but it is expensive and again, only a small amount of heat is lost through doors.

Floors
Most uninsulated ground floors are unlikely to have a U-value below 1.1, whereas Building Regulations recommend 0.25. For a suspended timber floor this is achievable by insulating between the floor joists with a 4-inch (100-mm) solid insulation board. All floor boards will need to be removed, supports installed for the insulation and the floor relaid once insulation is complete. It is much more difficult to insulate a concrete floor. Doing this would necessitate excavation to a minimum depth of 1 foot 4 inches (400 mm), then laying a 4-inch (100-mm) insulation board over a sand blinding with concrete on top. If you choose this option, it is worth considering under-floor heating as the pipe work can be laid over the insulation before the concrete is poured on.

As only 15% of heat is lost through the floor, the most sensible improvement is to stop draughts coming through the gaps between the boards. DIY stores have products which are easy to apply. Alternatively, laying a natural fibres-based carpet and good underlay will also reduce heat loss.

Possible savings
To demonstrate the benefits of insulating these elements, I have used a three-bedroom terraced house as an example, and calculated the boiler size necessary to replace the heat lost with different levels of insulation:

Unconverted	27 kW
With loft insulation	22 kW
With wall insulation	20 kW
With double glazing	24 kW
If all three are implemented	13 kW

So it is possible to cut the heat loss by more than half!

Methods of heating
Most houses are heated by either a boiler or a cooker-boiler fuelled by natural gas, lpg or oil. The latest boilers use condensing technology to liberate more of the latent heat from the burnt gases and these are available in varying forms. In a small house or flat, a 'combi', or combination boiler, which produces instantaneous hot water could be an option, but it is only really suitable for properties with one bathroom. Installing a more efficient boiler, however, can only produce limited gains. Much bigger savings can be achieved by using more than one source of heat. There are numerous combinations of renewable technology that can be integrated with traditional heating methods. For example, solar-thermal panels, air-source heat pumps, ground-source heat pumps and biomass boilers can be linked together in varying combinations to produce optimum energy generation for your house.

Solar panels for heating
Solar-thermal panels convert daylight into heat which is transferred to the hot water cylinder, so providing up to 65% of your annual hot water needs. In some instances they can make a contribution to heating. There are two main types of solar-thermal panels: vacuum tubes, which are the more efficient but do not blend in well with their surroundings; and flat-plate collectors which can be roof-mounted or built in like a skylight and are the preferred type in areas of planning sensitivity. Solar panels are best sited on a south-facing pitched roof or a frame on a flat roof, although deviations to the east or west do not affect performance too much.

Heat pumps
Ground- and air-source heat pumps harvest low-grade heat from the environment and turn it into high-grade heat useful in the home. Heat pumps work on the same principle as your fridge, which is kept cool by taking the heat from inside and expelling it outside; this is why the back of your fridge is always warmer than the rest of the room! Ground-source heat pumps use collectors buried in trenches or sunk into bore holes in the garden, but a large amount of space is needed for the trenches and the bore holes are expensive to drill; the heat pump itself needs to be sited indoors, in a garage or utility room. Though cumbersome, ground-source heat pumps are very efficient. They have a seasonal coefficient of performance (COP) of 4.3, which means that for every 1 kW of electricity used by the pump, 4.3 kW of heat are generated. Air-source heat pumps are similar in design to an air conditioning unit and are easily sited outside the property, but they are not as efficient as ground-source heat pumps. They have a typical COP of 3.8.

If you are lucky enough to have a large body of water nearby you can use a ground-source heat pump to gather heat from the water rather than digging trenches or bore holes. If it is a river, permission must be gained from the Environment Agency. Collector size will be smaller as water has better heat-carrying properties than the ground. Heat pumps work at lower temperatures than traditional heating systems, so are better suited to well-insulated properties with under-floor heating. They can be used with radiators but these are normally considerably larger than average.

Biomass
Biomass is a renewable energy source, a biological material derived from living or recently living organisms, such as wood. The three main domestic fuel types are logs, wood chips and manufactured wood pellets. Boilers and stoves with back boilers can use logs as their fuel but normally need to be manually loaded. Boilers using wood chips or pellets use large hoppers to store the fuel supply and can be left to run for long periods without attention. Wood is a

low-carbon fuel – carbon dioxide emitted when the fuel is burned is the same amount as was absorbed as the tree was growing.

Heat store
To link various heat-supplying appliances together you may need a thermal store. This consists of a large cylinder which stores heating water rather than domestic hot water, and enables the appliances to generate heat in a more efficient way. Heat pumps need a specially designed cylinder, as lower heating temperatures take longer to produce hot water.

Solar panels for electricity generation
Solar photovoltaic panels use daylight to generate electricity which can either be stored in batteries or exported to the National Grid if not being used in the home. These need to be south-facing on a pitched roof or a frame on a flat roof. At the moment these panels are a relatively expensive option: to generate 1 kW of electricity, approximately 7m² of panels are required.

Combined heat and power
Micro-combined heat and power units are boilers which generate electricity from the excess heat in the flue gas. They use a Stirling engine, also known as an external combustion engine, which is attached to a small generator, normally of 1 kW. This technology is very new and still being developed by most major manufacturers, but in the coming years will probably displace traditional gas boilers.

Heat recovery
Heat-recovery systems capture the heat that would otherwise be lost from air expelled through extractor fans. These systems remove stale air and bring in fresh air without a major loss of heat, normally using a large centrally mounted unit fed by ducting from bathrooms and kitchen.

Energy-saving devices
Replacing incandescent lamps with fluorescent or LED equivalents is a simple method of reducing energy consumption in the house. Although more expensive, they will last considerably longer and will normally pay for themselves within one year.

Smart meters display power usage on a screen mounted in a prominent position so that you can identify and modify wasteful habits. Your energy supplier may be able to provide these, or you could consider buying products such as an Owl meter, which are widely available.

Grants for renewable technology systems are available from either local or central government and vary constantly, so research is advised to establish your eligibility.

Installation of any of the following qualifies for a 5% rate of VAT: controls for central heating and hot water systems; draught insulation; insulation on walls, floors, ceilings, lofts, etc; solar panels; wind turbines; water turbines; ground-source heat pumps; air-source heat pumps; micro-combined heat and power units; and wood-fuelled boilers. You can only get this lower rate if the energy-saving materials are installed and in your home. You will be charged the lower rate on the installation work as well as the materials. The following are NOT covered by the scheme: energy-efficient boilers; secondary or double glazing; low-emission glass; energy-efficient fridge-freezers; materials and equipment that you buy but do not install.

Denis Meehan *read engineering at Durham University and now runs Ecological Heating Ltd, 138 Broomwood Road, London, SW11 6JZ, tel. 020 7193 3264, mobile 07543 345 400, e-mail contact@ecologicalheating.com, web-site http://ecologicalheating.com.*