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Q&A: Energy efficiency in old houses

Energy efficiency in old houses

Improving the energy efficiency of the UK's housing stock has become increasingly important in light of increasing energy prices. This is particular the case in older properties that tend to be less energy efficient. Furthermore, housing is a major contributor the UK's carbon emissions and changes will need to be made if the Government is to meet its net zero targets.

Research by the Office of National Statistics, based on Energy Performance Certificates (EPCs), shows energy costs and carbon emissions in existing dwellings are double those of new dwellings. According to research from BRE Trust (PDF), the UK's housing stock is the oldest in the world and being replaced at a slow rate[1]. Wales has the oldest stock in the UK with over a quarter of houses being 100 years old or more.

A 2019 Business, Energy and Industrial Strategy (BEIS) Committee report on energy efficiency and net zero (PDF) highlighted that energy efficiency measures are needed across the UK's buildings to not only meet net zero greenhouse gas emissions by 2050 but also to tackle fuel poverty and cut energy bills.[2]

Terminology and scope

This briefing paper answers some commonly asked questions about improving energy efficiency in older domestic buildings. It does not focus on specific issues associated with listed or heritage buildings. For clarity, some terms used for classifying specific classes of older domestic properties are set out below, however, this briefing aims to address energy efficiency issues common to older houses regardless of any designation.

Traditional, historic and listed buildings

Buildings built before 1919 are often referred to as traditional buildings. The Centre for Sustainable Energy (CSE) uses the term 'traditional dwelling' and provides the following definition:

> If your home was built before 1919, and has solid walls (i.e. there are no cavities to fill with insulation), then it's known as a 'traditional dwelling' in conservation terms.[3]

The Historic Building Annex (PDF) published by the Government Property Agency in 2020 also refers to buildings built before 1919, but uses a more general term of historic buildings:

1 BRE Trust, The Housing Stock of The United Kingdom, (opens PDF), February 2020
2 BEIS Committee, Energy efficiency: building towards net zero (opens PDF), 9 July 2019
3 CSE, Love your old home (opens PDF),

> Historic buildings are not all protected by law. Those chosen for listing are a minority of those built before 1919, and a tiny minority of those built since. Compromise and ingenuity may be necessary to preserve the significance of this minority.[4]

The Historic Building Annex goes on to say that:

> Historic buildings are 'Heritage Assets' – assets in the sense of buildings worth retaining for their character and significance. They have cultural value. Strictly speaking, they are irreplaceable. This should not prevent reasonable change, but it should always provoke the question: how much do we have to change this building, to achieve what we need to do?[5]

Older listed buildings and buildings in conservation areas can present an additional set of challenges due to planning restrictions. These are covered in more detail in a separate casework article on restrictions residents may face when seeking to make changes, including energy efficiency improvements, to buildings which are listed or in conservation areas.

Where referred to in this briefing, when quoting external sources, the terms 'traditional' or 'historic' are used synonymously with older buildings and not to imply any special designation.

1 Energy efficiency challenges

What are the challenges of heating and insulating older homes?

Historic England, the public body that helps protect and promote England's historic environment, explains "there are many measures that can be applied to traditional houses to improve energy performance". However, "each will have risks and benefits that need to be weighed-up and balanced before deciding on the most appropriate selection. The "wide range of types, constructions and heritage significance of England's traditional homes" means that "every historic building is individual, so it is not possible to provide definitive statements about the impact of each possible measure."[6]

A particular challenge with old buildings is that they need to breathe, and therefore some modern insulation products may not be suitable. According to the Society for the Protection of Ancient Buildings (SPAB):

4 Government Property Agency, Historic Building Annex (opens PDF), 2020
5 Government Property Agency, Historic Building Annex (opens PDF) , 2020
6 Historic England, Energy Efficiency and Traditional Homes: Historic England Advice Note 14, 7 July 2020

buildings constructed before the mid-19th century generally rely on allowing the moisture which has been absorbed by the fabric to evaporate from the surface. The thickness of the wall alone in these earlier buildings may have been relied upon to achieve acceptably dry conditions internally.[7]

What factors affect a building's energy efficiency?

Historic England and several other sources recommend using a wholistic approach to energy efficiency in older buildings. This means looking at the whole home and the factors that affect its energy use, such as construction, condition, orientation and historical significance.

Historic England highlights the four most important factors that affect a building's energy efficiency:

- **House location and orientation**
  The performance of a house will be affected by your local climate and its exposure to wind, rain and sun.

- **House design and fabric**
  The form and design of the house, the construction materials and components and their condition also affect energy performance.

- **Services and equipment**
  Heating, cooling, lighting and ventilating a house all use energy. So does the equipment and appliances we use for cooking and entertainment.

- **People**
  We all use our houses in different ways. The amount of energy we use varies too. The number of people in a house, the levels of comfort they expect, and the services and equipment they use all have a significant effect on how much energy a household consumes.[8]

Why aren't older houses energy efficient?

Older buildings are generally less airtight than more modern buildings meaning heat escapes more easily. They also tend to take up moisture more easily, leading to dampness. As well as potentially leading to mould growth and associated health risks, excess moisture can significantly affect the levels

7 SPAB, The Need for Old Buildings to 'Breathe' (opens PDF), February 2020
8 Historic England, Energy Efficiency and Older Houses, accessed 5 July 2022

of heat loss and energy efficiency of old homes. The Energy Savings Trust reports "homes lose around a third of the heat through their walls, and wet masonry accelerates this heat loss, potentially leading to higher energy bills due to increased heating requirements."[9]

Historic England, has produced a series of guidance documents on Energy Efficiency and Historic Buildings. Its document on How to Improve Energy Efficiency explains modern buildings "depend on impermeable barriers to control the movement of moisture and air through the building fabric."[10] Conversely, older buildings have a tendency to "take up moisture from their surroundings and release it according to environmental conditions."[11] The guidance also explains older buildings heat up and cool down slower than more modern buildings.

The Centre for Sustainable Energy (CSE), a charity offering free advice on domestic energy use, say the design of traditional construction homes to not be airtight was partly due to needing ventilation for open fires. CSE note "It wasn't really until the 1990s that rising fuel costs and concern over fossil fuel emissions resulted in concerted efforts to conserve fuel and heat, mainly through improved insulation."[12]

Historic England also highlight that assumptions about poor performance in historic buildings are not always justified. A study by the Society for the Protection of Ancient Buildings (SPAB) found "most old walls lose less heat than often assumed" but in appropriate settings they may still benefit from enhanced insulation.[13]

2 Reducing energy use in old houses

General energy efficiency measures

The CSE recommends using the 'energy hierarchy', when trying to achieve sustainable energy objectives and reduce energy consumption in any home. This ranks the three different stages that should be applied consecutively to use less energy in the home:

9 Energy Savings Trust, Damp walls? Energy Saving Trust has verified products that can help, 4 July 2019

10 Historic England, Energy Efficiency and Historic Buildings: How to improve energy efficiency [PDF], 29 June 2018, p7

11 Historic England, Energy Efficiency and Historic Buildings: How to improve energy efficiency [PDF], 29 June 2018, p7

12 CSE, Low-carbon retrofitting

13 SPAB, SPAB Completes Over Ten Years of Research into the Energy Efficiency of Old Buildings: A Precis [PDF], July 2020, p1

1. energy conservation
2. energy efficiency
3. renewable energy

Energy conservation means reducing the need for energy in the home, by changing the way energy and energy consuming appliances are used. This includes measures such as closing curtains or running appliances on low energy settings. Regular maintenance can also play an important role.

Historic England has published guidance on how to improve energy efficiency. It provides a range of measures that vary in cost and complexity, such as:

- Optimising use of natural and artificial lighting
- Reducing the quantity of energy-using equipment
- Insulating pitched roofs at ceiling level (loft insulation)
- Insulating flat or low-pitched roofs at ceiling level (for roofs with accessible voids)
- Repairing (Including repointing and repairs to permeable renders)
- Draughtproofing
- Adding curtains and blinds
- Refurbishing or replacing lost shutters[14]

Higher risk options include measures such as replacing windows, insulating a framed construction or cavity walls.

The final stage in the hierarchy is installing renewable energy measures. As set out by CSE:

> By reducing energy demand through the first two stages, you should have cut down on how much energy you use and therefore need to produce. This means the size of energy system you require to meet your needs may be smaller and cheaper than had you installed it without considering the other two factors.
>
> It will not be as clear-cut as this in real life, but the energy hierarchy should still be regarded as an integral element of the 'whole house' approach, as it can help you decide which measures to prioritise.[15]

[14] Historic England, Energy Efficiency and Historic Buildings: How to Improve Energy Efficiency, 29 June 2018

[15] CSE, Low-carbon retrofitting

The CSE highlights the importance of not thinking about each action individually and looking for opportunities to save costs and time by effectively planning when and where to make changes.

What are some of the challenges with renovating or retrofitting historic buildings?

Renovating and retrofitting traditional buildings may be complex and must be done carefully to avoid damaging the building. It may also be cheaper to keep much of the building than carrying out a complete rebuild. Research by Historic England has also shown demolishing and replacing an older building with a new build can lead to greater carbon emissions.[16] An article from Real Homes looks at some of the considerations for deciding whether to renovate or rebuild an older property.

Breathable materials

The SPAB caution against the use of materials that prevent a building 'breathing' when carrying out renovations or energy effeminacy improvement works. They also highlight many modern materials, classed as breathable, may be inadequate for historic buildings:

> The term 'breathing' is often applied to many products which are only slightly vapour permeable. In general, no synthetic modern materials should be applied to the masonry or plaster surfaces of historic buildings. If in any doubt, contact the SPAB.[17]

Ventilation

Whilst the SPAB stress the importance of using breathable materials in historic buildings, they also highlight "they are not a substitute for a good ventilation system and, without such a system, the challenges of making insulation work effectively increase considerably."[18]

This view is also supported by the CSE who state:

> Most energy efficiency measures will improve airtightness, thereby impacting the movement of moisture, meaning that appropriate ventilation needs to be considered. The more airtightness is increased, the more important ventilation becomes. This might be through any 'breathable' materials you chose, but should usually include mechanical extractor fans as well, as a more reliable way of ensuring adequate ventilation.[19]

16 Historic England, There's no place like old homes (opens PDF), February 2020
17 SPAB, The Need for Old Buildings to 'Breathe' (opens PDF), February 2020
18 SPAB, The Need for Old Buildings to 'Breathe' (opens PDF), February 2020
19 CSE, Low-carbon retrofitting

Installing double glazing

According to the CSE, "homes lose 10-20% of their heat through windows and external doors."[20] Installing energy efficient glazing in the form of double or triple glazing can improve a home's energy efficiency, therefore reducing energy bills and a building's carbon footprint.

Two barriers to installing double glazing are appearance and costs. The Energy Savings Trust estimates a set of A-rated windows for a semi-detached house will typically cost around £7,500. However, costs vary, and wooden frames are more expensive than PVC windows. Savings on energy bills will also vary depending on the double-glazing rating:

> By installing A-rated double glazing to windows in an entirely single-glazed semi-detached gas heated property, you could save £145 a year and 335kg of carbon dioxide.
>
> If you installed A++ rated double glazed windows replacing single glazing, the savings could be up to £175 a year and 410kg of carbon dioxide.[21]

Alternatives to double glazing

Double glazing options may be limited in listed building and conservation areas. As explained by Historic England, a homeowner may need consent to replace or make alterations to windows if the house is in such areas.[22] This can be found by contacting the Local Planning Authority or conservation officer.

Installing double glazing may also be an undesirable option due to costs, or for aesthetic reasons. In these cases, a number of alternative measures are available. Historic England has cited draught-proofing as "one of the most cost effective and least intrusive ways" to reduce energy used for heating for "little to no change to a building's appearance":

> It also has the added benefit of helping to reduce noise and keeping out dust. Research has shown draught-proofing can reduce air leakage from windows by between 33% and 50%, therefore significantly reducing the heating requirement needed for the room.[23]

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20 CSE, Energy efficient glazing & high performance external doors

21 Energy Savings Trust, Windows and doors

22 Historic England, I want to alter my windows (accessed 5 July 2022)

23 Historic England, Energy Efficiency and Historic Buildings: Draught-proofing windows and doors, 29 April 2016

Research by Historic England into the thermal performance of traditional windows has shown measures such as installing well-fitting shutter or heavy curtains can reduce heat loss by up 58% and 41% respectively.[24]

Installing insulation

According to the Energy Savings Trust, around a third of all the heat lost in an uninsulated home escapes through the walls: "In general, houses built from the 1990s onwards have wall insulation to keep the heat in, but if your house is older than that, it may not have any wall insulation at all."[25]

Older houses, built before the 1920s tend to have solid walls, whilst houses built after this date tend to have cavity walls. The Energy Savings Trust's guide to cavity wall insulation has information on how to identify which type of wall a property has and how insulation can be installed. Further guidance on solid wall insulation is also available.

Information on insulation from the Planning Portal states that:

> Planning permission is not normally required for fitting insulation (where there is no change in external appearance).
>
> However, if the building is listed or is in a conservation area you should consult your local planning authority.[26]

The planning portal also provides links to information on specific types of insulation.

The SPAB also highlight a number of considerations that should be taken when planning for and installing new insulation:

> Consideration should be given to user behaviour and expectations, ventilation and heating strategies. In addition, care needs to be taken not to compromise the building's aesthetics or special interest; loss of historic fabric and the accelerated deterioration of components must also be guarded against.[27]

Further information on planning responsible retrofit of traditional buildings is available in guidance produced by the Sustainable Traditional Buildings Alliance (STBA). The STBA has also produced an interactive Guidance Wheel which allows users to research the interactions between different options of retrofit. It also categorises the risks associated with different measures and

24 Historic England, Research into the Thermal Performance of Traditional Windows: Timber sash windows, 30 April 2018
25 Energy Savings Trust, Cavity wall insulation,
26 Planning Portal, Planning permission: insulation
27 SPAB, Energy efficiency in old buildings (opens PDF), 2014

links to "peer assessed research that has been produced on the topics in question."

1 Energy Performance Certificates (EPCs)

EPCs are required when selling or renting a property, although some listed buildings may be exempt if meeting the minimum energy performance requirements would unacceptably alter the building. Despite this, it may be difficult to sell or rent a property if information about its energy efficiency is not available. As set out in Government guidance, other buildings which are exempt include places of worship and residential buildings intended to be used for less than 4 months of the year.

An EPC gives a property an energy efficiency rating from A (most efficient) to G and is valid for 10 years. It also provides information about a property's energy use and typical energy costs and makes recommendations on how to reduce energy use and save money.

Further guidance on EPCs is available from Historic England.

Rented properties

Some older buildings may be exempt from the requirement for an EPC, however, owners may wish to voluntarily make energy efficiency improvements to rented properties and can seek financial support for this. Government guidance for landlords on the Domestic private rented property: minimum energy efficiency standard sets out the different options for funding improvements to a property.

Further guidance to support landlords to meet their minimum energy efficiency obligations can be found in The Domestic Private Rented Sector Minimum Standard and in A guide to Energy Performance Certificates for the marketing, sale and let of dwellings.

3 Renewable energy technologies

Before installing renewable energy, it is recommended to initially reduce energy demand through measures such as improved roof and wall insulation, double and even triple glazing and better lighting, prior to installing any low carbon or renewable heat and energy technologies. PBC Today states "once those efficiency improvements are made the building consumption has been optimised, so considering renewables then becomes more appropriate. Heat

pumps, solar panels, wind and waste heat recovery will all support achieving net zero."[28]

Heat pumps in older buildings

Most heat pumps are designed to provide heat to low temperatures over a long period of time, rather than quickly providing high-temperatures when turned on. They function most effectively in well-insulated properties, and subsequently may require improvements to insulation and the central heating system to work effectively.

Despite this, the government-funded Electrification of Heat project found that "there is no property type or architectural era that is unsuitable for a heat pump".[29] Whilst there is a "greater challenge in successfully designing heat pump systems for older homes… such challenges are manageable".[30]

Guidance on installing heat pumps in older buildings, is available from Historic England. This contains information on the different types of heat pumps, how they work and how to select the most appropriate type for a particular building or application and guidance on their installation. The guidance also highlights reasons why heat pumps may be particularly suitable in some traditional buildings:

> Heat pumps are generally well-suited to historic buildings as they work efficiently when run on a constant low temperature, a method suited to buildings with thick masonry walls that are able to retain heat and release it slowly. This is referred to as having thermal mass.
>
> Running heating on a constant low temperature can also be beneficial for older buildings because the building will heat up and cool down slowly. This means there will be less thermal movement within the building caused by expansion and contraction, thereby reducing potential damage such as shrinkage cracks.
>
> Historic buildings are often surrounded by areas of land which increases the range of heat pumps that can be installed.[31]

Despite their potential suitability, Historic England recommends taking the following factors in consideration, to identify the type of installation best suited for the building:

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28 PBC Today, Renovating historic buildings sustainably: The challenges and opportunities, 21 March 2022

29 Energy Systems Catapult, All housing types are suitable for heat pumps, finds Electrification of Heat project, accessed 5 July 2022

30 Energy Systems Catapult, All housing types are suitable for heat pumps, finds Electrification of Heat project, accessed 5 July 2022

31 Historic England, Heat Pumps, 4 December 2017

- the potential impact on the building's historic fabric
- the amount of energy that could be generated and value for money
- any technical risks associated with the measure
- what electrical capacity is there at the site? Heat pumps require electricity to operate.[32]

Installing solar panels

Solar panels can be installed in a variety of ways, either on or within a building structure (most commonly the roof) or, where space permits, in a free-standing setup away from a house.

Solar photovoltaic panels generate electricity for use around a property, whereas solar thermal panels generate heat which can be used for hot water and supplementing central heating.

The Energy Savings Trust points out that space and orientation are key considerations for photovoltaic solar panels:

> The average system size is around 4.2kWp and this will typically take up around 25m2 roof area.
>
> An unshaded, South facing roof is ideal for maximum electrical output. East or West facing roofs could still be considered, but North facing roofs are not recommended. A system facing East or West will yield around 15-20% less energy than one facing directly South.[33]

Historic England's guidance on solar panels and historic buildings (PDF) also recommends considering the following factors prior to installing photovoltaics:

- the potential visual or physical impact on the building's historic fabric
- carrying out an assessment of all renewables to ensure that photovoltaics are the right solution for your application
- what energy you require – heating or electricity?
- the amount of energy that could be generated and what the payback period would be

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32 Historic England, Heat Pumps, 4 December 2017

33 Energy Savings Trust, Solar Panels

- any technical risks associated with the measure
- whether you need consent: consent will most likely be needed if the installation is located on or near a listed building or within a conservation area[34]

The Energy Savings Trust has further information on Solar water heating which explains how these systems work and the benefits they can offer.

Restrictions on solar panels

Historic England outline the consents that might be needed, such as planning permission, listed building consent and building regulations and encourages people to check local policies.[35] It also discusses the impact on building fabric and landscape.[36]

In April 2022, it was reported Kensington & Chelsea has become the first borough to allow solar panels to be installed on listed homes without planning permission. According to the Evening Standard article "80 per cent of the borough's carbon emissions come from buildings".[37]

The Library briefing paper, Q&A: Solar panels (February 2020), contains general information on some of the issues that may occur when installing solar panels.

What other renewable energy options are there?

Historic England provides further guidance and information on a range of Low and Zero Carbon Technologies and assesses when and where they may be suitable for use in older buildings.

This includes wind turbines, hydroelectric power, biomass boilers and combined heat and power (CHP). In most of these, a case study is presented showing how these different technologies have been successfully implemented in a historic building.

A review article on the integration of renewable technologies in historical and heritage buildings was published in the Energy and Buildings Journal in 2018.

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34 Historic England, Energy Efficiency and Historic Buildings: Solar Electric (Photovoltaics), (opens PDF) October 2018

35 Historic England, Energy Efficiency and Historic Buildings: Solar Electric (Photovoltaics), (opens PDF) October 2018

36 Historic England, Energy Efficiency and Historic Buildings: Solar Electric (Photovoltaics), (opens PDF) October 2018

37 Evening Standard, Kensington & Chelsea becomes first borough to relax solar panels rules for historic homes, 12 April 2022

This provides examples of "energy efficiency approaches and the integration of renewable energies in historical buildings, including solar and geothermal energy, and the use of heat pumps and other high-efficiency heating ventilation and air conditioning systems."[38]

4 Financial assistance

A number of general Government schemes are currently available to support homeowners with their heating and energy efficiency. These may be applicable to owners of historic buildings depending on the individual circumstances of each property. These and additional funding sources are covered in more detail in the Library briefing Help with energy efficiency, heating and renewable energy in homes.

5 Further information and resources

The following resources provide further information and advice on the topics in this briefing and a range of additional areas which may be useful.

- Commons Library, Planning permission in Conservation Areas and listed buildings in England, 04 February, 2022
- Commons Library, Q&A: Solar panels, February 2020
- Energy Savings Trust, Reducing home heat loss, (multiple resources)
- Centre for Sustainable Energy, Advice & information for householders, (multiple resources)
- Historic England, Saving Energy in your Home, (multiple resources)
- Historic England, Low and Zero Carbon Technologies, 17 March 2021
- SPAB, Control of Dampness, 2018
- SPAB, The Need for Old Buildings to 'Breathe', 2020
- STBA, STBA Guidance Wheel, 2020
- STBA, Responsible Retrofit Knowledge Centre

[38] Cabeza et al., Integration of renewable technologies in historical and heritage buildings: A review, Energy and Buildings, 15 October 2018

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