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Energy Conservation in historic houses:
A Guide for historic house owners

Produced for the joint Historic Houses Association and Smiths Gore seminar *Climate Change – Changing Historic Houses*

Energy Conservation in historic houses: A Guide for historic house owners May 2009

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This information pack contains the main findings of the Historic Houses Association and Smiths Gore survey on energy efficiency in historic houses, carried out by Dr Jason Beedell, and a guide to energy conservation in historic houses, written by Lee Evans, Senior Sustainability Consultant at Smiths Gore.

We hope you find this information useful and informative, and that it encourages you to increase the energy efficiency of your house.

If you have any questions about the survey, please contact Dr Jason Beedell of Smiths Gore on 01733 866562 or jason.beedell@smithsgore.co.uk .

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Results of the HHA / Smiths Gore survey of energy use and efficiency in 46 historic houses

The survey of 46 historic houses was carried out between September 2008 and February 2009, and includes houses from England, Scotland, Wales and Northern Ireland.

Most of the houses are large, with more than 28 rooms; there was not a significant difference between the responses for them and smaller houses, which account for about a third of the responses.

The survey considered energy consumption, insulation, windows and doors, heating systems, lighting and use of renewable energy.

There is a range of measures that can be taken to improve the energy efficiency of historic houses, even with the restrictions on them, such as Listed Building status. Good levels of energy efficiency can protect the sustainability of the houses, both of the fabric and function, and ensure that the house owners achieve affordable warmth.

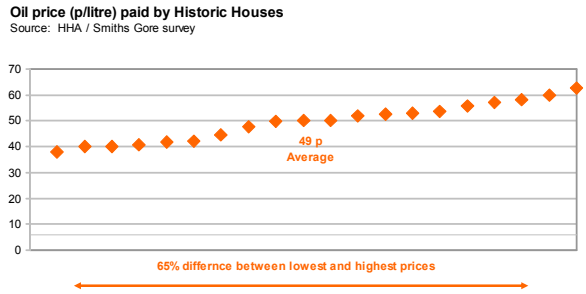
To put energy use and efficiency of historic houses into context, the houses are not immune to the effects of climate change; they contribute to it through burning of fossil fuels for heating and hot water, they are affected by extreme weather and also by rising fuel costs.

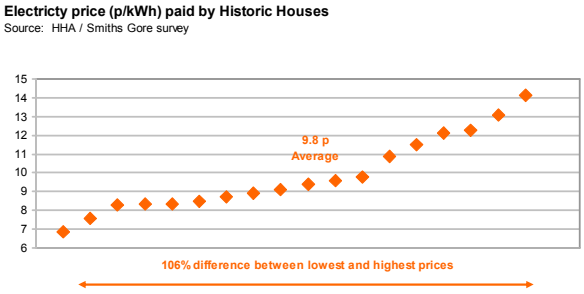
The main findings of the survey are:

Energy consumption and bills

1. The average energy bill is £14,773 per house and it could be more. This means that the houses are significant energy consumers. Also, it means that any energy savings made, can have a bigger effect on bills.

2. This amount of energy represents 55.5 t of CO_2.





Monitoring

3. In most houses a family member (64 %) is responsible for checking bills and monitoring energy consumption. But do the family members know what to look for? They should look at whether consumption is increasing or decreasing and identify unnecessary drains, such as lights left on, inefficient appliances and pumps running continuously.

Boilers

4. Half the boilers (48 %) were less than 10 years old, so they are likely to be efficient and most are serviced annually so their efficiency and safety is maintained.

5. 40 % of new boilers are conventional boilers as opposed to condensing boilers. This may be due to fitting issues or cost. Condensing boilers are significantly more efficient than conventional ones.

6. A fifth of boilers were over 20 years old so there is an opportunity to replace them with more efficient modern ones.

Controlling and insulating the heating system

7. A significant minority of houses do not have effective control of their heating systems.

8. Most houses had insulated hot water tanks (91 %) and lagged hot water pipes (72 %). This is positive especially if modern, efficient insulation is used. But 10-20 % of houses do not have this insulation and should fit it.

7% not insulated

Min 75mm thick (EST)

22% not insulated

24% no controls

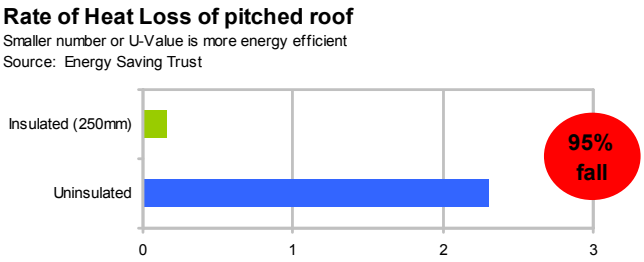
9. Most heating systems (84 %) were controlled by a timer – but 13 % were not on a timer. Where a timer is installed, ensure that its settings are correct and change with seasons, weather and demand.

10. 20 % of heating systems have no thermostatic controls – these are cheap and relatively easy to install.

11. Most radiators had individual heating controls but a quarter did not. Installing controls can a very cost effective way of using heat where it is needed.

Insulation

12. A third of houses don't have any roof insulation. Where there is insulation, it is old (50 % of it is 10 years old or more) and so likely to be thinner than the 250-270mm now recommended. The rate of heat loss from roofs can be reduced by over 90 % by insulating them.

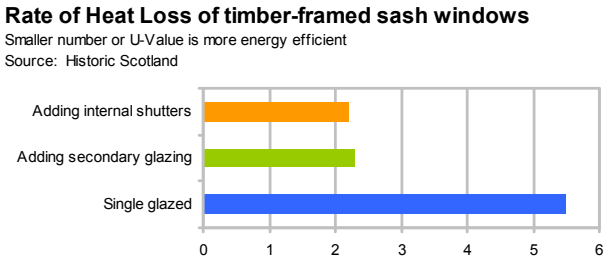


13. 80 % of houses do not have cavity walls. Where houses did have cavity walls, most were not insulated. Internal insulation is something to consider in refurbishments and cavity insulation in new build work.

Windows and doors

14. There was little use of internal shutters, which can halve heat loss through a wooden framed sash window, as well as being useful for security.

15. Less than 5 % of houses had draught proofed a significant proportion of their windows. Good draught proofing can reduce the number of air changes per hour from 2.5-3.0, the typical standard of a sash window on an exposed site, to 0.4.



Lighting

16. The houses in the survey had an average of 313 bulbs each – with some houses having over 700 bulbs.

17. 62 % of the bulbs being used in the houses are incandescent light bulbs. These bulbs are not going to be sold by 2011 and 75-100W bulbs should not now be sold. So alternatives will be needed.

18. In the houses surveyed, it is possible to cut electricity for lighting by 48 % by changing the bulbs about to be phased out - a typical saving of £1,400 per annum at a cost of £1,600 so a payback period of just over 1 year.

19. Another benefit of changing to low-energy bulbs is their much longer-life which can save a lot of time changing bulbs. For example, a candle bulb may have an expected life of around 1,000 hours compared with around 6,000 – 15,000 hours for a low-energy equivalent.

Renewable energy

20. A fifth of the houses had installed at least one type of renewable energy technology and many had installed more than one. The most popular types installed were biomass boilers, solar thermal panels and hydro electric power.

Biomass boilers

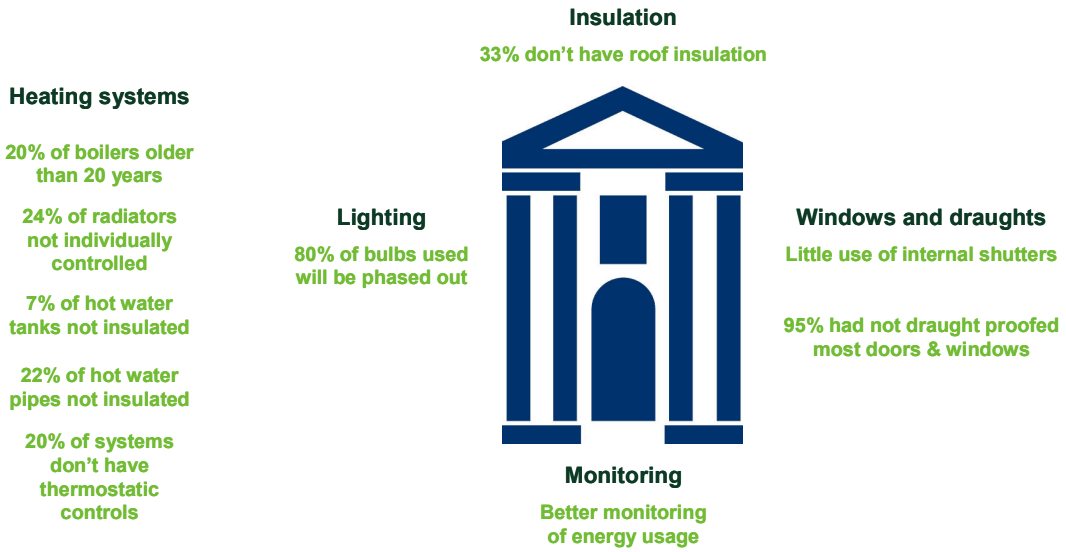
Solar thermal panels

Hydro-electric power

21. Almost all (98 %) of the house owners would consider installing renewable technologies.

Summary

22. Historic houses can typically save 10-25 % of energy costs by employing low-cost or no-cost measures – equivalent to £1,500-4,000 pa on bills, saving 8-14 tonnes of CO_2.



Can save 10 - 25% of energy costs at low-cost or no-cost

Equivalent to 8 - 14 tonnes of CO_2 per house a year

A typical household generates 6 tonnes

Energy Conservation in historic houses: A guide for historic house owners

Introduction

Building conservation and energy efficiency are both key aspects of sustainability. Government figures indicate that home energy use is responsible for 27% of the UK's carbon dioxide emissions which contribute to climate change[1].

It is vital that historic houses balance the need to reduce energy load and increase efficiency against the need to conserve the fabric and contents of the house. There is no reason why historic homes should not be reasonably efficient, comfortable and healthy and it is possible to increase energy efficiency of historic houses without compromising historic character. The most important factor is to strike a balance between character and retention of the original fabric, energy conservation and the needs of house users.

In England and Wales Part L of the Building Regulations requires that sensible and reasonable energy efficiency measures be incorporated during refurbishment work. With historic houses, the Building Regulations in England and Wales permit building control officers to adopt a 'reasonable' approach.

The average historic house surveyed was found to emit 55.5 tonnes of CO_2 per annum. This is the equivalent to the emissions produced by over nine average UK houses[2].

Reducing energy load and maximising energy efficiency will deliver both environmental and financial savings. Smiths Gore's experience and recent survey shows that historic houses can typically save between 10 – 25% on energy consumption through the adoption of low-cost and no-cost measures.

Conducting Energy Efficiency Projects

The following table outlines Smiths Gore's suggested approach to conducting energy efficiency improvement projects in historic houses.

Action	Details
Identify	Areas requiring improvement and the likely solutions
Liaise	Consult planners, building control and conservators
Prioritise	Prioritise improvement actions according to suitability, achievability and energy savings
Implement	Ensuring to obtain any necessary permissions
Monitor	Monitor progress and review the success of any actions

[1] Energy Saving Trust (2007)
[2] The carbon footprint of the average UK house is 6 tonnes of CO_2 annually (Energy Saving Trust, personal communication)

Identifying and Monitoring Energy Consumption

Monitoring energy costs will allow Historic Home owners to identify main areas of expenditure, the areas to concentrate on and the results of any energy saving measures. It is essential to establish volumes currently used, usage patterns, seasonal changes and to provide bench marking data.

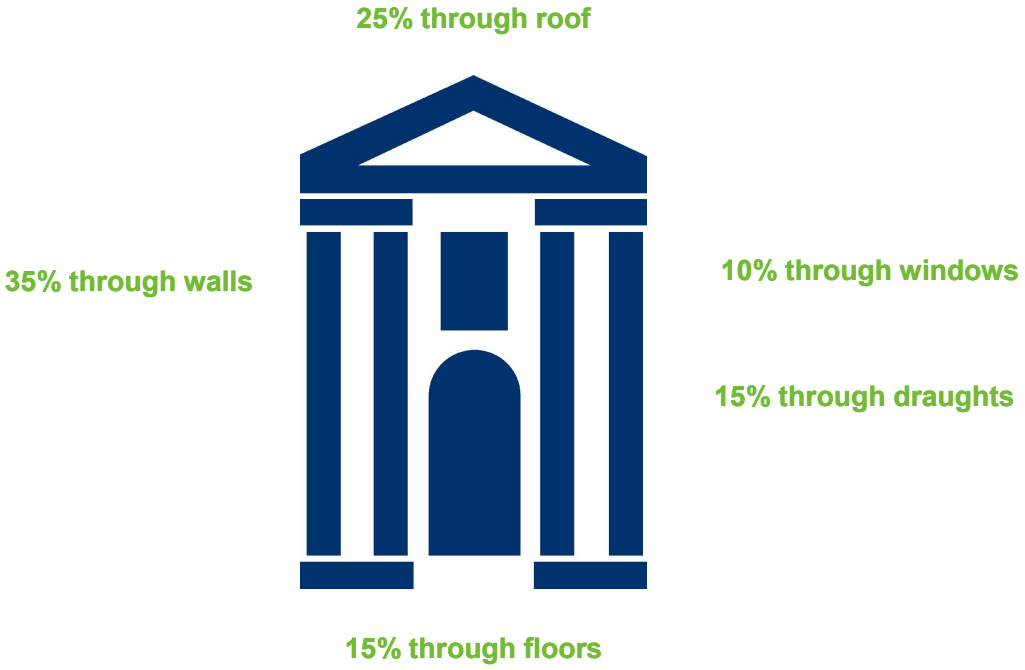
Actions to improve monitoring of energy consumption

Improvement area	Recommendation
Energy management	Appoint an on-site energy manager responsible for monitoring and controlling energy consumption (as part of job description).
Monitoring electricity	Record weekly electricity meter readings in order to establish a clear consumption pattern.
	Compare day and night consumption (overnight readings for electricity usage should be low as most lights and appliances will not be in use).
	When renegotiating electricity contracts, consider profile in relation to usage data.
	Consider smart meters or sub metering for larger houses.
Monitoring Oil and LPG	Where possible, record monthly usage.
Energy management	Interpret all monitoring data and develop appropriate action points in line with information provided below.

Heat loss in historic houses

Once heat is generated, it is lost from historic houses in two ways; through the fabric and through ventilation. The following chart highlights the areas where heat is lost in Historic houses.

Areas of heat loss for typical historic house[3]



Generating heat as efficiently as possible and minimising the rate of heat loss are two of the most effective and viable ways of reducing energy consumption and hence costs in historic houses.

[3] Figures adapted from Energy Saving Trust and Smiths Gore's experience.

Insulation

The amount of heat wasted in homes annually through un-insulated lofts and cavity walls is enough to heat 1.8 million UK homes[4].

Insulation is typically the most environmentally beneficial and financially viable option when minimising the heat wasted from a property and maximising heating efficiency.

Insulating Roof Spaces

Recommendations	Approx payback period (years)
Conduct an exercise to identify all accessible roof spaces and existing levels of insulation and appropriate insulation type.	NA
Insulate accessible loft spaces throughout.	1-3
Insulate inaccessible roof areas using blown insulation.	2-4
Insulate the underside of any flat roofs where access can be gained or during any refurbishments or maintenance work.	3-5

Considerations

A roof with no insulation loses around 25% of a historic house's heat. The type of insulation used is usually dictated by its affect on moisture levels, personal preference, budget and access to roof space.

It is very important that ventilation of loft space is maintained. It is essential to ventilate the roof structure between any insulation and the roofing felt with continuous air gaps along the eaves and at the ridge. Special ventilation tiles are available for ridge ventilation.

When insulating between eaves it is essential to cross-ventilate the attic space to prevent condensation by leaving a continuous air gap along the eaves at each side.

When insulating roof spaces ensure that any roof located tanks and pipes are insulated over - and not beneath - in order to prevent winter freezing.

English Heritage do not recommend the use of mineral wool for roof insulation, although it is used in many Historic Homes. Organic insulation materials (such as sheep's wool and flax) allow moisture to escape, but they are more expensive and greater thicknesses may be required to achieve the same thermal performance as modern, man made, high performance insulation materials.

[4] Energy Saving Trust (2007)

Roof insulation does not require any formal permission (regardless of listed status). Roof vents may require planning permission (although purpose built vents are designed to be sympathetic and unobtrusive).

Modern insulating materials often have a high global warming potential due to substances used in their manufacture or composition.

In historic homes it is not usually possible to achieve the ideal of a uniform level of insulation around the building. This means that there are likely to be gaps known as 'thermal bridges' that can channel and allow heat to escape. Thus all gaps in insulation should be eliminated (or minimised as far as possible).

Insulating Walls

Recommendations	Approx payback period (years)
Consider opportunities for internal insulation for solid walls during any refurbishment projects.	4-7
Insulate any cavity walls, if present.	2-4

Considerations

Up to 35 % of heat loss occurs through external walls. Walls vary in construction and materials and this obviously affects how and if they can be insulated; solid walls are more difficult to insulate than cavity walls.

Insulating walls can reduce heat lost through them by 60 %. Insulation may be placed on the outside, in the cavity or on the inside of a wall, but most historic houses have solid walls and so only internal insulation can be considered.

Internal insulation involves fixing insulation to the inner surfaces of external walls. Internal dry lining is likely to be the only viable option for the solid walls of historic houses. This technique is generally only viable where the original wall lining is absent or needs to be replaced.

It is very important that all materials used to insulate walls of traditional buildings are compatible with the breathing performance of the wall. Insulation must be designed to allow walls to continue to breathe. Cement based renders, foil backed insulations, glues and impervious paints can all trap moisture in walls. Non-breathable materials should be avoided.

Methods include fixing insulation boards to the wall and covering with a vapour barrier and plasterboard. Alternatively, composite boards of plasterboard backed with insulation and incorporating a vapour barrier may be fixed to the wall.

The work is quite labour-intensive and may involve the repositioning of skirting boards, any electrical sockets or switches and other wall attachments for existing walls.

Internal insulation reduces room space. This limits the permissible thickness of insulation in existing buildings. If room space is a factor, high-performance insulation should be preferred.

Internal insulation costs more to install than cavity insulation and, because it is generally installed in smaller thicknesses, energy savings will be lower.

If the walls suffer from rain penetration this problem must be remedied prior to insulating.

Thermal bridges should be avoided at junctions with walls and floors.

When making decisions regarding wall insulation it is important to note that internal insulation isolates the thermal mass from the room reducing both the response time of the heating system and the energy required to reach comfort levels in the room. Occupancy patterns, the response time of the central heating and its controls and the optimal thermal mass of the building will determine the appropriate action.

The local conservation officer should be consulted and the installation of wall insulation is subject to the satisfying of the local planning or building control department. Listed building consent may also be required.

Insulating Floors

Recommendations	Approx payback period (years)
Consider opportunities for insulating floors from beneath during any refurbishment projects.	3-5

Considerations
Ground floors can account for 15 % of heat loss from historic homes. Whether these are solid or suspended timber floors, it is possible to insulate them and reduce this heat loss. Insulation can be installed from either above or below the floor; the type of insulation used will depend on the floor type. When insulating floors from above, the insulation is visible and so it has to be carefully selected and, in many cases, will be inappropriate.

Windows and draught proofing

Draught proofing

30% of heat loss in historic houses can be caused by ventilation and draughts and this can be significantly reduced by fitting British Standard quality draught proofing to all windows and appropriate doors.

Draught proofing is one of the most inexpensive yet effective ways of making efficient use of energy in historic houses. It will often pay for itself in one to three years.

Sealing draughty gaps in traditionally built homes is unlikely to cause problems associated with over-sealing, as the fabric of the building is porous. Draught proofing is relatively unobtrusive and involves little or no removal of original materials. Listed building consent is not required for draught proofing historic buildings.

General Considerations when draught proofing

Recommendations	Approx payback period (years)
Ensure a thorough understanding of the breathability of the historic house prior to any large scale draught proofing exercise.	NA
Ensure that all draught proofing products are correctly fitted.	NA
Do not draught-proof windows in bathrooms, kitchens, and utility rooms where lots of water vapour is produced and high levels of ventilation are required.	NA
Fit only durable high quality draught proofing, as low quality products may only last a year and represent poor value for money and effort.	NA

Considerations
Older properties, and especially historic buildings, need to 'breathe' through the entire envelope, allowing moisture to escape. Typically, moisture from the walls and ground floors of an historic building evaporates into the structure itself. In these cases, heating and adequate ventilation allow the moisture to escape. English Heritage states that the main risks to historic buildings when making energy efficiency improvements are: Moisture trapped within the building materials; Condensation within unheated areas of buildings; Condensation at thermal bridges, especially corners; and Ventilation and heating which are insufficient for removing moisture.

Draught proofing windows

Energy is lost through windows by heat passing through the glass and by warm air escaping though gaps in and around the frames.

Active maintenance and draught proofing usually provides the best option. The benefits of simple repairs should not be underestimated and are the best place to start with any window improvement. Much of the heat lost through windows is actually through leaks and the resulting draughts are a disproportionately large source of discomfort.

Recommendations	Approx payback period (years)
All windows and skylights should be regularly inspected and repaired; free windows to open and shut properly, repair broken glass panes and close gaps around casements and sashes.	1-3
'Wiper' or 'brush' should be fitted to sliding sash windows. These surface mounted seals form an effective barrier to air movement around perimeters without creating excessive friction.	1-2
Consider secondary glazing where practical.	3-4
Consider installing wooden shutters to windows.	3-5
Ensure that shutters and curtains are closed at night.	NA

Considerations
Providing old windows with effective draught stripping yields great benefits. In most cases draught stripping is not a DIY job and specialist help should be sought. More complex systems of draught proofing involve integral channels in window frames. This involves the removal of the windows but this can be carried out rapidly on site. The benefit of shutters and curtains is often overlooked; working shutters cannot match the performance of modern double-glazing, but can make a big difference. They are also attractive features which add to the value of the home. Heavy curtains, if drawn at dusk, will also reduce heat loss. Secondary glazing is generally acceptable to building conservators provided the work is not damaging or permanent. Some systems sit quite a way from the original window causing intrusion into the room, loss of window ledge space, loss of use of internal shutters, the need to reposition blinds or curtains and a reflection that is sometimes visible externally. Systems that sit directly against the main window are therefore often preferred.

The style of secondary glazing should always compliment the existing window. Listed building consent may be required for secondary glazing (dependant upon grade and the local authority).

Secondary glazing should still allow access to the original window and safety should be considered (in terms of being able to escape in an emergency).

Secondary glazing can also improve sound insulation.

Double or triple glazed windows are rarely permitted in historic houses due to the appearance of both the frames and the glazing.

The thermal efficiency of a building's envelope is defined by its U-value; it is a measure of the rate of heat loss through the material. The lower the U-value, the greater the thermal efficiency. The following table highlights the typical U values of various types of window.

Window type	**Typical U value**
Timber-framed single glazed sash windows	5.5
Timber-framed single glazed sash windows with secondary glazing	2.3 (using the most efficient systems)
Timber-framed single glazed sash windows with closed well fitted wooden internal shutters	2.2
Modern double or triple glazing	3.1–1.3

Draught proofing doors and flues

Recommendations	Approx payback period (years)
All loft hatches, external doors or doors between heated and unheated areas should be fitted with draught exclusion products such as brush strips or rubber compression seals.	1-2
Identify any open unused flues and reduce heat loss and air influx using a 'balloon and cap' system.	2-3

Considerations

Heavy curtains, brush seals and even sausage-shaped excluders are effective draught reduction measures.

It is wise to invest in cowls or chimney pots and minimise openings at the throat of the chimney.

Care is needed to prevent moisture becoming trapped if sealing redundant flues. Ventilation into the chimney is needed to help remove any moisture. Condensation can form in the chimney above roof level on damp cold brickwork. Similarly if the stack is against an external wall the cold air could result in condensation forming.

Draught proofing floors

Recommendations	Approx payback period (years)
The simplest method of draught proofing floors is to seal floor and skirting board gaps using gunned mastic type material.	1-2

Draught proofing ceilings

Recommendations	Approx payback period (years)
Identify and draught proof ceiling cracks and holes.	1-3

Considerations
Draughts often enter or leave via cracks and holes in ceilings, particularly around pipes and cables and around recessed light fittings. The sealing of such cracks and joints as part of an insulation package can reduce draught levels significantly. Cracks should be sealed to prevent moist air from bathrooms and kitchens entering the roof space and adding to the risks of condensation, especially from areas of high humidity such as bath and shower rooms. Spider's webs will often identify areas where ceiling draughts exist as spiders like to build their webs in areas of air movement.

Heating and controls

On average, over 70 % of energy used by Historic Homes is used for space and water heating.

Boiler Efficiency

Typically, replacing a fifteen year old boiler with a new high efficiency condensing model will save around 30 % on heating costs.

A high efficiency condensing boiler works on the principle of recovering as much waste heat as possible. This is normally wasted from the flue of a conventional (non-condensing) boiler. The best high efficiency condensing boilers convert more than 90 % of their fuel into heat, compared to an average of 78 % for conventional types.

Recommendations	Approx payback period (years)
Ensure that the existing boilers are effectively maintained and that efficiency is tested and reported annually.	0.5-1
Replace all boilers over 15 years old.	2-6
Consider replacing any conventional boilers with condensing systems.	NA
Ensure all exposed pipework is lagged and that any concealed pipes are insulated during refurbishment works.	1-3

Considerations
The main consideration when installing a modern condensing boiler in a Historic Home is the siting of the boiler flue. The flue should not be sited where it can be easily seen and existing flues should be utilised where possible. The local authority planning and building control departments should be consulted in order to establish whether any formal permissions would be required.

Heating Controls

A full set of heating controls is essential in order to ensure a boiler is only turned on when it needs to be and generates as efficiently as possible.

Fitting the correct heating controls and appropriately operating them can save between 10-20 % of heating costs in Historic Homes.

Recommendations	Approx payback period (years)
Ensure that heating systems are properly controlled either as part of a Building Management System or, more typically, have a time programmer, room thermostats, hot water cylinder thermostats (if conventional system) and thermostatic radiator valves (TRVs).	0.5-2
Appoint and appropriately train an individual to control the heating system, clearly define that individual's role and inform others of this appointment.	NA
Ensure that any boilers communicate appropriately and are operated in the most efficient manner. Ensure that thermostats are appropriately positioned. Ensure heating regimes reflect seasonality, current activities and requirements. Ensure that electrical immersion systems are turned off when not required i.e. when there is no hot water requirement or hot water is being provided via the boiler.	
Where immersion systems are regularly operated, fit and appropriately operate timers.	1-3
Ensure hot water tanks are fitted with thermostatic controls.	1-3

Considerations
The temperatures recommended in open houses (17˚C–22˚C) are governed by the comfort of people. When people do not have to be considered, the temperature can be controlled to give the required relative humidity (see next section for further details). Low temperatures (below 5˚C) should be avoided for paintings, since the paint becomes brittle when it falls below this temperature and may crack if the painting is moved.
Programmable thermostats, room thermostats and thermostatic radiator valves all need a free flow of air to sense the temperature. They should not be covered by curtains or blocked by furniture. Nearby sources of heat such as woodburning stoves, AGAs and lamps could also stop them from working properly.

As a guide for open historic houses the National Trust recommends that:

- The minimum temperature limit should be 5˚C in winter. If ambient temperature falls below this, heating should be used regardless of relative humidity.
- In winter an upper air temperature limit of 18˚C is recommended. At this point, heating should be switched off regardless of relative humidity (as an energy efficiency measure).
- In summer maximum air temperatures should be limited to 22˚C.
- Do not exceed the 12˚C for conservation heating.

Most thermostatic radiator valves can be fitted on either flow or return units. It is important that boiler manufacturer's requirements are checked before fitting thermostatic radiator valves, because some boilers require that a minimum water flow rate is maintained at all times. Such boilers will require that a system bypass or an automatic bypass valve is fitted.

Wall mounted thermostats and thermostatic radiator valves generally operate well together; the wall thermostat determining the maximum temperature for the house and the radiator valves allowing room by room variations on that limit.

Relative Humidity (RH) Control

This is recognised as extremely important for historic houses and, as such, significant resources are often directed at the management of RH.

The majority of conservation scientists agree that for the conservation of artefacts, it is less important to control temperature than RH. In general, lower temperatures are preferred, since they reduce the rate of chemical and biological change. In these controlled temperatures, hygrometers or humidistats are used to measure RH to ensure it does not rise above the levels recommended by conservators (often 50-65 %).

Conservation heating

Conservation heating is the main form of RH control used in historic houses. This form of heating usually utilises electronic humidistats instead of thermostats. Electronic humidistats are available with small switching differentials that can be incorporated into controllers with built-in temperature limits. As a general rule, the RH inside a building can be maintained at around 60 % by ensuring that the internal temperature is maintained at 5°C above the external temperature.

Comfort heating

In domestic conditions, when comfort heating is required, heating systems are controlled by thermostats, but constant temperature does not give rise to constant RH.

The majority of objects found in historic houses are made from materials that do not respond to rapid changes in RH. It is recommended that for comfort heating during the winter, the heating should be turned on for as short a time as possible.

Conservation heating versus electrical dehumidification

The National Trust has conducted some useful research in this area[5]. Dehumidifiers were used to control RH in spaces that did not require heating for human comfort. Monitoring carried out showed that dehumidification used as little as one-fifth of the energy input of heating for the same measure of RH reduction using heating. The study demonstrated the need for well-sealed spaces when using dehumidification and found that it was much less effective in rooms in historic houses; which are designed to have high levels of ventilation.

Heating in buildings is generally less damaging than environmental control systems that alter the internal air moisture content, since it is changes in vapour pressure that set up the gradients within walls resulting in the movement of water molecules, leading to condensation and soluble salt transport. The study concluded that room-based humidifiers or dehumidifiers, should be avoided unless the units can be contained within sealed structures, such as exhibition cases or polyethylene tents in storage areas.

The impact of the appearance of environmental control equipment in historic houses is also important. The thoughtless selection of radiators, heaters and monitoring devices and their positions in a room, can have a significant impact on aesthetics.

[5] Conservation Heating to Slow Conservation: A Tale of the Appropriate Rather Than the Ideal, Sarah Staniforth, Contribution to the Experts' Roundtable on Sustainable Climate Management Strategies (2007).

Recommendations	Approx payback period (years)
If RH is directly controlled, identify the RH range currently set within the system. Aim for an appropriate rather than an ideal environment and ensure parameters are adjusted seasonally. Consider broadening target RH and temperature bands to maintain an appropriate environment and improve energy efficiency. On hot days, close shutters in unused rooms to prevent RH becoming too low. In the summer, when RH becomes low because of solar gain, open doors and windows. On wet days, if large numbers of visitors are to be received, then they should be asked to remove all wet raincoats at the entrance (ideally with a specialist cloakroom provided).	NA

Considerations
The upper limit of 65 % is the level below which most moulds will not grow and the lower 50 % limit is the level below which significant shrinkage and desiccation may occur in wood and glues. Where a system of RH control is used, it should be set at a particular point around which the RH will fluctuate within the target band. The National Trust consider 'good' RH control to be when the RH is within the target band for more than 90 % of the time. When conservation heating is replaced by comfort heating, RH levels may fall below the desired 50 % ; this is unlikely to cause damage for short periods (e.g. six hours per day during colder months) but could cause problems if humidity is lowered for longer periods. Systems can be managed to switch off comfort heating when RH falls below 50 % . Windows should not be opened if the inside of the house is colder than the outside, as this will increase the risk of condensation.

Lighting

The type of lighting utilised has a significant effect upon electricity consumption. Lighting and appliances can account for up to 40% of energy consumption in historic houses.

No formal permissions are required when upgrading lighting in historic buildings and traditional incandescent lamps are to be phased out completely in the UK by 2011[6].

Low-energy lighting

Many traditional lamps (or bulbs) and candle lamps utilised in historic houses are inefficient at 50 - 60 Watts. These can be replaced with modern Compact Fluorescent Lamps (CFLs) or Light Emitting Diode (LED) based lights that use between 2 Watts and 20 Watts of electricity and can last up to 40,000 hours (40 times a normal Halogen spot) saving between £60 and £200 over the life of a fitting.

A chandelier fitted with 21 40W bulbs that is on for six hours per day on average will consume over £160 of electricity per annum[7]. If fitted with 12W low energy lamps electricity costs could be reduced by over £110 to £50 per annum.

This saving does not consider that modern efficient lamps can last over ten times as long as traditional lamps and so costs are further reduced as there are fewer lamp replacements and maintenance time is minimised.

Natural light

Access to sunlight and daylight helps to make a building energy efficient; effective day lighting will reduce the need for electric lighting, while winter solar gain can meet some of the heating requirements (although excessive summer solar gain can also be an important consideration). The quality and quantity of natural light in an interior depends both on the design of the interior environment (size and position of windows, depth and shape of rooms, colours of internal surfaces) and the design of the external environment (obstructing buildings and objects).

Recommendations	Approx payback period (years)
Replace standard 50-60W GLS bulbs with good quality 20W CFLs.	1-3
Replace 40-50W candle bulbs with good quality 15W CFL equivalents.	
The use of small halogen spot lighting should be avoided. LED or CFL fittings should be used if spot lighting is desired.	
Do not use heavy light shades or protectors that detract from the intensity of the lamp.	NA
Ensure that all lights are turned off when not required.	
When replacing external flood lighting, consider LED equivalents.	2-5

[6] Hilary Benn, Secretary of State for Environment, Food & Rural Affairs (2007).
[7] Calculated at £0.09 per kWh.

Install and appropriately operate timers for external lights.	1-3
The appropriate location and design of modern efficient lighting should be fully considered at the design stage of any refurbishment projects.	NA
Ensure that natural light is fully utilised at the design stage of any refurbishment projects. A daylight factor of 5% should be targeted where possible.	

Considerations

Floodlights are available as LED 60W, 120W and 240W equivalents. Not only do they use significantly less power, but they last up to 100,000 hours equating to nearly 25 years of normal use.

An average daylight factor of 5% or more will ensure that an interior looks substantially day-lit (except early in the morning, late in the afternoon, or on exceptionally dull days). An average daylight factor below 2% generally makes a room look dull and electric lighting is likely to be in frequent use.

Low-energy lamps have traditionally been criticised for taking a time to warm up, delivering inadequate lighting levels, not having dimming functions, providing 'the wrong colour' light and being aesthetically obtrusive. Modern CFLs and LEDs (from high end manufacturers) have addressed this, with many lamps now far more suited to use in historic houses.

Modern efficient lamps from better manufacturers can cost significantly more than low quality energy saving units. However these units represent better value in terms of reliability and performance.

Energy Efficiency Grant Funding

Enhanced Capital Allowance

Enhanced Capital Allowances (ECAs) enable a business to claim 100% first-year capital allowances on their spending on qualifying technologies. There are three schemes for ECAs:

- Energy-saving technologies;
- Low carbon dioxide emission cars and natural gas and hydrogen refuelling infrastructure; and
- Water conservation technologies.

Businesses investing in the products on the Energy Technology List (ETL) or Water Technology List (WTL) can claim tax relief on both the capital and installation costs and can offset 100% of the cost and installation of products against their profits. All organisations that pay corporation tax and income tax in the UK are eligible for the tax allowance.

Examples of energy technologies that may be eligible for Enhanced Capital Allowance include high efficiency boilers, renewable heat installations and lighting controls.

Sources

Carbon Trust 2009

Energy Saving Trust 2009

English Heritage – Energy Conservation in Traditional Buildings

Changeworks – Energy Heritage, A Guide to Energy Efficiency in Traditional Historic Homes

About the authors

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Jason Beedell is Head of Research at Smiths Gore. He is a Chartered Surveyor and Chartered Environmentalist and prior to joining Smiths Gore, worked as a lecturer at The University of Reading. His team has carried out research projects for many private, public and government organisations, including a project on the woodfuel supply chain for the Forestry Commission which resulted in a series of events for people interested in installing a woodfuel boiler.

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As Senior Sustainability Consultant at Smiths Gore, Lee has nearly ten years of experience in dealing with practical energy efficiency and renewable energy issues. He has managed numerous projects developing environmental management systems, producing energy reduction strategies and renewable energy feasibility studies, calculating carbon footprints and providing renewable energy awareness training and planning advice for many historic houses and estates. Prior to working with Smiths Gore, Lee worked as an environmental consultant with clients ranging from large corporations and public bodies through to small rural businesses.