Improving Energy Efficiency in Historic Cornish Buildings
Cornwall Council Historic Environment Service

Camborne, Roskear, Tuckingmill Townscape Heritage Initiatives
Acknowledgements

This report was written and produced by:

Andrew Richards, Advice Team Leader (West), Cornwall Council
Peter Smith, THI Administrative Officer, Cornwall Council

This followed preparatory work from Will Segal and Marc Staddon, students from Cornwall College’s FdSc Renewable Energy Technologies Course.

Contributions were also received from the following:

Iain McCaig Building Conservation and Research Team English Heritage
Dr Michael Hunt Curriculum Area Manager for Science, Cornwall College
Claire Lenihan Lecturer - Technology Faculty, Cornwall College
Adele Oakes Business and Enterprise Faculty Site Access Coordinator, Cornwall College
Kay Pearce Cornwall College Student
Phil Brown Cornish Lime Company
Paul Watts Mike Wye and Associates Ltd
Antony Best Eddie Jewell Acoustics
Paul Bright Chief Executive, Cornwall Sustainable Buildings Trust
Sarah Williams Building Control, Cornwall Council
Caius Simmons Townscape Heritage Initiative Project Manager, Cornwall Council
Dr Alyson Cooper Principal Historic Environment Officer, Cornwall Council
Dan Nicholls Natural Resources, Planning and Regeneration, Cornwall Council

Planning Status

This ‘Improving Energy Efficiency in Historic Cornish Buildings’ guide was approved by Cornwall Council as a material consideration for land use planning purposes in June 2014.

Limitations of this guidance

This guide includes costs and references to products, suppliers, contractors and organisations. It includes weblinks highlighted in blue to enable further research. This information is believed to be accurate at the time of issue. It is liable to change, however, and every effort will be made to review and update it. The references to products, suppliers and contractors is not comprehensive and there may be other suitable products and firms that we are not aware of. Any inclusion of products and firms does not constitute a recommendation as to their suitability.

Costs

Unless otherwise indicated, costs in this document have been provided by: EC Harris Built Asset Consultancy, Exeter. All capital costs provided are based on prices at 2nd Quarter 2016. These capital costs are forecast to increase 4% year on year until 2nd Quarter 2019 (i.e. prices included will require uplifting by 12% in 2nd Quarter 2019)

Further information

If you have any queries on the products, firms or suppliers highlighted in this guide please contact:

andrew.richards@cornwall.gov.uk
Executive Summary

Historic buildings all differ and are subject to varying levels of protection under the planning system. They vary in their construction, location, quality of services and the way they are used. Consequently there is no ‘one size fits all’ solution to upgrade their energy efficiency.

Retrofitting can often damage the authenticity, character and setting of a historic building. This guide highlights behavioural changes and principles that could be followed to upgrade a historic building whilst retaining its special character.

The guide provides local examples of good practice along with current costs and performance details of suitable products. It is intended to be used by local authority staff, building owners, professional agents and contractors at an early stage in the planning process and before Building Control applications.

Sections within the guide provide information and advice on:

- Why historic buildings are worth keeping and policy background for retrofitting (Section 1).
- The influence of climate and climate change on historic Cornish buildings and factors affecting energy reduction. (Section 2).
- How historic buildings work, ways of controlling moisture and maintaining healthy living conditions (Section 3).
- Simple changes in occupants’ behaviour that can reduce energy consumption (Section 4).
- Suitable products for retrofitting historic buildings and good local examples of their use including performance details and costs. Useful web links are provided within sections of the guide to enable further research and will be regularly updated (Section 5).
- Details of sustainable materials that could be used for extensions to historic buildings or new buildings within historic areas. (Section 6).
- Reclaimed and recyclable materials (Section 7).
- Available funding and useful contacts (Sections 8 and 9).
- Feedback on energy monitoring carried out through Camborne, Roskear, Tuckingmill THIs (Appendix 1).
- Energy saving options for heating, lighting and appliances (Appendix 2).
- Microgeneration options and guidance (Appendix 3).
- Local case studies (Appendix 4).
Contents

1. General information 1
   1.1 Introduction 2
   1.2 Why historic buildings are worth keeping 3
   1.3 The National Planning Policy Framework 3
   1.4 Historic buildings 3
   1.5 Listed Building Consent 4
   1.6 Principles of repair and alteration 5
   1.7 Building Regulations and historic buildings 6
   1.8 Energy Performance Certificates 7
   1.9 BREEAM 7
   1.10 Measurement terms explained 8

2. The impact of climate change on Cornish historic buildings 9
   2.1 Cornish climate and historic buildings 10
   2.2 Embodied energy 11
   2.3 Thermal mass 11
   2.4 Heat loss 12
   2.5 Reducing energy use and carbon emissions in traditional buildings 13-14

3. Keeping buildings healthy and comfortable 15
   3.1 Why solid walled buildings need to breathe 16
   3.2 Internal moisture vapour 16
   3.3 Condensation and dew points 17
   3.4 Membranes and barriers 17
   3.5 Healthy buildings 17
   3.6 Ways of controlling moisture 18
   3.7 Ventilation and security 19
   3.8 Trickle ventilation 20

4. Reducing energy consumption 21
   4.1 Introduction 22
   4.2 'Trigger Points' for retrofitting 22
   4.3 Reasons to retrofit 22
   4.4 Simple ways to reduce energy use 23
   4.5 Heating systems 24
   4.6 Draught reduction 25

5. Building fabric improvements 26
   5.1 Introduction 27
   5.2 Windows 27
   5.2.1 Improving the performance of traditional windows 27
   5.2.2 Repairs and maintenance 28-29
   5.2.3 Draught proofing 30-31
   5.2.4 Secondary glazing 32-33
   5.2.5 Shutters 34-35
   5.2.6 Thermal blinds and thermal curtains 36
   5.2.7 Double glazing 37-38
   5.2.8 Types of glass 39
   5.3 Insulation 40-41
   5.4 Roof insulation 42
   5.5 Floor insulation 43-44
   5.6 Wall insulation 45
   5.6.1 External wall insulation 46-47
   5.6.2 Internal wall insulation 48-53
   5.6.3 Cavity/hollow wall insulation 54
   5.7 Costings and performance tables 55-56
   5.8 Links to guidance on insulation 57
   5.9 Further technical guidance 57
   5.10 Suppliers and products 58

6. Sustainable materials 59
   6.1 Sustainability 60
   6.2 Building materials 60
   6.2.1 Timber 61
   6.2.2 Hempcrete 62
   6.2.3 Straw bale construction 62
   6.2.4 Cob 63
   6.2.5 Thermoplan clay block system 64
   6.2.6 Rammed earth 65
   6.2.7 Green roofs 65
   6.2.8 Sustainable finishes 66
   6.2.9 Painting traditional joinery 67
   6.2.10 Sustainable finishes suppliers 68
   6.2.11 Sustainable building materials 69
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>7. Reclaimed and recyclable materials</strong></td>
<td>70</td>
</tr>
<tr>
<td>7.1 Architectural salvage</td>
<td>71</td>
</tr>
<tr>
<td>7.2 Minimising waste</td>
<td>71</td>
</tr>
<tr>
<td>7.3 Metal rainwater goods</td>
<td>71</td>
</tr>
<tr>
<td><strong>8. Funding options</strong></td>
<td>72</td>
</tr>
<tr>
<td>8.1 Current funding schemes</td>
<td>73</td>
</tr>
<tr>
<td>8.2 Tax savings</td>
<td>74</td>
</tr>
<tr>
<td>8.3 Additional income</td>
<td>74</td>
</tr>
<tr>
<td><strong>9. Further information and advice</strong></td>
<td>75</td>
</tr>
<tr>
<td>9.1 Organisations</td>
<td>76-77</td>
</tr>
<tr>
<td>9.2 Professional services</td>
<td>77</td>
</tr>
<tr>
<td>9.3 Local contractors for historic building work</td>
<td>78</td>
</tr>
</tbody>
</table>

## Appendices

**Appendix 1:**
Energy efficiency and noise monitoring

**Appendix 2:**
Energy saving guidance / cost comparisons on heating, lighting and appliances

**Appendix 3:**
Microgeneration

**Appendix 4:**
Case studies

THI grant funded internal shutters (first floor) and secondary glazing (ground floor) to traditional single glazed sash windows, Trevu Road, Camborne.
1. General information
1. General information

1.1 Introduction

The Heritage Lottery Fund’s Townscape Heritage Initiative (THI) programme funds traditional repairs to targeted historic buildings in Conservation Areas. The Camborne, Roskear, Tuckingmill THIs (2008-2016) are multi funded grant schemes administered by staff from Cornwall Council’s Historic Environment Service and have an emphasis on traditional skills training and energy saving measures.

This guide has been written and produced by Andrew Richards and Peter Smith of the THI Project Team and complements the energy saving initiatives progressed through the schemes. Further details of the THIs including slide shows of completed works and summaries of ongoing traditional skills training and energy saving initiatives are accessible via links on the THI web page:

Camborne, Roskear, Tuckingmill Townscape Heritage Initiatives

Details of other heritage led regeneration schemes carried out by Cornwall Council’s Historic Environment Service are available through the following link:

Cornwall Council - Heritage Led Regeneration
1.2 Why historic buildings are worth keeping

Historic buildings are inherently sustainable. Most have survived because they are robust, durable and adaptable. Original materials and architectural detailing often survive and can be easily repaired, maintained and recycled at the end of their service life.

They are part of our cultural heritage and reflect the nature and history of the communities that created them. They add distinctiveness, meaning and quality to the places we live and provide a sense of continuity and identity. The following links provide more details on the importance of historic buildings:

- [Historic England - Heritage and People: Value and Impact](#)
- [IHBC - Valuing Historic Places](#)
- [Heritage Counts - Historic Environment and Sense of Place](#)

1.3 The National Planning Policy Framework (NPPF)

The [NPPF](#) sets out the Government’s planning policies for England and how these are expected to be applied. It stresses the need to understand the reason why people value particular buildings or places, so that changes can be made to them without losing the things that make them special. It refers to places which have cultural and economic value to society as heritage assets and defines them as:

"a building, monument, site, place, area or landscape positively identified as having a degree of significance meritng consideration in planning decisions"

It defines significance as the value of a heritage asset to our own and future generations because of its heritage interest. In other words significance is the sum of all cultural values people associate with a building or place.

1.4 Historic buildings

Historic buildings are usually recognised as:

- Listed buildings.
- Buildings within Conservation Areas.
- Buildings of local architectural or historical interest which are referred to as a material consideration in a Local Authority’s Development Plan.
- Buildings of local architectural or historical interest within national parks, areas of outstanding natural beauty or World Heritage Sites.
- Scheduled monuments.

For information on listed buildings and to check if a building is listed please use the following link:

- [Cornwall Council - Listed buildings](#)

For information on Conservation Areas and to check if a building is in a Conservation Area please use the following link:

- [Cornwall Council - Conservation Areas](#)
1. General information

1.5 Listed Building Consent

Listed Building Consent is needed for the alteration or extension of a listed building, which would affect its character in any way. Carrying out unauthorised works on a listed building is a criminal offence. Consult Cornwall Council’s Planning and Building Control services before making any changes:

Cornwall Council - Planning
Cornwall Council - Listed building information including FAQs
Cornwall Council - Planning and Listed Building application forms
1.6 Principles of repair and alteration

As the nature of historic fabric varies between buildings and within buildings it is important that a methodical approach is taken to assess the impact of any proposed interventions. This approach should take the following principles into account:

- Minimise disturbance of historic fabric.
- Keep works to the minimum necessary.
- Ensure any new works are reversible.
- Take a holistic approach and fully understand the building.
- Avoid impermeable materials or membranes in breathable traditional construction.
- Be aware of the contribution that the manufacture or use of new materials make to greenhouse gases / carbon emissions.

Historic England’s Conservation Principles, Policy and Guidance 2008 provides a comprehensive framework for the sustainable management of the historic environment.

Main contents
1.7 Building Regulations and historic buildings

The Building Regulations 2010 set standards for design and construction that apply to most new buildings and alterations to many existing buildings, including Listed buildings. Any new work such as extensions and alterations will require Building Regulation Approval. There is no general requirement, however, to upgrade all existing buildings to comply with Building Regulations.

In the Regulations, Part L: Energy Conservation deals with conservation of fuel and power and is most relevant in terms of upgrading the performance of historic buildings.

Listed buildings, buildings within a Conservation Area or Scheduled Monuments are exempt from compliance with the energy efficiency requirements of this part if proposed works would unacceptably alter the character, appearance and significance of a building.

Special consideration can also be given under Part L to the following buildings:

- Buildings of architectural or historic interest listed in the Local Development Plan (locally listed buildings).
- Buildings of architectural or historic interest that are within National Parks, Areas of Outstanding Natural Beauty, Registered Parks, Gardens and Battlefields, World Heritage Sites and the curtilage of Scheduled Ancient Monuments or World Heritage Sites.
- Buildings of traditional construction with permeable fabric that both absorbs and readily allows the evaporation of moisture (which can conflict with modern materials and methods).

Buildings used primarily or solely as places of worship are exempt from Part L altogether although this doesn't apply to other parts of the building used separately for offices, meetings, catering, etc.

There is usually some flexibility in how the Regulations can be interpreted when upgrading historic buildings and a compromise solution can often be reached which retains the building’s character. The aim when upgrading historic buildings should be to improve energy efficiency as far as reasonably practicable without damaging their character or causing long term deterioration. Further information is available through the following links:

- Historic England guidance on the Building Regulations

The Building Regulations are evolving regularly through government commitments under the Climate Change Act 2008. Latest versions should always be used and are available through the following link:

- Planning Portal - Building Regulations

To obtain advice and check whether a Building Control application is required, please contact Cornwall Council’s Building Control Service through the following link:

- Cornwall Council Building Control Service Information

Advice on appropriate and sympathetic ways of upgrading historic buildings can be obtained from your local Conservation Officer:

- Cornwall Council - Building Conservation Contacts
1.8 Energy Performance Certificates

Energy Performance Certificates (EPCs) show a building’s performance in bands similar to those used to indicate the efficiency of electrical appliances. They are now needed when both residential and commercial properties are built, sold or rented. An EPC contains information about a property’s energy use, typical energy costs and recommendations about how to reduce energy use and save money. They give an energy efficiency rating from ‘A’ (most efficient) to ‘G’ (least efficient) and are valid for 10 years.

There are exemptions on officially protected buildings (e.g. Listed buildings), places of worship, temporary buildings, stand alone buildings with a total useful floor area of less than 50m² and incomplete or due to be demolished buildings. Failure to comply with EPC legislation could result in fines of up to £5,000.

EPCs are carried out by qualified assessors, regulated by an approved accreditation scheme. It involves assessment of boilers, heating controls, insulation and windows.

Further information

Historic England - Energy Performance Certificates
Gov.uk - Energy Performance Certificates
Community Energy Plus - Energy Performance Certificates
Energy Saving Trust - Energy Performance Certificates

1.9 Building Research Establishment Environmental Assessment Method (BREEAM)

BREEAM is an environmental assessment method and rating system for buildings that was launched in 1990. It sets the standard for best practice in sustainable building design, construction and operation and provides a comprehensive measure of a building's environmental performance. It encourages low carbon, low impact design and minimising the energy demands created by a building before energy efficiency and low carbon technologies are considered.

For further information see the following link: BREEAM

Sample EPC for THI funded Reynolds House (part of former Holman’s No.3 Works, Trevu Road, Camborne) and BREEAM certificate for the converted Carpenter’s Shop, Heartlands, Pool.
1.10 Measurement terms explained

**K (or \( \lambda \) lambda) values**: the ‘thermal conductivity’ values – the standard unit of measurement for any material’s ability to conduct heat. The higher the k-value of an insulation material, the thicker the layer that will be required to achieve a desired U-value. K values are usually given in manufacturers’ literature and are used to calculate U-values.

**U-values**: a measure of heat flow through a composite building element such as a wall, floor or roof. The higher the U-value the worse the thermal performance of the element. A low U-value usually indicates high levels of insulation. They provide a way of assessing the thermal performance of the building element and are used to demonstrate compliance with Building Regulations.

**R-values**: an expression of thermal resistivity for a material of a given thickness. The higher the R-value, the better the insulator.

**SAP and RdSAP**: The Government’s methodology for assessing and comparing energy and environmental performance is:
- **Standard Assessment Procedure (SAP)** - new buildings
- **Reduced Data Sap (RdSAP)** - existing dwellings

SAP ratings are expressed on a scale of 1 to 100. A higher number denotes a better rating. SAPs are accepted by Building Control but RdSAPs are not as they are generic as opposed to property specific. Information on SAPs, EPCs and air pressure tests is available through the ES Consult section of the Council’s website:

[ESConsult - Extended Services](https://www.esconsult.gov.uk)

Further information on SAP and RdSAP assessments:
- [Gov.uk - Standard Assessment Procedure (SAP)](https://www.gov.uk)
- [Building Research Establishment - SAP ratings](https://www.bre.co.uk)

---

**Performance data in this guide**

**Savings / Payback**: where indicated these are Energy Savings Trust (EST) estimates based on a hypothetical three bedroom gas heated semi-detached property. The figures are theoretical approximations - real savings and costs may differ considerably.

**Costs**: prices are estimates. Purchasing in bulk could help to reduce costs. Each price is written in context of the thickness it comes in / is applied in. Unless otherwise indicated, costs have been provided by E C Harris Built Asset Consultancy, Exeter and are based on building costs for medium-sized projects.

---

[ESConsult web page](https://www.esconsult.gov.uk)
2. The impact of climate change on historic Cornish buildings
2. The impact of climate change on historic Cornish buildings

2.1 Cornish climate and historic buildings

Cornwall is one of the UK’s more exposed areas with around 300 miles of coastline. MET Office data shows that only western Scotland has greater average wind speeds than the south west of England. Annual rainfall totals for most coastal areas of Cornwall and Devon are 900-1000mm, but up to double this amount falls on upland areas such as Dartmoor, Bodmin Moor and Exmoor. These rainfall figures can be compared to annual totals of around 500mm in the driest parts of Eastern England and over 4000mm in the western Scottish mountains.

The combination of a relatively high annual rainfall and exposure to wind has influenced the style of buildings and the types of building materials used in the South West.

Cornish vernacular buildings were often robustly built of locally quarried stone and slate to withstand local weather conditions. Building stone included granite, elvan and killas, all of which have differing properties. Other common walling materials were hung slate, cob and occasionally brick. Roofs were mostly in locally quarried Delabole and Trevillet slate although thatch is common in certain areas.

To withstand the local weather building techniques such as wet laid roofs and slate hanging to walls emerged to prevent up lift from wind and protection from horizontal driving rain. Poorer quality building stone was often limewashed or lime rendered.

More information on Cornish building materials:
English Heritage county building stone atlases
More information on climate change affecting Cornwall:
Cornwall Council - Climate change and energy
Met Office - South West England: climate
Wikipedia - Geography of Cornwall
Historic England - Heritage and Climate Change

Main contents
2. The impact of climate change on historic Cornish buildings

2.2 Embodied energy

Upgrading historic buildings is a more sustainable option than pulling them down and building new structures. Embodied energy is the energy used for the erection of a building. Operational energy is that used in the operation of a building. Both activities result in emissions of carbon dioxide. Embodied energy includes the energy used to extract raw materials, the manufacture of building products and construction on site as well as the energy used to transport the materials and products. Retaining an existing building instead of replacing it with a new one avoids the embodied energy and carbon required to construct a new building.

The before and after images to the right show a historic building at the former Holman’s No.3 Engineering Works at Trevu Road, Camborne. This site contains unlisted historic buildings protected from demolition through Conservation Area designation. The historic buildings were retained and converted with THI funding as part of an affordable housing scheme which also contained new buildings. Retaining rather than demolishing the historic buildings added character to the overall scheme which received a commendation from the Cornish Buildings Group Design Awards in 2013. The scheme also won a Cornwall Sustainability Award in 2012, a South West and Wales RICS award in 2013 and was voted as one of the UK’s top 50 affordable housing developments by sector magazine Inside Housing.

2.3 Thermal mass

Many solid walled historic buildings have good thermal mass. This is the ability of a material to absorb, store and release heat over time. Older buildings can save energy costs by absorbing and storing heat from solar gains and internal appliances and releasing it at a later stage. This will happen quicker with well insulated lightweight materials than dense masonry walls. Thermal mass can also help prevent overheating in the summer and reduce the need for mechanical cooling.
2. The impact of climate change on historic Cornish buildings

2.4 Heat loss

Over 60% of domestic energy is used for heating as shown in the diagram to the right. Heat is lost through the building envelope, mainly through the walls and roof. Heat in old buildings is lost through air leakage and conductivity. Air leakage occurs in gaps through windows and doors, cracks in walls and junctions between different building elements. Thermal conductivity results in heat loss through the fabric of a building. Air tightness is more critical than insulation as heat is lost much faster through draughts than through conductivity. Historic buildings differ and require different solutions to reduce heat loss. The diagrams below show breakdowns of heat loss through building fabric. The four examples of heat loss through traditional building fabric below show how heat loss differs from building to building.

Source: www.scotland.gov.uk - The Key Behaviour Areas - Home Energy (Data from DECC (2013) Energy Consumption in the United Kingdom, Domestic Data Tables)
2. The impact of climate change on historic Cornish buildings

2.5 Reducing energy use and carbon emissions in historic buildings

Reducing energy use and carbon emissions in historic buildings provides sustainable benefits by minimising environmental pollution and mitigating climate change. It also makes properties more comfortable to live in and provides potential savings in energy bills.

Awareness is needed of the ways we use energy as well as a desire to use less. Consideration should be given to reducing energy use and being more energy efficient; reducing waste and switching to low carbon energy supplies.

A systematic ‘whole building’ approach to energy efficiency helps to identify the most appropriate improvements to a building or household. This approach should take into consideration the way the building is used and the performance of its fabric / building services. Available resources and short, medium and long term opportunities to make improvements (e.g. when a kitchen or bathroom is going to being refitted) also need to be taken into account.

First steps should always be to understand how a building works by considering its:

- Location
- Construction and condition
- Building services
- Heritage values and significance
- Occupant behaviour

Location
Cornwall is a narrow, exposed county surrounded by coastline. It is subject to extreme and changeable weather conditions particularly in coastal and hilly areas. Location, orientation and exposure to sun, wind and rain affects a building’s fabric and energy use. South facing elevations benefit more from heating from the sun while south westerly facing elevations feel the force of strong winds and horizontal driving rain. Weather proofing buildings in exposed areas in order to keep walls dry should be considered before trying to insulate internal areas.

Construction and condition
Historic buildings differ in their construction, insulation, thermal mass and air tightness. A dressed stone wall with tight mortar joints, for example, performs differently to a composite wall built of random rubble. Regular or lack of maintenance also affects performance of external walls, roofs, floors, windows and doors. Historic building fabric will often perform better than assumed. RdSAP consistently over estimates energy use in traditional buildings. Default U-values for solid walls used in energy assessments have also been found to be generally higher than U-values obtained from in situ measurements. Evidence also exists of retrofit projects where solid wall insulation has been installed not fully understanding a building’s physics. This has led to problems with condensation, summer overheating and loss of benefits from heat retention and the cooling capabilities of solid walls. Poor installation of energy saving measures and inadequate skills training for their installation can also be problematic.

Building services
Before making physical alterations to building fabric it is essential to review how the building is used and how effectively its heated. Energy efficiency will be affected if building services do not operate as intended through equipment faults or poor maintenance.
2. The impact of climate change on historic Cornish buildings

Heritage values and significance

Historic buildings differ in levels of protection and in their significance. Section 132 of the National Planning Policy Framework states:

‘when considering the impact of a proposed development on the significance of a designated heritage asset, great weight should be given to the asset’s conservation. The more important the asset, the greater the weight should be.’

Options to improve the energy efficiency of a Listed building could differ from those for an unlisted building. Care is needed to avoid damaging the character and significance of a historic building with any alterations to improve thermal and acoustic performance.

Occupant behaviour

Occupant behaviour is a major factor in energy use. People use energy and heat rooms in different ways and properties are not always similar (e.g. removal of internal walls and cellar and attic conversions). There is no need to maintain uniform temperatures throughout the whole building all year round. If temperatures can be controlled when they become too hot or too cold, a better internal thermal environment can be achieved.

Summary

Consideration of the factors described above can help to plan an effective and affordable package of energy efficiency measures that strikes an appropriate balance between conserving the heritage values of the building and reducing energy use and carbon emissions.

The purpose of this guide is to help in this process by providing information on low to medium and high cost energy efficiency measures for use on historic buildings. The pros and cons of individual measures are also reviewed.
3. Keeping buildings healthy and comfortable
3. Keeping buildings healthy and comfortable

3.1 Why solid walled buildings need to breathe

Modern buildings are usually built with insulated cavity construction. External walls are non-permeable and layered to prevent moisture reaching internal rooms. Most historic buildings have solid walls which are built from materials that can absorb and release moisture freely. The diagram on the right shows how moisture movement in modern and historic buildings differs. For more information see: Historic England - Energy Efficiency and Historic Buildings

The moisture buffering capacity of solid walls can help to stabilise humidity and reduce condensation on surfaces. The thermal mass of thick masonry walls also has the effect of reducing the size of internal temperature variations by buffering changes in external temperature. This results in increased thermal comfort, and reduced peak loads for heating or cooling installations.

When a traditional building is working as intended there is an equilibrium between ventilation, heat and moisture. Upsetting this balance by carrying out well intentioned alterations to improve energy efficiency can harm the building fabric and adversely affect the health and well-being of its occupants. This can also occur if a building is poorly maintained or if unsuitable, non-breathable materials are introduced in repairs or retrofitting.

3.2 Internal moisture vapour

Not all damp in buildings with solid walls is caused by external water penetration. Moisture vapour is produced internally by simply living and breathing and through activities such as cooking, washing and drying clothes.

Diagram showing differences in moisture movement between modern and historic buildings. Diagram © Robyn Pender.
3. Keeping buildings healthy and comfortable

3.3 Condensation and dew points

Condensation occurs when water vapour in the air makes contact with a cold surface and condenses, returning to a liquid state. The dew point is the temperature it condenses at. It is noticeable on windows and cold external walls and can lead to mould growth on surfaces. Interstitial condensation occurs when water vapour passes from the internal environment and condenses within a wall.

3.4 Membranes and barriers

A variety of membranes and barriers are available for use in retrofitting:

**Non-woven geotextile membrane**: a strong, bonded fibre sheet that allows liquid and vapour to pass through easily while stopping larger particles. Common uses are under patios and paths as a weed suppressant and on soakaways and French drains. They can also be used under limecrete floors.

**Vapour-permeable membrane**: finely perforated sheeting material that allows water vapour to pass through but blocks the passage of water. Often installed on the cold side of insulation where some degree of waterproofing is required.

**Vapour control layer (VCL)**: a vapour check used on the warm side of insulation to prevent interstitial condensation.

**Vapour barrier**: a highly vapour resistant membrane often unsuitable for use on historic buildings. Care is needed as workmanship and punctures from surfaces often affects the vapour tightness of the barrier.

**Damp-proof membrane (DPM)**: a strong, impermeable plastic membrane laid under floors to prevent rising damp. Care is needed when used on historic buildings in case water is pushed out to external walls.

3.5 Healthy buildings

Human health is directly affected by the built environment. ‘Sick building syndrome’ can result from internal temperatures, light levels, dampness and air quality. Great care is needed when increasing air tightness in a building as it could potentially lead to unhealthy living conditions. Inappropriate thermal insulation or materials could have a direct effect on the health of a building’s occupants. Healthy living conditions in an older building can be achieved by using suitable breathable materials/products and controlling moisture and ventilation.

Further information

[Changeworks - the health impacts of fuel poverty and living in a cold and damp home](#)

[Historic Scotland - Indoor air quality and energy efficiency in historic buildings](#)

[NHS Choices - Sick building syndrome](#)

Main contents
3. Keeping buildings healthy and comfortable

3.6 Ways of controlling moisture

All buildings need adequate ventilation to remove excess moisture, reduce the risk of condensation and to maintain good healthy indoor air quality. In Cornwall regular ventilation also reduces health problems from Radon gas. A balance is needed between ventilation, draught reduction and any additional insulation.

<table>
<thead>
<tr>
<th>Action</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure regular building maintenance.</td>
<td>Reduces damp problems.</td>
</tr>
<tr>
<td>Ensure rainwater goods and surface water drainage systems are effective.</td>
<td>Reduces damp and provides long term benefits to health of building fabric and occupants.</td>
</tr>
<tr>
<td>Ensure adequate ventilation: open windows if condensation forms and install extractor fans in kitchens and bathrooms. Install air bricks to walls.</td>
<td>Allows condensation to evaporate/removes humid air. Open windows provide increased ventilation and solar gain.</td>
</tr>
<tr>
<td>Open windows and secondary glazing during the day. Traditional windows can be fitted with window stops to provide a form of secure trickle ventilation allowing windows to remain open more regularly (see page 19).</td>
<td>Promotes regular ventilation. Prevents moisture build up. Reduces mould and condensation.</td>
</tr>
<tr>
<td>Keep lids on saucepans and vent clothes driers externally to avoid excess moisture (see page 23).</td>
<td>Reduces internal damp and damage to building fabric.</td>
</tr>
<tr>
<td>Avoid trapping moisture within building fabric.</td>
<td>Reduces internal damp and damage to building fabric.</td>
</tr>
<tr>
<td>Ensure any insulation used on internal or external walls is permeable.</td>
<td>Allows solid walls to breathe.</td>
</tr>
<tr>
<td>Avoid cold bridging (heat loss at junctions such as window reveals) when insulating.</td>
<td>Reduces condensation.</td>
</tr>
<tr>
<td>Dehumidifiers can be used to remove excess moisture although this is not an energy efficient option.</td>
<td>Reduces internal moisture.</td>
</tr>
</tbody>
</table>

Further information

- Historic England - Energy Efficiency and Historic Buildings
- Context article: dew points / condensation by Ian Brocklebank
- Community Energy Plus guide to condensation and mould
- SPAB - Technical Questions and Answers - Condensation
- Sustainable Traditional Building Alliance - including draft Moisture Risk Assessment and Guidance.
3. Keeping buildings healthy and comfortable

3.7 Ventilation and security

On traditional double hung sash windows both the top and bottom sashes can be opened at the same time. This is a healthy arrangement that provides adequate ventilation to rooms.

Security is still possible on traditional windows with appropriate ironmongery. Sash window stops fixed slightly above the meeting rail are an easy way to allow ventilation but maintain security. They provide a form of trickle ventilation without cutting through the window frame.

Ventilation can also be provided by air bricks, grilles, appropriate ridge and eaves ventilation and by retaining and reusing existing chimneys.

Existing chimneys should not be permanently blocked and flues should be opened in the summer to assist cooling and reduce dampness in the flue. If not in use, chimneys should be vented to help air circulation within rooms. Chimney balloons can reduce draughts to chimneys while still allowing ventilation. Before carrying out any works to flues and chimneys seek further advice from the Fire Service.

Further information

Historic Scotland - Ventilation in traditional houses
SPAB Briefing - energy efficiency in old buildings
Buildingconservation.com - fireplaces, chimneys, fire protection
Thatched Owners Group
3. Keeping buildings healthy and comfortable

3.8 Trickle ventilation

A trickle vent is a small opening on a window or door which allows internal spaces to be naturally ventilated when windows or doors are closed. On new windows this normally involves cutting a ventilation slot through the top frame. This can look unsightly on traditional sash windows. It is possible, however, to provide neat, discreetly concealed trickle vents by cutting a vent slot in the underside of the top case of the sash and venting through the top case as shown in the sketch and photographs on this page. For new build dwellings or extensions please refer to Approved Document F of the Building Regulations.
4. Reducing energy consumption
4.1 Introduction

Older buildings vary in construction, character, location and orientation. As such they may require different ways of improving their energy efficiency. Before making any physical alterations to the fabric of a building it is essential to review how the building is used and how effectively it is heated (as highlighted in Section 2). Occupant behaviour and maintaining the building and building services in a good condition are major factors in reducing energy use. Such a review will help establish what measures need to be taken to improve energy efficiency.

The aim with any measures is to find the best balance between reducing energy use, carbon emissions and preserving the heritage value of a building.

4.2 ‘Trigger Points’ for retrofitting

Many energy efficiency measures can be carried out with little disturbance to the building or its occupants. Others are more disruptive and opportunities to carry them out might occur only occasionally. Installing a new roof, for example, might give an opportunity to install insulation from above which would be beneficial for attic conversions. Internal wall insulation is cheaper to install and less disruptive if carried out at the same time as other renovation works. A change in building ownership could also be a trigger for carrying out energy efficiency improvements.

A whole house approach to saving energy is recommended. Inexpensive and less intrusive improvements should always be considered first before more costly and potentially harmful works. See the following link for more information:

Westminster City Council - Retrofitting Historic Buildings for Sustainability

4.3 Reasons to retrofit

Research by the National Energy Foundation for social housing has shown that difficult or expensive to heat premises are more likely to be under-heated and suffer from damp and condensation problems. This increases maintenance/repair costs for property owners and occupant dissatisfaction. In rented properties it can lead to rent default and associated lost revenue due to more frequent tenancy change as well as increasing the workload of local authority housing staff. In addition, the extra heating required for poorly insulated buildings proportionately increases the carbon dioxide (CO₂) emissions associated with the buildings’ heating system.

Retrofitting requires careful consideration of the interrelationship between ventilation, heat and moisture to avoid unintended consequences that might be harmful to human health or to the fabric of the building.

Further information

Changeworks - energy and fuel poverty

Drying clothes outside avoids the expense of using tumble driers that also contribute to internal condensation.
4.4 Simple ways to reduce energy use

- Ensure building fabric and services are in good repair and properly maintained to maximise performance.
- Reduce draughts through doors, windows, flues and other leaky parts of the building envelope.
- Close doors to retain warmth in occupied rooms. Install heavy curtains and thermal blinds to reduce heat loss. Draw curtains and close blinds/shutters at night.
- Consider lower risk insulation opportunities such as loft and floor insulation and secondary glazing.
- Consider wall insulation only after less invasive works have been explored or implemented.
- Install low energy lighting and heating systems.
- Turn lights and appliances off at the socket when not required and avoid leaving appliances on standby.
- Insulate your hot water cylinder.
- Fix leaking taps and ensure they are fully turned off.
- Have shorter showers; consider a high quality aerating shower and taps.
- Install energy efficient appliances when the existing appliances need replacing. Check the EU energy label or buy ‘Energy Saving Trust’ recommended products.
- Make sure you fully load your washing machine and try to dry clothes outside.
- Don’t boil a full kettle if not necessary. Use lids on saucepans to speed up cooking, reduce energy use and condensation.
- Defrost your freezer to increase its efficiency.
- Wear more clothes in the winter and turn the heating down.
- Consider use of renewables.

Poor maintenance can lead to damp problems in historic buildings.

Further information

Community Energy Plus - Reduce your Energy Bills
Community Energy Plus - Films
Community Energy Plus - Factsheets and Leaflets
Historic England - Saving Energy
4.5 Heating systems

Modern houses are highly insulated to reduce heat loss and respond rapidly to heating. They are typically heated for a couple of hours in the morning and evening when the occupants are at home. Heating regimes like this may not be suitable for many older houses with thicker walls that take longer to heat up and cool down. They can create dramatic temperature fluctuations leading to increased risk of condensation. More information on suitable heating systems for historic buildings is located in Appendix 2.

Domestic hot water heating accounts for 25% of energy use. The efficiency of domestic hot water provision should be considered. Smart meters, energy meters and other investigative tools can help to assess and plan an effective heating regime for your property. Smart meters can be locally bought from around £20 and will be offered by the Government to every home in England, Wales and Scotland by 2020. More information on smart meters is on the Energy Saving Trust website. Information on energy assessments can be found in Section 1.10.

There is no need to return to 18th century living arrangements, but small behavioural changes should lead to a more comfortable home and lower energy bills.

### Easy ways to reduce energy use

<table>
<thead>
<tr>
<th>Action</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat house constantly at a lower temperature.</td>
<td>Allows the dense material of the house time to absorb heat and release it slowly.</td>
</tr>
<tr>
<td>Alternatively, heat main rooms with greater intensity. Unoccupied rooms don't need as much heating as occupied rooms.</td>
<td>Allows main rooms to be kept at a comfortable temperature while other rooms can be heated less.</td>
</tr>
<tr>
<td>Familiarise yourself with your heating system. Install more sensitive heating controls such as thermostatic radiator control valves. Turn off radiators in rooms that aren't being used and close doors.</td>
<td>Allows appropriate temperatures to be maintained throughout the house. Prevents over-heating. Tailors heating to the way occupants use the building.</td>
</tr>
<tr>
<td>Use existing fireplaces and install a wood burner if a good source of fuel is available. Make sure flue is properly lined and be wary of fire risk in thatched properties.</td>
<td>Chimney breasts are designed to store heat and release it slowly. Rest of the flue system distributes heat to upper floors in similar manner. Chimneys also help internal evaporation.</td>
</tr>
<tr>
<td>Install an energy-efficient condensing boiler.</td>
<td>Improves efficiency of heating system, reducing running costs.</td>
</tr>
<tr>
<td>On alterations to large historic buildings take simple measures to improve efficiency of heating systems. Lag hot water cylinders and pipe work. Consider combi boilers and local water heaters to reduce pipe run lengths.</td>
<td>Improves efficiency of heating System, reducing running costs.</td>
</tr>
<tr>
<td>Consider use of energy audits / assessments.</td>
<td>Assess performance of existing heating, lighting and take appropriate measures to improve efficiency.</td>
</tr>
</tbody>
</table>
4.6 Draught reduction

The table below shows inexpensive and unobtrusive methods of draught reduction that are easy to install. Reducing draughts will make a building easier and cheaper to heat. Good draught proofing should be durable and inconspicuous. Maintaining adequate ventilation is essential in older buildings.

Further information on draught proofing and options to upgrade existing windows is available in Section 5.2.3

<table>
<thead>
<tr>
<th>Action</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draught-strip your doors, windows and floors and install chimney balloons.</td>
<td>Inexpensive ways to reduce draughts. For more information see Section 5.2.3 (Draught proofing).</td>
</tr>
<tr>
<td>Install secondary glazing, (permanent or seasonal). Reinstating or installing shutters, blinds and curtains can also help reduce draughts.</td>
<td>A cost-effective way to improve energy efficiency. Secondary glazing is also effective at reducing noise and can be installed with acoustic glass (see Section 5.2.4).</td>
</tr>
<tr>
<td>Open curtains, shutters and blinds during the day and close them at night.</td>
<td>Reduces draughts, maximises solar gains during the day and retains heat during the night.</td>
</tr>
<tr>
<td>Close internal doors when temperatures are cold.</td>
<td>Reduces effect of draughts. Retains heat in each room.</td>
</tr>
<tr>
<td>Use doorway draught excluders (such as sausage dogs).</td>
<td>Cheap way of reducing draughts, especially on loose-fitting doors.</td>
</tr>
<tr>
<td>Lay carpets on floors or use rugs where carpets are not suitable.</td>
<td>Adds an additional thermal layer to the floor. Reduces draughts.</td>
</tr>
<tr>
<td>Hang tapestries or other fabrics from walls.</td>
<td>Adds an additional thermal layer to the wall, improving comfort. Reduces radiant heat loss.</td>
</tr>
</tbody>
</table>
5. Building fabric improvements
5.1 Introduction
This section provides examples of sympathetic products and materials for upgrading historic buildings and covers:
- Window upgrading
- Roof insulation
- Floor insulation (ground and intermediate floors)
- Wall insulation (external, internal and cavity)

5.2 Windows
Original windows in historic buildings should be preserved as they provide significant architectural and historic character. This is reflected in the large number of unsuccessful planning appeals for replacing traditional windows in historic buildings. Repairing and maintaining original windows is always preferable to removing and replacing them. Replacing traditional windows on your property can reduce its market value. English Heritage emphasises this in a short video:

Historic England - Making Sash Windows Energy Efficient

5.2.1 Improving the performance of traditional windows
The thermal performance of an original window can be improved easily and cost effectively without affecting its character. The table below shows options to upgrade single glazed windows with comparative U-values. It shows that original windows can be retained and upgraded to a thermal performance up to or near the standards required by Part L of the Building Regulations.

These options will be cheaper than installing new double glazing throughout your house, while still retaining character and providing highly effective improvements to thermal performance. The measures below can also be combined to further increase performance.

A number of these options have been trialled and monitored as part of the Camborne, Roskear, Tuckingmill Townscape Heritage Initiatives. Results of this monitoring is included in Appendix 1.
**5.2.2 Repairs and maintenance**

Old windows often look in worse condition than they actually are and can easily be professionally overhauled and draught proofed. Draughts can be reduced by as much as a third if windows are repaired and maintained properly.

Many good long lasting paints are now available which can reduce maintenance periods. Linseed paint, for example, can last up to 15 years which is comparable to the lifespan of a uPVC window. *Section 6.2.8* provides information and costs on appropriate and sustainable finishes for timber windows.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows often look worse than they are and often only the cills and lower frames need replacing. Allows windows to open, improving ventilation. Retains original fabric, increasing window life Reduces amount of further improvements required Resin repairs / reclaimed timber can improve the quality of repairs and significantly extend the lifespan of the repair. Good quality paints and stains now available which significantly reduce maintenance periods. Maintaining original glazing adds character.</td>
<td>Requires regular maintenance and painting. Maintenance of high level detailing sometimes difficult.</td>
</tr>
</tbody>
</table>

**Further information**

- [Historic England - Traditional Windows: repair, care, maintenance](#)
- [Historic England - Making Sash Windows Energy Efficient](#)
- [Historic Scotland - Sash and Case Windows guide](#)
- [Buildingconservation.com - articles on window repair](#)
- [Technical Q and As from SPAB](#)
- [Greenspec - search ‘timber preservation’](#)
- [Wood Window Alliance - Specifiers’ Guide to Timber Windows](#)

### Costs / lifespan (based on typical sash window 800x1000mm)

<table>
<thead>
<tr>
<th>Process</th>
<th>Capital Costs (Supply &amp; install)</th>
<th>Lifespan in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical overhaul of sash window using splicing</td>
<td>£160-650</td>
<td>100 plus</td>
</tr>
<tr>
<td>New hardwood cill</td>
<td>£160</td>
<td>Up to 50</td>
</tr>
<tr>
<td>New softwood cill</td>
<td>£110</td>
<td>Up to 30</td>
</tr>
<tr>
<td>Reclaimed wood cill repair</td>
<td>£55</td>
<td>Up to 20</td>
</tr>
<tr>
<td>Typical overhaul of sash window using resin repair</td>
<td>£55- £185 (resin only)</td>
<td>20-25 (resin only)</td>
</tr>
<tr>
<td>Replacement timber sash windows</td>
<td>£990 - £1,400</td>
<td>35 - 100</td>
</tr>
</tbody>
</table>
5. Building fabric improvements

THI funded resin repairs to original timber windows and doors, Trelawney Road, Camborne
5.2.3 Draught proofing

Draughts account for 15-20% of all heat lost in old buildings. They can come from windows, doors, loft hatches, electrical fittings on walls and ceilings, suspended floors, pipe work leading outside, ceiling-to-wall joints and chimneys/fireplaces.

Draughts can be reduced using appropriate gap fillers and weatherising rubber tubes or pile brushes. Care is needed to allow sufficient ventilation to provide fresh air and remove moisture and pollutants. More ventilation is needed in wet rooms, kitchens, bathrooms and rooms with fireplaces.

A draught proofed house will feel more comfortable at lower temperatures due to the reduction of any wind chill factor. This reduces heating requirements, increases savings and efficiency. If a window rattles it is likely to have gaps and draughts. Draught proofing reduces any rattling making the window easier to open which allows it to be used more frequently for ventilation.
5. Building fabric improvements

5.2.3 Draught proofing (continued)

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduces uncontrolled ventilation in houses. Reduces heat demand. Reduces heating bill. Reduces carbon emissions. Easy to install.</td>
<td>Can sometimes affect character of windows and doors. Draught proofing windows where secondary glazing has been installed can cause condensation on outer glazing. Chimneys should not be permanently blocked. Flues should be open in summer to assist with cooling and reducing dampness in the flue.</td>
</tr>
</tbody>
</table>

Costs / savings / payback

Figures from Energy Saving Trust

<table>
<thead>
<tr>
<th>Process</th>
<th>Typical Costs</th>
<th>Savings per year</th>
<th>Payback in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draught proofing around windows, doors, etc.</td>
<td>£130 DIY £260 Professional</td>
<td>Draught proofing: £55 Heating saving: £60 Total: £115</td>
<td>1 – 2 DIY 2 – 3 Professional</td>
</tr>
<tr>
<td>Filling gaps between floor and skirting board.</td>
<td>Around £27</td>
<td>Around £20</td>
<td>Around 1 year</td>
</tr>
<tr>
<td>Chimney Sheep Draught Excluder</td>
<td>£21 - £52</td>
<td>1% - 5% per annum on heating bill</td>
<td>1-5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Area</th>
<th>Solution</th>
<th>Cost (materials only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows</td>
<td>Self adhesive foam strips – cheap option. Professionally installed seals – more expensive but longer lasting. Replacement traditional windows can be rebated to allow draught proofed seals to be fixed.</td>
<td>£1 / m plus £5 plus</td>
</tr>
<tr>
<td>Doors</td>
<td>Keyhole cover. Letterbox flap with brush. Draught exclusion strip along bottom. Foam, brush or wiper strips along sides.</td>
<td>£5 plus £15.50 plus £10.50 plus £1 / m plus</td>
</tr>
<tr>
<td>Chimneys / Fireplaces</td>
<td>Install chimney balloon/chimney sheep or fit register plate with vent grille that can be opened or closed.</td>
<td>£15.50 plus</td>
</tr>
<tr>
<td>Floorboards</td>
<td>Filler, decorators caulk. Proprietary flexible seals.</td>
<td>£15.50 plus</td>
</tr>
<tr>
<td>Loft Hatches</td>
<td>Draught proof as doors and provide insulation on back.</td>
<td>£1 / m plus</td>
</tr>
</tbody>
</table>

Further information

Historic England - Draught proofing general information
Historic England - Draught proofing windows and doors
Historic England - open fires, chimneys and flues
Energy Saving Trust - draught proofing your home
The greenage - draught proofing chimneys
5.2.4 Secondary glazing

Secondary glazing has improved in recent years and can open in a similar way to a traditional sliding sash window. This gives it an unobtrusive appearance. It is a good way of providing thermal improvements, particularly where low emissivity glass is used. Secondary glazing avoids having to remove the window’s original glass. It is reversible, can be easily cleaned and is a very effective way of reducing noise especially if acoustic glass is used. Condensation risks can be reduced by not draught proofing original windows and relying on draught proofing secondary glazing.

![Secondary glazing image](image.jpg)

THI funded secondary glazing fixed through magnetic strips, Cross Street, Camborne.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>No need to remove original windows. Kits can be purchased and installed DIY. Cheaper than new double glazed units. Modern secondary glazing is unobtrusive, easy to open and clean. It can open in a similar way to a sash window. Opening sash and secondary glazing together has visual benefits and makes ventilation easier. Option to remove secondary glazing in the summer. High quality noise reduction through larger air gap. Good option for buildings fronting highways. Provides additional security.</td>
<td>Some additional reflections when viewed from outside. Older secondary glazing often looks clumsy. May interfere with operation of internal shutters.</td>
</tr>
</tbody>
</table>

### Costs / lifespan
Based on typical sash window 800x1000mm

<table>
<thead>
<tr>
<th>Process</th>
<th>Capital Costs (supply &amp; install)</th>
<th>Lifespan in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secondary glazing with magnetic strip fixing</td>
<td>£270-£435</td>
<td>90</td>
</tr>
<tr>
<td>Secondary glazing with acoustic glass</td>
<td>£340-£390</td>
<td>90</td>
</tr>
<tr>
<td>Secondary glazing with standard glass</td>
<td>£270-£325</td>
<td>90</td>
</tr>
<tr>
<td>Secondary glazing with acrylic</td>
<td>£110-£215</td>
<td>40</td>
</tr>
<tr>
<td>Transparent film (DIY option)</td>
<td>£10-£22</td>
<td>15</td>
</tr>
<tr>
<td>Secondary glazing with low emissivity glass</td>
<td>£200</td>
<td>90</td>
</tr>
</tbody>
</table>
5. Building fabric improvements

Secondary glazing can be easily and cheaply installed. Acrylic panels can be clip fixed to internal timber frames as shown here at converted former Carpenter’s Shop at Heartlands, Pool.

A DIY secondary glazing solution at the Old Rectory, North Cornwall using aluminium profiling and anti reflective Perspex fixed with magnetic tape. The secondary glazing is installed in autumn and removed in spring. Care is needed to ensure that adequate fire escape is still possible from internal rooms.

Further information

Buildingconservation.com - Secondary Glazing
Historic England - Secondary glazing for windows
Historic England - Research: thermal performance of traditional windows
Centre for Sustainable Energy - Secondary Glazing
Historic Scotland - Thermal performance of traditional windows
Storm Windows - bespoke secondary glazing for historic buildings
5.2.5 Shutters

Internal shutters were historically used to retain heat and improve security and privacy. They are an important feature of many historic buildings and add character to interior rooms. They often remain in historic buildings and can be easily and cheaply restored or reinstated.

Thermal performance can be increased through draught proofing and insulating shutter panels on new shutters (see images below). Energy monitoring carried out as part of the Camborne THI (see Appendix 1) indicated that reinstated shutters could reduce annual energy bills by 5-10%.

New shutters should be rebated on both sides of each individual panel, extend to the internal window cill and be accurately restrained at window reveals.

Pros Cons

- Significantly reduces heat loss.
- Cheap solution if shutter already installed and only draught proofing required.
- May be able to be installed DIY.
- Looks good and adds character to a room.
- Draught proofing shutters increases performance.
- Offer reasonable noise protection.
- Option to install thermal shutters.
- Increases security.

- Shutters usually left open during the day, increasing heat loss.
- Care needed not to trap fingers when opening and closing shutters.
- Could damage window or reveal if not adequately restrained at reveal or stops for locking bars not fixed.

Costs / lifespan

Based on typical sash window 800x1000mm

<table>
<thead>
<tr>
<th>Process</th>
<th>Capital Costs (supply &amp; install)</th>
<th>Lifespan in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restored existing original timber shutters</td>
<td>£57-£160/nr</td>
<td>10-15 until another restoration needed</td>
</tr>
<tr>
<td>Replacement original timber shutters</td>
<td>£160 - £325/nr</td>
<td>30-40</td>
</tr>
<tr>
<td>New purpose made timber shutters</td>
<td>£215 - £540/nr</td>
<td>30-40</td>
</tr>
<tr>
<td>New purpose made thermal timber shutters</td>
<td>£865/nr</td>
<td>30-40</td>
</tr>
<tr>
<td>Extra over draught proofing for shutters</td>
<td>£80 - £160/ nr</td>
<td>10-20</td>
</tr>
</tbody>
</table>
5. Building fabric improvements

Traditional timber shutters installed as part of THI works.
Above: reinstated traditional shutters at 3 Penlu, Tuckingmill.
Right: new shutters installed at Trevu Road, Camborne.
5.2.6 Thermal blinds and curtains

The use of modern insulated or traditional heavy lined curtains or reflective and/or insulated blinds is a simple and cheap way to improve the thermal performance of windows.

Thermal roman blinds, made of flexible fabrics, including low emissivity films, 'Thinsulate' insulation and Aluminised Mylar (space blanket) are available. These can be sealed to existing window frames using powerful magnets and can substantially reduce heat loss and draughts from single glazed windows.

Clear insulating blinds are also available which can be used in addition to curtains.

Thermal blinds and curtains would often be used anyway in a historic building and can prove an easy and cost effective way of improving efficiency while retaining the character of an internal space.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheap option to upgrade thermal performance.</td>
<td>Risk of mould.</td>
</tr>
<tr>
<td>Good range of available colours.</td>
<td>Magnetic fixing strip for thermal blinds needs careful detail to avoid looking clumsy.</td>
</tr>
<tr>
<td>Adds character.</td>
<td>Lack of privacy when blinds open.</td>
</tr>
<tr>
<td>Blinds and curtains would usually be used anyway.</td>
<td></td>
</tr>
<tr>
<td>Clear insulated blinds allow light to enter and can be left closed.</td>
<td></td>
</tr>
</tbody>
</table>

**Costs / lifespan**

<table>
<thead>
<tr>
<th>Process</th>
<th>Typical Costs (Supply only rates)</th>
<th>Lifespan in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal blinds</td>
<td>£32 - £105/nr</td>
<td>10</td>
</tr>
<tr>
<td>Clear insulating blinds</td>
<td>£32 - £105/nr</td>
<td>10</td>
</tr>
<tr>
<td>Thermal curtains</td>
<td>£42/nr</td>
<td>10</td>
</tr>
<tr>
<td>Thermal linings for existing curtains</td>
<td>£17/nr</td>
<td>10</td>
</tr>
<tr>
<td>Standard blinds</td>
<td>£16 - £210/nr</td>
<td>10</td>
</tr>
<tr>
<td>Standard curtains</td>
<td>£16 - £210/nr</td>
<td>10</td>
</tr>
</tbody>
</table>

**Suppliers**

- The Thermal Blind Company - thermal and roman blinds
- Insu - clear insulating and draught proof blinds
- Natural Curtain Company - thermal curtains
- Sail Shade blinds for conservatories

---

Main contents

---

5. Building fabric improvements
5.2.7 Double glazing

Replacing windows should only be considered on historic buildings where existing windows are truly beyond repair or are inappropriate replacements. It is essential to retain original fabric and glass wherever possible.

Single glazed traditional timber windows are usually the only acceptable option for listed buildings. Recent appeal decisions support this view. Good quality timber double glazed windows may be appropriate for extensions to listed buildings and unlisted buildings in Conservation Areas. uPVC double glazing is always inappropriate for use in historic buildings and is harmful to produce. uPVC glazing bars cannot replicate original detailing and are often either too bulky or ‘stuck on’.

Double glazing is more appropriate on larger Victorian windows as it is easier to replicate larger original glazing bar details. It is impossible to replicate glazing bars on smaller paneled Georgian windows. When used on historic buildings double glazing should be in timber and consideration should be given to colour coding spacing bars to match the paint finish of the window and puttied beading.

Slim double glazed units are now available with units 10-12mm thick. These units have inert gas sandwiched between the two panes of glass which provides thermal benefits. Slim profile double glazing is not suitable for many listed buildings as the glazing rebates are too small to accommodate the thicker units. They are more suitable for use with heavier Victorian and Edwardian profiles. The increased weight of the glass can strain parts of windows and cause problems balancing sashes. This sometimes leads to use of spiral balances as opposed to traditional lead weights.

Testing of slim profile double glazing by Historic Scotland shows that its thermal performance is not as effective as secondary glazing.

<table>
<thead>
<tr>
<th>Process</th>
<th>Capital Costs (supply and install)</th>
<th>Savings per year</th>
<th>Lifespan in years</th>
<th>Payback in years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard timber double glazing sash</td>
<td>£1,025</td>
<td>£166</td>
<td>10 - 20</td>
<td>6</td>
</tr>
<tr>
<td>Slim double glazing timber sash</td>
<td>£1,400</td>
<td>£171</td>
<td>10 - 20</td>
<td>9</td>
</tr>
<tr>
<td>Typical single glazed timber sash</td>
<td>£1,295</td>
<td>£90</td>
<td>60 plus</td>
<td>14</td>
</tr>
<tr>
<td>Typical uPVC double glazing sash</td>
<td>£1,075</td>
<td>£40</td>
<td>10 - 20</td>
<td>25</td>
</tr>
<tr>
<td>Histoglass (Float Glass) double glazing timber sash</td>
<td>£1,015</td>
<td>£170</td>
<td>35-100</td>
<td>7</td>
</tr>
</tbody>
</table>

Guidance

Historic England - Energy Efficiency in Historic Buildings
Historic England - Thermal performance of timber sash windows
Historic Scotland - technical report on slim double glazing
Historic Scotland - Slim-profile double-glazing in listed buildings

Slim double glazing suppliers

Slimlite
Slenderglaze
Histoglass
5. Building fabric improvements

THI funded slim double glazing.

Timber double glazed window with chamfered timber mock putty beading to reduce glazing bar size (top left) and double glazed timber sash windows at Mill Street, St Day (above right/below) showing the benefit of coordinated colour schemes in a terrace.
5.2.8 Types of glass

A number of options are available for glazing windows in historic buildings. Retaining original glass is always preferable as it adds character to traditional windows and may be of heritage value in its own right. Historic glass can also be incorporated into slim profile double glazing - see the Histoglass website.

Heat loss occurs around the edge of a window. If putty beading is well maintained, retained original glass should not unduly contribute to heat loss through windows. Other types of glazing are available that provide additional security and compliance with Building Regulations.

Pros / Cons / Costs

<table>
<thead>
<tr>
<th>Process</th>
<th>Pros</th>
<th>Cons</th>
<th>Costs per m² (Supply only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard glass</td>
<td>Easily available.</td>
<td>Lacks character and not as strong as others.</td>
<td>£57</td>
</tr>
<tr>
<td>Reclaimed glass</td>
<td>Original fabric, adds traditional character.</td>
<td>Very thin. Expensive.</td>
<td>£261</td>
</tr>
<tr>
<td>Low E Glass</td>
<td>Improved U value. Increased passive solar gains.</td>
<td>More expensive than standard glass.</td>
<td>£168</td>
</tr>
<tr>
<td>Laminated glass</td>
<td>Safety glass holds together when shattered.</td>
<td>Difficult to cut.</td>
<td>£73</td>
</tr>
<tr>
<td>Toughened glass</td>
<td>Strong safety glass crumbles rather than splinters when broken.</td>
<td>Possible security risk through shattering.</td>
<td>£68</td>
</tr>
<tr>
<td>Cylinder/heritage glass</td>
<td>Adds traditional character by replicating original detailing.</td>
<td>Expensive.</td>
<td>£157</td>
</tr>
<tr>
<td>Acoustic glass</td>
<td>Reduces noise, strong, absorbs harmful UV rays, improves energy efficiency</td>
<td>Expensive.</td>
<td>£185</td>
</tr>
</tbody>
</table>

5. Building fabric improvements

Low E glass

Hard Coat Low E glass has a coating applied at a high temperature which creates a durable surface which uses passive solar gains and increases thermal performance. There may be a slight haze visible at certain angles which might restrict its use in some listed buildings. Low E glass can be mounted in secondary glazing, allowing original glazing to be retained.

Further information / suppliers

- Historic Scotland - Maintaining traditional glass guide
- Cornwall Glass and Glazing Co.
- London Crown Glass Company - conservation glasses
- Pilkington - manufacturer of Low E Glass
- Tatra Glass - imported cylinder glass
- Histoglass - slim profile double glazing
- Sash Window Specialist - Acoustic Glass
5.3 Insulation

In older houses care is needed when choosing insulation as it must allow for moisture transfer through the building fabric. Natural or synthetic ‘breathable’ materials are suitable for solid walled buildings. Natural materials may have lower thermal performance figures than their synthetic counterparts, but are more compatible with historic building fabrics.

Problems often occur when materials designed for use with modern construction systems are used in old buildings. Many of these act as a barrier to moisture and do not take into account the need for old solid walled buildings to breathe.

Poor choices of insulation materials and techniques could result in trapped moisture within the fabric of a building. This can result in mould and decay which is damaging to building fabric as well as the health of occupants.

Installing appropriate levels of insulation can reduce heat loss and energy demand leading to savings in money and carbon emissions. This section highlights appropriate products and provides performance data, costs and web links to enable further research.
5. Building fabric improvements

External insulation to these terraced properties in Camborne has resulted in loss of original material and architectural character especially to doors and windows.
5.4 Roof insulation

In an uninsulated building, 25% of all heat lost is through the roof. Insulating the loft, attic or flat roof (including lagging water pipes and tanks) is a simple way to reduce heat loss as well as saving money and carbon. Roof insulation is easy to install, has a large DIY market and is cost effective with a lifetime guarantee on most products of 40 years or more.

Check if bats are present in the roof space as this could affect building programmes. For information: Natural England - Bats

Suitable materials for roof insulation include cellulose, sheep’s wool, hemp and flax (see insulation table in Section 5.7 for costs and technical information).

Sheepswool roof insulation being laid. Photo courtesy of Mike Wye and Associates Ltd.

Costs / Savings / Payback (Energy Saving Trust 2012)

The following table shows savings under two scenarios:
- installation of any insulation where there has been none.
- installation in addition to existing insulation.

<table>
<thead>
<tr>
<th></th>
<th>Loft Insulation (0 – 270mm)</th>
<th>Loft insulation (100 –270mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Savings per year</strong></td>
<td>Up to £175</td>
<td>£25</td>
</tr>
<tr>
<td><strong>Installation cost</strong></td>
<td>£110 to £380</td>
<td>£110 to £380</td>
</tr>
<tr>
<td><strong>Payback time</strong></td>
<td>Up to 2 years</td>
<td>4 years plus</td>
</tr>
<tr>
<td><strong>DIY cost</strong></td>
<td>£57 to £370</td>
<td>£57 to £370</td>
</tr>
<tr>
<td><strong>Payback time</strong></td>
<td>Up to 2 years</td>
<td>2 years plus</td>
</tr>
<tr>
<td><strong>Carbon dioxide saved per year</strong></td>
<td>Around 720kg</td>
<td>Around 110kg</td>
</tr>
</tbody>
</table>

Further guidance

Historic England - Insulating Roofs in Historic Buildings
Community Energy Plus - Loft Insulation (Guide for Homeowners)
Energy Saving Trust - Roof and loft insulation
5.5 Floor insulation

Insulating ground floors can help reduce heat loss. On solid ground floors installing a ‘floating floor’ with integral insulation is potentially damaging to internal features of historic buildings such as floors and skirting boards. Limecrete can provide a vapour permeable alternative to a solid concrete floor with or without a damp proof membrane. Insulated clay aggregates can be incorporated into the slab rather than using sand to insulate a limecrete floor. Glass foam granulates are another sustainable option for insulating building floors.

In Listed buildings original fittings such as skirting boards and other timber detailing should be retained rather than replaced wherever possible.

For suspended timber ground and intermediate floors the least damaging solution is to carefully raise the floor boards and insulate the void between joists. This is especially important for floors on upper rooms above lower rooms with historic plasterwork cornices and ceiling roses. It is essential to maintain adequate ventilation in suspended ground floors after insulating. If the floor in your property is suitable for being insulated, the following information should be of help.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduces heating bills. Carbon savings. Creates a warmer, more comfortable floor. On Building Control applications extra insulation on floors can avoid need to upgrade single glazed windows. Carpets and thermal underlays can be an easy way of insulating suspended or solid floors.</td>
<td>Blocking ventilation flows in floors can increase moisture. Original doors and skirting boards can be affected when insulating solid ground floors.</td>
</tr>
</tbody>
</table>

### Costs/Savings/Payback [Energy Saving Trust 2012]

Figures below are supply and install rates

<table>
<thead>
<tr>
<th>Process</th>
<th>Annual Saving</th>
<th>Cost</th>
<th>Payback time (years)</th>
<th>Carbon dioxide savings per year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor insulation – timber floor (between or over timbers)</td>
<td>Arround £110 (DIY)</td>
<td>Arround £835 (Professional)</td>
<td>Arround 2 (DIY)</td>
<td>Arround 12 (Professional)</td>
</tr>
<tr>
<td>Solid floor insulation (rate includes 150mm reinforced concrete slab, screed and insulation)</td>
<td>£60</td>
<td>£57 / m²</td>
<td>Depends on floor area - typical 50 m² floor will take 40 years</td>
<td>Around 240kg</td>
</tr>
<tr>
<td>Limecrete - including membrane, insulation and limecrete slab</td>
<td>Same as concrete floor</td>
<td>£88 / m²</td>
<td>Depends on floor area - typical 50 m² floor will take 65 years</td>
<td>40% over concrete</td>
</tr>
<tr>
<td>Insulated clay aggregate</td>
<td>Same as concrete floor</td>
<td>£110 / m²</td>
<td>Depends on floor area - typical 50 m² floor will take 85 years</td>
<td>45% over concrete</td>
</tr>
<tr>
<td>Glass foam granulate sub floor - insulation only</td>
<td>£60</td>
<td>£21-£26/m² based on 160mm thickness</td>
<td>Depends on floor area - typical 50 m² floor will take 50 years</td>
<td>Around 240kg</td>
</tr>
</tbody>
</table>

### Guidance/Suppliers

- [Historic England - Insulating floors in Historic Buildings](https://historicengland.org.uk/insulating-floors-in-historic-buildings/)
- [Energy Saving Trust - Floor insulation](https://www.energysavingtrust.gov.uk/)
- [IHBC - New developments in insulated, breathing lime floors](https://ihbc.org.uk/new-developments-in-insulated-breathing-lime-floors/)
- [Mike Wye and Associates Ltd - search ‘foam glass aggregate’](https://www.mikewyeassociates.com/foam-glass-aggregate/)
- [Tŷ Mawr Lime Ltd - search ‘Sublime® flooring system’](https://www.tymawrlime.co.uk/sublime-flooring-system/)
- [Tŷ Mawr Lime Ltd - search ‘recycled foamed glass’](https://www.tymawrlime.co.uk/recycled-foamed-glass/)

Main contents
5.5 Floor insulation

Limecrete floor slabs installed at Grade I Listed Godolphin House, near Helston, allow the floor to breathe.

Image English Heritage (© John McKay Bolsover DC.).

Floorboards being re-fixed over an air and vapour control layer laid over insulation within the floor.

Image English Heritage (© John McKay Bolsover DC.).
5.6 Wall insulation

Many historic buildings have thick solid walls of stone, brick or earth which vary in condition and quality of construction. Some well-built walls retain heat but others account for as much as a third of the heat lost from a building. Many old buildings have good thermal mass which helps to absorb, store and release heat over time. Any defects or damp problems in solid walls should be remedied and walls allowed to dry out before installation of any wall insulation.

External and internal walls are often a significant feature of a historic building, so any wall insulation needs to be sympathetic to the character of the building.

The following sections include information on external, internal and cavity insulation and apply to timber framed as well as solid wall construction.

Details of costs, lifespan and thermal conductivity are combined in a table at the end of this section.

### Insulation costs / savings / payback

<table>
<thead>
<tr>
<th>Type of insulation</th>
<th>Internal</th>
<th>External</th>
<th>Cavity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Savings per year</strong></td>
<td>£460</td>
<td>£490</td>
<td>£140</td>
</tr>
<tr>
<td><strong>Total cost including installation</strong></td>
<td>£5,925 to £9,150</td>
<td>£10,220 to £14,145</td>
<td>£110 to £380</td>
</tr>
<tr>
<td><strong>Carbon dioxide saved per year</strong></td>
<td>1.8 tonnes</td>
<td>1.9 tonnes</td>
<td>Around 550kg</td>
</tr>
<tr>
<td><strong>Payback time</strong></td>
<td>13–20 years</td>
<td>20–30 years</td>
<td>Up to 3 years</td>
</tr>
</tbody>
</table>

These are estimated figures taken from the Energy Saving Trust. They are based on insulating a gas-heated, semi-detached home with three bedrooms. The average installed cost is unsubsidised.

---

5.6.1 External wall insulation

External insulation can keep solid wall construction warm and reduce the risk of condensation. Unfortunately for Listed buildings and historic buildings in Conservation Areas, external insulation is often unacceptable as it alters the architectural character, detail and historic value of the building as well as the character of its surroundings. This conflicts with core planning principles of the NPPF that advise to:

‘conserve heritage assets in a manner appropriate to their significance so that they can be enjoyed for their contribution to the quality of life of this and future generations’

There are cases where slate hanging and lime renders are acceptable traditional external finishes that might be used in addition to external wall insulation.

Further information about external wall insulation including costs is available at the end of this section.

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal disruption. Does not reduce the floor area of your home. Improves weatherproofing and sound resistance. Helps airtightness. Increases the life of your walls by protecting masonry. Reduces moisture ingress. Retains beneficial thermal mass of solid walls.</td>
<td>Can be expensive: reduced costs if carried out when external refurbishment planned. May need planning permission. Unlikely to be approved in historic buildings if it affects character and significance. Not recommended if the outer walls are structurally unsound and can’t be repaired. Likely to require alteration to roof overhang, fascia, soffits and rainwater goods. Affects proportions of original details (quoins, window reveals, cills, thresholds). Could be a less breathable end product. Rendered surfaces will need redecoration. Need for careful design and installation to avoid risk of water penetration and trapping.</td>
</tr>
</tbody>
</table>
5.6.1 External wall insulation

**Diffutherm board**
Diffutherm board is a rigid insulation board made from natural wood fibres which gives good thermal and acoustic properties. The board is hygroscopic allowing moisture control and is quick and easy to install.

**Suppliers**
- Greenspec - search ‘Pavatex NBT Diffutherm’
- Ecomerchant.co.uk - search ‘Diffutherm’
- Tŷ Mawr Lime Ltd - search ‘Diffutherm’
- Mike Wye and Associates Ltd - search ‘Diffutherm’

---

**Hofatex board**
Hofatex board is a softwood fibre board for use as thermal insulation and soundproofing in floors, walls and ceilings. It can be used as part of the Warmshell system to create a breathable add on insulation to existing solid walls.

Hofatex board installed as part of the Warmshell system at a property in St Buryan. The board can be lime rendered allowing the building to breathe.

**Suppliers**
- www.wood-fibre.co.uk - Hofatex wood fibre insulation
5.6.1 External wall insulation

All photos: the grade II* listed former carpenters shop at Heartlands, Pool was insulated and clad externally (using 260mm thick rigid insulation boards between cladding). This allowed original timber boarding to be exposed internally. The shadow gap on the window reveal above subtly indicates where the new external cladding starts. The building has been converted to a café and bar serving the heritage and parkland development at Heartlands. Completed works achieved a BREEAM score of ‘excellent’.
5.6.2 Internal wall insulation

On many historic buildings internal wall insulation is only a viable option where the original wall lining or finishes are not present or need to be replaced.

Internal insulation in solid wall construction should still allow walls to breathe to reduce the risk of trapping moisture in the fabric of the walls. Many good breathable products are now available which enable sympathetic internal upgrading of historic buildings.

Internal insulation restricts heat loss through fabric and lowers the U value of a wall to a level that can comply with Building Regulations. There is a need to balance the amount of insulation applied against the creation of cold bridges, increased condensation and reduced benefits of thermal mass.

Non permeable internal insulation requires a well fixed and sealed vapour barrier to prevent internal moisture vapour reaching the insulation. This is difficult to achieve and vapour barriers eventually break down. Removable internal insulation is preferable and good sustainable options such as hemp plaster and clay renders are now available.

### Thermal bridging

Thermal or cold bridging is a local cold spot which can occur when thermal performance is improved in one area with the addition of insulation, while an adjacent area is not insulated. It can occur on window reveals, concrete floor slabs, steel lintels and metal fixings (such as screws penetrating internal plaster board and spreader plates on wall plates).

<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generally cheaper to install than external wall insulation.</td>
<td>Reduction of room dimensions.</td>
</tr>
<tr>
<td>Can be done wall by wall based on convenience and budgetary constraints / availability.</td>
<td>Some disruption due to removal and replacement of skirting, door frames and services.</td>
</tr>
<tr>
<td>Breathable internal insulation is available e.g. hemp plaster / wood fibre boards.</td>
<td>Changes proportions of detailing such as window reveals, cornicing, skirting.</td>
</tr>
<tr>
<td>Hemp plaster could lead to retention of internal features if taken back to original wall surface.</td>
<td>Can make it hard to fix heavy items to internal walls – although special fixings are available.</td>
</tr>
<tr>
<td>Does not affect external appearance of building.</td>
<td>Any problems with penetrating or rising damp need to be fixed first.</td>
</tr>
<tr>
<td>Technical risks not fully understood and currently being researched.</td>
<td>Could encourage cold bridging and condensation.</td>
</tr>
<tr>
<td>Could damage any hidden original detailing such as early plaster / paint / timber panelling.</td>
<td>May increase levels of damp in wall behind insulation.</td>
</tr>
</tbody>
</table>
5.6.2 Internal wall insulation

**Hemp plaster**

Hemp plaster is a low carbon alternative to gypsum based plasters and renders. It is made from hemp, lime and recycled materials. It has good thermal qualities and allows walls to breathe, promoting a healthy indoor environment. As it is a wet-applied plaster it forms an effective anti vapour control layer. There are some concerns with drying times.

[Image of hemp plaster]

**Suppliers**

- **St Astier - hemp construction**
- **Cornish Lime Company** - search ‘Hempsulate’
- **Tŷ Mawr Lime Ltd** - search ‘Lime Hemp Plaster’

---

**Reed board**

Reed board is a rigid building board made from natural reeds. It is suitable for use as a base for plastering on walls and ceilings as a sustainable alternative to gypsum plasterboard. It can be used as a curved backing for plaster and to create an insulated ceiling.

[Image of reed board]

**Suppliers**

- **Mike Wye and Associates Ltd** - search ‘Reed board’
- **Greenspec** - search ‘Claytec reed mats and reed boards’
5.6.2 Internal insulation

Cork insulation board system
This is a high performance, vapour permeable board made entirely from natural and renewable cork. It provides permeable insulation with excellent acoustic properties. More details of cork insulation are available in Appendix 4.

![Lime rendered cork board, Rosewarne House, Camborne.](image1)

Suppliers
Mike Wye and Associates Ltd - search ‘SecilVit cork board’
Tŷ Mawr Lime Ltd - search ‘EcoCork Board’

Clay boards
These are composite boards made of clay, reed and hessian which offer a practical alternative to gypsum plaster board. It is suitable for use internally in dry wall construction on walls and ceilings. It is compatible with clay and lime based plasters, helps regulate temperature and moisture and provides acoustic insulation.

![Photo courtesy of Greenspec.](image2)

Suppliers
Mike Wye and Associates Ltd - search ‘Clayboard’
Greenspec - search ‘Plasterboard’, ‘clayboard’
Passivhaus Store - search ‘Claytec’
5.6.2 Internal insulation

Internal wood fibre board
Breathable wood fibre boards are natural, renewable products made from waste softwood such as splinters and woodchips from local sawmills. They are easy to handle, vapour permeable, have outstanding hygroscopic properties and can help create healthy living conditions. They can be recycled, composted or used to produce heat at the end of their life.

Suppliers
Mike Wye and Associates Ltd - search ‘Pavadocenter’
Naturepro - select ‘wood fibre insulation’
Tŷ Mawr Lime Ltd - search ‘Pavadocenter’

Wool insulation
Wool insulation is easy to handle and quick to install. It can be securely fitted between studwork to fill or part fill a void and can be used as part of a system to internally insulate solid walls. It requires a breather membrane to the inner face of the solid wall on the cold side and a vapour control layer on the warm side before installation of wall finish. It is available in batts or rolls.

Suppliers
Mike Wye and Associates Ltd - search ‘Thermafleece’
Tŷ Mawr Lime Ltd - search ‘Thermafleece’
Black Mountain Insulation - manufacturers of sheep’s wool and hemp insulation
5. Building fabric improvements

5.6.2 Internal insulation

Hydraulic lime render with natural cork aggregates (Secil ecoCORK Lime)

This is a vapour permeable lightweight render with good thermal and acoustic properties. It is made from natural cork aggregates, natural hydraulic lime, lime aggregates and additions. It can be used on exterior and interior walls and ceilings and can be finished with lime wash or mineral silicate paint.

Clay plasters

Clay plasters are a healthy, sustainable internal finish and can be a cost effective alternative to conventional plasters. They can be applied on top of internal wall insulation. As well as providing character to internal spaces they have hygroscopic properties which means they absorb and desorb indoor humidity. This reduces the chance of mould growth and airborne infectious bacteria and viruses, providing benefits for asthma sufferers. They carry a significantly lower embodied energy than conventional and lime based plasters and paints. In Cornwall clay plasters can be sourced locally.

Suppliers

Mike Wye and Associates Ltd - search ‘EcoCork’
Tŷ Mawr Lime Ltd - search ‘EcoCork’
Natural Building Centre - select ‘lime plasters’
Greenspec - search ‘Diathonite Evolution’

Guidance / suppliers

Buildingconservation.com - search ‘clay plasters’
Clayworks - unfired clay
Mike Wye and Associates Ltd - search ‘Claytec’
5.6.2 Internal insulation

Thermablok Aerogel Magnesium Wall Board

Very thin, breathable thermally efficient panels used internally to upgrade solid walls, floors and roofs. They are useful where space is at a premium and on areas of potential cold bridging such as window reveals.

The board is available in a range of thicknesses and can be mechanically fixed to a range of materials. It offers health benefits to internal spaces. Being breathable it has a natural ability to repel liquid while allowing the passage of water vapour. It is also offers no bacterial platform for mould growth as it is hydrophobic not being affected by age or moisture.

 Suppliers

Thermablok - select ‘Products’ for Aerogel Insulation

Calsitherm Climate Board

An insulation board made from calcium silicate, a micro porous building material with effective insulating properties. The board helps regulate humidity and inhibits mould growth creating healthier internal living conditions. Its resistance to mould make it useable on vulnerable walls such as basements. It can be used internally and on window reveals to prevent cold bridging.

 Suppliers

Ecological Building Systems - search ‘Calsitherm’
5.6.3 Cavity/hollow wall insulation

In uninsulated homes, around 33% of all heat lost is through the walls. Some older buildings (early to mid 1920s) have a cavity wall. Filling the cavity with insulation is one way of reducing heat loss. It can also help reduce condensation inside the house which is a common problem in older buildings.

This method is not without risk and if not done correctly can make damp and condensation problems worse. Walls should be free from damp and defects which could allow moisture penetration. This method should not be used on walls exposed to driving rain. Additional information should be sought if considering insulating timber or early masonry cavity walls.

There are opportunities to insulate within hollow wall construction. This building technique is quite common in Cornwall and is often seen in slate hanging and render on lath and timber framed buildings. Please bear in mind that technical considerations differ with cavity and hollow wall construction.
5. Building fabric improvements

### 5.7 Insulation materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Price (£/m²) (Supply &amp; install)</th>
<th>Thermal Conductivity (W/mK)</th>
<th>Lifespan (years)</th>
<th>Description</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose</td>
<td></td>
<td></td>
<td></td>
<td>Made from recycled paper. Fire resistant, non-toxic, low embodied energy. Comes loose in bags so can be fitted into most spaces. Also blown in professionally.</td>
<td>Roof, internal wall, floor (not suitable for cavity wall insulation).</td>
</tr>
<tr>
<td>Sheep's wool</td>
<td>£10.10 – £13.42</td>
<td>0.035 – 0.040</td>
<td>50 plus</td>
<td>Natural fibre from a renewable source (sheep) with low embodied energy. Comes as a roll.</td>
<td>Roof, internal wall, floor.</td>
</tr>
<tr>
<td>Hemp</td>
<td>£4.30 – £6.45</td>
<td>0.038 – 0.040</td>
<td>100 plus</td>
<td>Hemp based insulation with similar properties to Sheep's wool. Comes as a roll.</td>
<td>Roof, internal wall, floor.</td>
</tr>
<tr>
<td>Flax</td>
<td>£52.00 plus depending on availability</td>
<td>0.038 – 0.040</td>
<td>100 plus</td>
<td>Natural fibre from an inexhaustible source (linen). Comes in a roll.</td>
<td>Roof, internal wall, floor.</td>
</tr>
<tr>
<td>Wood fibre</td>
<td>£10.15 – £13.00</td>
<td>0.038 – 0.050</td>
<td>50</td>
<td>Made from natural wood fibre. High density and breathable. Comes in batts.</td>
<td>Roof, internal wall, external wall, floor.</td>
</tr>
<tr>
<td>Clay board</td>
<td>£30.00</td>
<td>0.14</td>
<td>30</td>
<td>These are composite boards made of clay, reed and hessian.</td>
<td>Internal walls and ceilings.</td>
</tr>
<tr>
<td>Reed board</td>
<td>£22.00</td>
<td>0.056</td>
<td>50</td>
<td>Rigid building board made from natural reeds.</td>
<td>Internal walls and ceilings.</td>
</tr>
<tr>
<td>Clay render</td>
<td>£26.50</td>
<td>0.15</td>
<td>40</td>
<td>Highly breathable low carbon product which can help regulate humidity levels. Used on top of insulation.</td>
<td>Internal walls.</td>
</tr>
<tr>
<td>Calsitherm climate board</td>
<td>£50.50 – £67.60</td>
<td>0.059 – 0.066</td>
<td>100 plus</td>
<td>Made from calcium silicate, a micro porous mineral building material with good insulating properties and high capillary action ensuring humidity regulation. Impervious to mould. Can be faced with a lime based plaster for an aesthetic and breathable surface finish. Climate Board is non-flammable and is classed as A1.</td>
<td>Internal walls.</td>
</tr>
<tr>
<td>Hemp plaster</td>
<td>£96.75</td>
<td>0.05 to 0.09</td>
<td>75</td>
<td>Made from hemp, lime and recycled minerals, Hempsulate is a low carbon alternative to gypsum based plasters and renders with good breathability and insulating properties.</td>
<td>Internal walls.</td>
</tr>
<tr>
<td>Cork board</td>
<td>£48.35</td>
<td>0.042</td>
<td>60 plus</td>
<td>Vapour permeable board made entirely from natural and renewable cork.</td>
<td>Internal walls. Also can be used internally.</td>
</tr>
</tbody>
</table>
## 5.7 Insulation materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Price (£ / m²) (Supply &amp; install)</th>
<th>Thermal Conductivity (W / mK)</th>
<th>Lifespan (Years)</th>
<th>Description</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secil ecoCORK</td>
<td>£110.00</td>
<td>0.18</td>
<td>100 plus</td>
<td>Natural hydraulic lime insulating render.</td>
<td>Internal/external.</td>
</tr>
<tr>
<td>Limecrete</td>
<td>£120.00</td>
<td>0.06</td>
<td>60</td>
<td>Limecrete is a vapour permeable solid floor which provides an alternative to a concrete floor with or without a DPC.</td>
<td>Floors.</td>
</tr>
<tr>
<td>Limecrete with insulated clay aggregate</td>
<td>£165.00</td>
<td>0.10</td>
<td>60</td>
<td>As above but with additional thermal properties.</td>
<td>Floor.</td>
</tr>
<tr>
<td>Technopor</td>
<td>£135 / m³</td>
<td>0.085</td>
<td>70</td>
<td>Glass foam granulate.</td>
<td>Floor slabs.</td>
</tr>
<tr>
<td>Hemp-Lime Composite</td>
<td>20mm: £9.90</td>
<td>0.070 – 0.090</td>
<td>100</td>
<td>Made from hemp and lime. Can be applied like render. Many layers used to increase U value.</td>
<td>External wall.</td>
</tr>
<tr>
<td>Hempcrete</td>
<td>£102.00</td>
<td>0.06</td>
<td>100 plus</td>
<td>A mixture of hemp shiv and lime with insulating properties. A low carbon alternative to block-work on extensions to historic buildings.</td>
<td>External walls.</td>
</tr>
<tr>
<td>Hofatex board (Warmshield)</td>
<td>£26.00</td>
<td>0.046</td>
<td>100 plus</td>
<td>Softwood fibre board.</td>
<td>External walling.</td>
</tr>
<tr>
<td>Diffutherm</td>
<td>£110.00</td>
<td>0.044</td>
<td>100 plus</td>
<td>Rigid, hygroscopic insulation board made from natural wood fibres which gives good thermal and acoustic properties.</td>
<td>External walling.</td>
</tr>
<tr>
<td>Thermaslim aerogel magnesium silicate board</td>
<td>£15.00-£31.00</td>
<td>0.029 - 0.080</td>
<td>30</td>
<td>Thin fully breathable, rigid hydroscopic insulation board available in multiple thicknesses for increased R values.</td>
<td>Internal-useful for window reveals and ceilings</td>
</tr>
<tr>
<td>Celotex (for comparison)</td>
<td>25mm:£6.50 50mm:£11.50 75mm:£15.50 100mm:£17.00</td>
<td>0.021-0.022</td>
<td>50 plus</td>
<td>Rigid Polyisocyanurate (PIR) insulation boards</td>
<td>Floor/wall (internal and external)/roof</td>
</tr>
</tbody>
</table>

### Unsuitable products:

- **Mineral wool:** all mineral wool has a higher embodied energy and cannot be recycled.
- **Polystyrene:** a synthetic thermoplastic material made by polymerizing styrene, available in solid form or foam, slow to biodegrade
- **Polyisocyanurate/Polyurethane foam:** plastic based product, previously made with CFCs, now produced with hydrofluorocarbons.
- **Multi-layered foil insulation:** thin, easy to handle and safe to cut but not breathable and unsuitable for old buildings.
5. Building fabric improvements

5.8 Insulating historic buildings guidance

**Historic England**
- External wall insulation in traditional buildings
- Insulating older homes
- Insulating pitched roofs at ceiling level - cold roofs
- Insulating pitched roofs at rafter level - warm roofs
- Insulating flat roofs
- Insulating thatched roofs
- Insulating dormer windows
- Insulation of suspended timber floors
- Insulating solid ground floors
- Insulating solid walls
- Insulating timber framed walls
- Early cavity walls

**Historic Scotland**
- Fabric Improvements for Energy Efficiency in Historic Buildings
- Internal wall insulation to six tenement flats

**Other organisations**
- Energy Saving Trust - Roof and Loft Insulation
- Cornish Lime Company - Insulating Lime Plaster research

5.9 Further technical guidance

**Historic England**
- Buildingconservation.com Subject Index on Building Conservation Ten ways to ruin an old building

**Historic Scotland**
- Historic England - Energy efficiency and Historic Buildings

**Local Authority guidance**
- Cornwall Council - Cornwall Design Guide
- Norfolk County Council - Making Old Buildings Energy Efficient
- Westminster City Council - Retrofitting Historic Buildings

**Sustainable Traditional Buildings Alliance (STBA)**
- STBA Guidance including Planning Responsible Retrofit of Traditional Buildings and The Responsible Retrofit Guidance Wheel.

**Other organisations**
- Bath Preservation Trust - Warmer Bath - energy efficiency guide
- SPAB - Information on energy efficiency
- BSI Standards - BS 7913:2013 - conservation of historic buildings
- Changeworks - Improving energy efficiency in historic buildings
- Edinburgh World Heritage - Energy Efficiency in Historic Buildings
- Historic Towns Forum - Saving Energy - guide for historic homes
5. Building fabric improvements

5.10 Sustainable building products suppliers

Back to Earth - Devon based supplier of natural products
Black Mountain – manufacturer of sheep’s wool and hemp insulation
Cellecta - thermal insulation products
Chroda Eco (Bauwer) - ThermoPor, insulating render made from recycled glass
Cornish Lime Company - manufacturer of Hempsulate render/plaster
Ecological Building Systems – sustainable building incl. Calsitherm
Ecomerchant - sustainable building materials supplier
Green Building Store - sustainable building supplier
Isolina – manufacturer of flax insulation
Mike Wye and Associates Ltd - supplier of natural building products
Minster - insulation supplier
Natural Insulations - supplier of various natural insulations
NaturePro – sheep’s wool, hemp and wood fibre insulation
NBT – manufacturer of wood fibre insulation including Pavaflex
Thermafleece – manufacturer of sheep’s wool / hemp insulation
Tinhay Building Supplies - EcoFill Insulation
Tŷ-Mawr Lime Ltd - Wales based supplier: ecological building products
Womersleys - Eco-friendly materials and building products

Firms specialising in timber repairs

Ventrolla - sash window renovation and draught proofing specialists
Repair Care International - Conservation of joinery guide

Further information on products and services suitable for use on historic buildings can be found in:

Buildingconservation.com - Building Conservation Directory

Converted property near St Keverne with internal walls finished with clay plaster. Works and photo by Clayworks. Design: Matt Robinson Architecture.
6. Sustainable materials
6.1 Sustainability
Sustainable construction is a balance between environmental, social and economic requirements. This guide shows how the environmental impacts of energy inefficiency can be resolved through reduced use of fossil fuels (in the context of materials used).

Further information
Cornwall Council - Sustainable Building Guide
Cornwall Council - Sustainable Development
Cornwall Sustainable Buildings Trust
Greenspec homepage
STBA- includes Responsible Retrofit Guidance Wheel tool
Bath/NE Somerset Council - Sustainable Construction & Retrofitting
Bath/NE Somerset Council - Energy Efficiency & Renewable Energy

6.2 Building materials
Always try and use sustainable materials. Natural materials generally have a lower embodied energy and environmental cost than synthetic materials. Sustainable materials such as Hempcrete, straw bales and cob/rammed earth could provide a sustainable alternative to conventional concrete blockwork construction.

Natural ‘breathable’ products are always preferable on solid walled buildings and often prevent deterioration of original fabric. It is advisable to avoid anything oil or cement based, as these often bind to surfaces in an irreversible manner. This section highlights sustainable products that could be considered when repairing, altering and extending historic buildings. These products could also be used on new buildings in historic areas.

Deteriorating stonework at All Saints Church, Roskear. Inappropriate hard cement pointing restricts that breathability of an external wall. Moisture cannot return through the mortar joint and consequently stonework delaminates.
6.2.1 Timber

Timber should ideally be produced from sustainable sources. Generally this will mean that the impact of logging has been minimised and a replanting programme is replacing harvested wood. There are certification schemes acknowledged by the Building Research Establishment (BRE) as acceptable proof of sustainability. Some examples are:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSC</td>
<td>Forestry Stewardship Council</td>
</tr>
<tr>
<td>PEFC</td>
<td>Program for the Endorsement of Forest Certification</td>
</tr>
<tr>
<td>MTCC</td>
<td>Malaysian Timber Certification Council</td>
</tr>
<tr>
<td>CSA</td>
<td>Canadian Standards Association</td>
</tr>
<tr>
<td>SFI</td>
<td>Sustainable Forest Initiative</td>
</tr>
</tbody>
</table>

Reclaimed wood is often preferable for timber repairs as it is often high quality, has similar properties to existing timber and lasts longer. Although each case should be judged on its own merits, timber boarding can often be a suitable external cladding material on new buildings and extensions to historic buildings.

The Forest Stewardship Council (FSC) standard is widely accepted as the most rigorous of these schemes and the only one that is independent of the forestry industry. If in doubt, check against the relevant certification scheme’s website.

Local FSC products and suppliers can be found through:

- FSC - UK Product and Supplier Database

Guidance on sourcing suitable sustainable timber:

- Greenspec - search ‘timber preservation’
- Wood Window Alliance - Specifiers’ Guide to Timber Windows

Further information on timbers suitable for traditional building repairs

- TRADA - Timber Research and Development Association
- IHBC Technical Publications - technical bibliography on timber
- SPAB - technical Q and As including timber repair

New buildings with cedar cladding built as part of THI funded conversion of former forge buildings, Trevu Road, Camborne.
6.2.2 Hempcrete

Hempcrete house, Roseland near Truro.

Hempcrete is a breathable, highly insulated material made of hemp shiv and lime. It can be used as external walling, timber frame infill insulation and with the addition of aggregate, floor slabs. Hempcrete regulates the temperature and humidity of a building; in some cases completely eliminating the need for heating and cooling systems. Hemp can also be grown locally.

Guidance / suppliers
- Greenspec - search ‘natural building materials’
- The Limecrete Company Ltd - select ‘Hempcrete’

6.2.3 Straw bale construction

Straw bale house, St Martin. Design: Matt Robinson Architecture.

Straw bale construction is a building method that uses bales of straw (commonly wheat, rice, rye and oats straw) as structural elements, building insulation, or both. This construction method is commonly used in natural building or "brown" construction projects.

Advantages of straw bale construction over conventional building systems include the renewable nature of straw, cost, easy availability, naturally fire-retardant and high insulation value. Disadvantages include susceptibility to rot and high space requirements for the straw itself. Straw for the bales can be grown locally.

Guidance / case studies
- BRE - Straw Bale
- Straw bale house, Cornwall
6.2.4 Cob

Cob is a traditional Cornish building material made of sand, straw and clay sub-soil, mixed with water to produce a moist, homogenous and malleable material with outstanding thermal capabilities. Originally trampled down by horses, it is now mixed by foot on a tarp, or a JCB for larger quantities. Walls are normally 450-600mm thick, built of masonry plinths in successive layers 600mm high.

When fully dried it becomes very hard, lasting for hundreds of years as long as it has a solid stone foundation and a good roof. Unfired clay blocks and bricks are readily available and can also be used to rebuild earth buildings and in new buildings. Cob bricks were used in a self build house in Gweek (top right image).

Guidance / suppliers

Devon Earth Building
Greenspec - search ‘unfired clay bricks’
Muddy Mortars
Cob in Cornwall
Leslie Cornell Building Restoration

Main contents
6. Sustainable materials

6.2.5 Thermoplan clay block system

The Thermoplan clay block system is a simple, quick and sustainable form of construction. Solid honey comb clay building blocks are breathable and have excellent thermal insulation values requiring no additional insulation.

Guidance / suppliers
Greenspec - search ‘Ziegelwerk Thermoplan ziegel blocks’
The Passivhaus Store - search ‘Thermoplan’

All photos courtesy of Mike Wye and Associates.
6.2.6 Rammed earth

Visitor centre at Eden Project, St Austell.

Rammed earth walls are constructed by compacting (ramming) moistened subsoil between temporary formwork panels. When dried, the result is a dense, hard monolithic wall. Rammed earth is an ancient form of construction, usually associated with arid areas. Many examples worldwide prove that rammed earth is a successful and durable way of building. A few historical rammed earth buildings are to be found in the UK.

In recent years, rammed earth has become popular amongst environmentally conscious architects. The Visitor Centre at the Eden Project near St Austell is constructed of rammed earth.

Guidance
- Greenspec - search ‘Rammed Earth’
- University of Bath - Developing Rammed Earth for UK Housing
- Earth Building UK - Eden Project

6.2.7 Green roofs

Green roof on Lakeside Café, Helston.

Sedum roof on barn conversions, Mawnan Smith.

Green or sedum roofs can be used on flat or shallow pitched roofs and can provide environmental benefits. They can provide a habitat for wildlife, temporarily store water during heavy rain, protect the roof covering from the sun, provide good thermal and acoustic insulation and improve local air quality.

Guidance
- Cornwall Council Sustainable Building Guide
- Greenspec - search ‘green roofs and planting’
- Livingroofs.org - green and living roofs in the UK
6. Sustainable finishes

Volatile Organic Compounds (VOCs) are chemicals that can evaporate into the air usually at room temperature and often produce an odour. VOCs can be harmful to the environment and human health and are often found in conventional paints.

Sustainable and breathable paints are now available which could provide health benefits to occupants when used internally:

**Lime paint**
A breathable paint highly suited to lime rendered buildings that can be used both internally and externally.

**Limewash**
A traditional finish to solid walls which when applied to a porous wall soaks in, absorbs carbon dioxide and reverts back to limestone. It can be used on internal and external surfaces and can be coloured using pigments.

**Clay paint**
A green, sustainable and vapour permeable alternative to emulsion paints. It helps to control internal humidity and condensation but should not be used on damp walls.

**Linseed paint** - Environmentally friendly, long-lasting and cost effective paint, made from natural 100% pure linseed oil. It can last up to 15 years (up to 3 times longer than modern paints).

**Naturepaint**
A breathable powder paint made using locally sourced clay.

**Mineral silicate paint**
A strong, stable and breathable paint, very durable and long lasting with a good colour range.

**General guidance**
- [Buildingconservation.com - articles on paint / decorative finishes](http://buildingconservation.com)
- [Historic England - I Want To Redecorate My House](http://historicengland.org.uk)
- [Cornish Lime Company - Decorating Old Buildings](http://cornishlimecompany.com)

---

THI funded traditional window reinstatement painted internally with linseed paint at the orangery, Rosewarne House, Camborne.

Huers Hut, Towan Head, Newquay. Lime painted, bag rubbed external rubble wall.
6.2.9 Painting traditional joinery

Good preparation and appropriate primers, undercoats, paints and stains will extend the period needed to repaint traditional windows and doors and avoid the need for replacement. Paints are available now with long lifespans benefiting retention of original fabric. Suitable paints for traditional joinery include:

**Oil based gloss paints**
Consisting of a primer, undercoat and gloss top coat.

**Water-borne gloss paints**
More flexibility over time and do not yellow.

**Wood stains**
Oil based or water borne and semi transparent or opaque. Some stains are ‘Microporous’ meaning vapour passes through them without breaking the skin which can allow an unseasoned wood to dry out more easily.

**Varnishes**
Oil or water based generally labelled as ‘Yaught’, ‘Spar’ or ‘Front Door’. Usually will not last as long outside as paint needing more maintenance).

**Timber oils**
Usually used on naturally oily woods such as teak. Needs to be applied to bare wood, hard to maintain in exposed locations and are slightly soft retaining dirt.

**Lead paints**
Durable paint can be used on Grade 1 and 2* listed buildings. Originally contained harmful white lead which since 1960’s has been replaced with other less harmful pigments).

Lead paint is restricted by environmental law due to its toxicity. Its use is permitted under license for use on Scheduled Ancient Monuments, Grade I and II* listed buildings, and artworks.

*Historic England - Sourcing Lead Paint* provides information on permitted uses and licensing requirements.

### Process Costs

<table>
<thead>
<tr>
<th>Process</th>
<th>Costs (Supply &amp; install rates) per m²</th>
<th>Lifespan in years (based on regular maintenance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lime paint</td>
<td>£12.00</td>
<td>7</td>
</tr>
<tr>
<td>Limewash</td>
<td>£5.25</td>
<td>5-7</td>
</tr>
<tr>
<td>Clay paint</td>
<td>£4.85</td>
<td>5-7</td>
</tr>
<tr>
<td>Linseed paint</td>
<td>£8.60</td>
<td>15-20</td>
</tr>
<tr>
<td>Breathable (microporous) paints</td>
<td>£14.00</td>
<td>20</td>
</tr>
<tr>
<td>Mineral silicate paint</td>
<td>£7.95</td>
<td>5-7</td>
</tr>
<tr>
<td>Conventional paint (low / standard)</td>
<td>£4.95</td>
<td>3-10</td>
</tr>
<tr>
<td>Conventional paint (high quality)</td>
<td>£7.80</td>
<td>5-15</td>
</tr>
<tr>
<td>Oil based gloss paints</td>
<td>£7.80</td>
<td>15-20</td>
</tr>
<tr>
<td>Water-borne gloss paints</td>
<td>£5.15</td>
<td>10-15</td>
</tr>
<tr>
<td>Wood stains</td>
<td>£10.50-42.00</td>
<td>10-15</td>
</tr>
<tr>
<td>Varnishes</td>
<td>£6.20</td>
<td>10-15</td>
</tr>
<tr>
<td>Timber oils</td>
<td>£5.30</td>
<td>15-20</td>
</tr>
<tr>
<td>Lead paints (specialist uses only)</td>
<td>£21.00</td>
<td>20-30</td>
</tr>
<tr>
<td>Linseed oil / synthetic alkyd resin paint (lead alternative)</td>
<td>£8.30</td>
<td>15-20</td>
</tr>
</tbody>
</table>
6. Sustainable materials

6.2.10 Finishes-Suppliers

Clay paints
Clayworks - clay plaster and clay wall systems
Mike Wye and Associates — search ‘Kreidezeit Vega’ (interior)

High performance paints
Zinsser - search ‘Grade 1’ - zero tension paint (interior use)

Lead alternative paint
Technical Paint Services - search ‘lead free paints’

Limewash
Cornish Lime Company - search ‘limewash’
Little Greene - select ‘limewash’

Lime paints
Cornish Lime Company - search ‘lime paint’

Linseed paints
Linseed Paint Company
Old House Store - search ‘Allback linseed oil paint’
Oricalcum

Microporous paint
Sadolin - search ‘Woodshield’ - a flexible paint for wood

Mineral paints
Beeck - Mineral Silicate Paints
Earthborn—Ecopro silicate masonry system
Tŷ-Mawr - search ‘paint’ to view a range of mineral paints
Mike Wye and Associates - search ‘Kreidezeit GekkkoSOL paint’

Natural breathable paints
Auro - natural eco paints, wood stains, floor oils and finishes
Nutshell Paints - natural paints, wood treatments, varnishes, stains
The Organic and Natural Paint Co.
Earth Born Paints - natural ‘breathable’ water based paints

Primers
Auro - primers for wood and metal
Cornish Lime company - range of primers
### 6. Sustainable materials

#### 6.2.11 Sustainable building materials

<table>
<thead>
<tr>
<th>Process</th>
<th>Costs per m² (Supply &amp; install rates)</th>
<th>Lifespan in years (based on regular maintenance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hempcrete</td>
<td>£102.00</td>
<td>100 plus</td>
</tr>
<tr>
<td>Straw bale</td>
<td>£130.00</td>
<td>100</td>
</tr>
<tr>
<td>Cob</td>
<td>£151.00</td>
<td>100</td>
</tr>
<tr>
<td>Rammed earth</td>
<td>£215.00</td>
<td>100 plus</td>
</tr>
<tr>
<td>Clay renders (internally and externally)</td>
<td>£26.00</td>
<td>40</td>
</tr>
<tr>
<td>Cedar Cladding</td>
<td>£150.00</td>
<td>50-100</td>
</tr>
<tr>
<td>Standard concrete block</td>
<td>£47.00</td>
<td>100</td>
</tr>
<tr>
<td>Rendered cavity blockwork wall</td>
<td>£73.00-£94.00</td>
<td>60 (render)</td>
</tr>
<tr>
<td>Thermoplan clay block</td>
<td>£85.00-£105.00</td>
<td>100</td>
</tr>
<tr>
<td>Green/Sedum Roof Intensive - high maintenance (shrubs, trees, lawn)</td>
<td>£125.00-£155.00</td>
<td>30-50</td>
</tr>
<tr>
<td>Green/Sedum Roof Extensive - low maintenance (e.g. mosses, herbs)</td>
<td>£12.50-£15.60</td>
<td>30 -50</td>
</tr>
<tr>
<td>Flat felt roof</td>
<td>£101.00-£125.00</td>
<td>15</td>
</tr>
</tbody>
</table>

### Further guidance

- AECB - The Sustainable Building Association
- The Alliance for Sustainable Building Products
- Cornwall Sustainable Buildings Trust
- Devon Earth Building Association
- Greenspec - green building products / design / materials
- UK Green Building Council

---


New cob bus shelter, Water-Ma-Trout, Helston. Works funded by Helston THI.
7. Reclaimed and recyclable materials
7. Reclaimed and recyclable materials

7.1 Architectural salvage

Care is needed when using reclaimed materials in case they have been taken from other historic buildings or have a short lifespan. There are many occasions, however, when they are acceptable. Reclaimed wood for scarifying repairs to original windows, for example, has similar properties to the wood of the original windows and provides long term benefits. Old wood was often heartwood and will last longer than newer wood. Architectural salvage companies can be a good source for reclaimed products.

Further information / suppliers

Salvoweb - directory of architectural salvage and antiques.
Eden Reclamation - architectural salvage near Eden Project
Shiver Me Timbers Reclamation Yard, Crowlas, nr Penzance
Stax Reclamation - Saltash based architectural salvage
Trenoweth Roofing and Reclamation Services Ltd, Penzance
Truro Reclamation, Newquay

7.2 Minimising waste

Minimising waste during building works will reduce the amount of material to be disposed of at landfill. This has associated financial and environmental benefits.

Cornwall Council - Recycling, rubbish and waste

7.3 Metal rainwater goods

Traditional leading and rainwater goods add significantly to the character of a historic building. Cast iron or aluminium rainwater goods are a sustainable option which can be made from recycled materials. Cast iron rainwater goods for example can include up to 70-75% of recycled content and can last over 60 years. Aluminium can contain up to 33% of recycled content and can last up to 60 years. This contrasts with plastic alternatives which are harmful to produce and last less than half as long.

Guidance / suppliers

The Building Conservation Directory
A guide to specialist suppliers, consultants and craftsmen
Greenspec - search ‘rainwater goods pipes and fittings’
Alumasc rainwater systems
Tuscan Foundry - Devon based cast iron guttering, radiators etc

Guidance on maintenance of rainwater goods

Buildingconservation.com - maintaining / preserving cast iron rainwater systems
8. Funding options
8. Funding options

8.1 Current funding schemes

Energy Companies Obligation (ECO)
The ECO is a government scheme requiring energy companies to support vulnerable people and those on lower incomes. One of the targets set by the ECO is Affordable Warmth which gives assistance to homeowners or tenants on certain benefits to heat their homes affordably. This is through:

Cold Weather Payment
If you are on benefits and your local temperature is either recorded as, or forecast to be, an average of zero degrees Celsius or below over 7 consecutive days you may be entitled to a Cold Weather payment.

Warm Home Discount Scheme
You may be entitled to a one off discount on your electricity bill if you receive the Guarantee Credit element of Pension Credit (even if you get Savings Credit as well), your name is on the bill and your electricity supplier is part of the scheme.

Winter Fuel Payment
You may be entitled to a tax free payment to help pay your heating bills if you were born on or before 5 January 1953.

Further information:
Details of all of these schemes are available from the Gov.uk web page:
‘Help from your energy supplier: the Affordable Warmth Obligation’

Domestic Renewable Heat Incentive (RHI)
Funding could be available for renewable heating costs for biomass boilers, solar water heating and certain heat pumps. Payments are made for 7 years and are based on the amount of renewable heat made by your system.

Further information:
Domestic Renewable Heat Incentive (RHI)

Feed-in Tariff (FIT)
Payments from your energy supplier are possible if you generate your own electricity through renewable heat such as solar panels or wind turbines.
This is through generation tariffs where a set amount is given for each unit (kilowatt hour or KWh) and an export tariff where any extra units not used can be sold back to your supplier.

Further information:
Feed-in Tariffs: get money for generating your own electricity

Other external links
Department of Energy & Climate Change
Energy Saving Trust
Community Energy Plus
Cornwall Council’s grants advice service

Cornwall Council provides a grants advice service with current information on available grants, primarily for community or business groups. Some of these may be relevant to owners of historic buildings:

Cornwall Council - grants advice service

8. Funding options

8.2 Tax savings

Landlords Energy Saving Allowance (LESA)

Landlords who improve the energy efficiency of their properties are entitled to a £1500 allowance per property.

See website for further details:

Gov.uk - Landlords Energy Saving Allowance

Enhanced Capital Allowances (ECA)

Tax breaks are also available under the Enhanced Capital Allowances scheme, offering 100% first-year capital allowances on investments in ‘green plant and machinery’, such as energy saving industrial and office equipment. In practice the ECA would also entitle a landlord to claim 100% tax on a new boiler.

See website for details:

Department of Energy and Climate Change - The Enhanced Capital Allowance Scheme
9. Further information and advice
9.1 Organisations

**Cornwall Council**
Planning and Historic Environment
Tel: 0300 1234 151
planning@cornwall.gov.uk

**Community Energy Plus**
www.cep.org.uk
Community Energy Plus is a charity and social enterprise providing a range of services to help householders, communities and businesses reduce their energy use and create a more sustainable future for all in Cornwall. For the last fifteen years they have worked in partnership with a number of public, private, charitable and voluntary organisations to support innovative projects relating to energy efficiency and renewable energy.
Telephone: 0800 954 1956 Email: advice@cep.org.uk

**Cornwall Sustainable Building Trust**
www.csbt.org.uk
CSBT is a charitable company committed to making building design and construction as sustainable as possible, with minimal negative impact on the environment, both locally and globally.

**CSBT OBJECTIVES:**
- To raise awareness and minimise the effects of construction on the Cornish and global environments.
- To promote sustainable construction by demonstration to local communities and the construction sector that it can make economic sense.
- To preserve, protect and enhance the environment of Cornwall.
- To act as a single source of expert advice for Local and Strategic Planning Authorities and others.

---

**9. Further information and advice**

**Historic England**
www.historicengland.org.uk
Historic England is a public body that looks after England’s historic environment. It champions historic places, helping people understand, value and care for them. It advises on planning and conservation issues, and provides support through grants and other resources. It offers:
- Advice on management and enhancement of the historic environment based on published conservation principles and promotes managing change through ‘constructive conservation’.
- Holds many information databases and produces a wide variety of publications which can be downloaded online for free, including energy conservation in historic buildings.

**Historic England’s South West Office covers Cornwall**

**Heritage and Climate Change - Historic England guidance on climate change and saving energy in older buildings**

**Carbon Trust**
http://www.carbontrust.com
The Carbon Trust’s mission is to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies. It provides a range of products and services to businesses, including online resources and publications.

**Energy Saving Trust**
www.energysavingtrust.org.uk
The Energy Saving Trust is organised as a social enterprise organisation with charitable status. Their website is full of useful information and advice and they operate a free advice phone line on 0300 123 1234.
9. Further information and advice

AECB - The Sustainable Building Association
The Association of Environmentally Conscious Builders (AECB) is a network of individuals and companies with a common aim of promoting sustainable building.
http://www.aecb.net/

The Society for the Protection of Ancient Buildings (SPAB)
SPAB provides advice on historic building repairs over the telephone, has a range of technical publications and runs regular courses and events.
https://www.spab.org.uk/
Telephone: 020 7377 1644

Cornwall Council
Historic Environment Advice: 0300 1234 151
Building Control: 0300 1234 151
buildingcontrol@cornwall.gov.uk
Planning Advice: 0300 1234 151
planning@cornwall.gov.uk
Sustainable Development
http://www.cornwall.gov.uk/default.aspx?page=2972

Conservation advice
The Heritage Help website includes advice on protection and planning, caring and conserving and heritage organisations:
http://heritagehelp.org.uk/

9.2 Professional services
It is important to use suitably qualified and competent contractors and professionals when undertaking works to historic buildings. Lists of conservation accredited professionals are available from the following links:
Royal Institute of British Architects (RIBA): http://www.architecture.com/Explore/Home.aspx
Royal Institute of Chartered Surveyors (RICS): http://www.ricsfirms.com/
Conservation accredited structural engineers: http://www.ice.org.uk/
Institute of Historic Building Conservation:
http://www.ihbc.org.uk/
IHBC Yearbook
Federation of Master Builders:
https://www.fmb.org.uk/
The Building Conservation Directory 2015
http://www.buildingconservation.com/books/bcd15/
http://www.buildingconservation.com/

Further information / guidance
Historic England -
Heritage and Climate Change
Historic Environment Local Management:
Helm website
9. Further information and advice

9.3 Local contractors for historic building work

- A list of contractors who have carried out traditional repairs as part of THI and HERs schemes in Cornwall can be obtained from: andrew.richards@cornwall.gov.uk

- **Sw-ecohub**
  This is a social enterprise website owned and run by Cornwall Sustainable Building Trust (CSBT) giving information on environmentally sensitive building methods, locally available eco supplies, alternative products/services and consultants.

- **Institute of Conservation (ICON)**
  Conservation register for finding professionally qualified conservator-restorers in the UK/Ireland

- **Local contractors with experience in historic and sustainable construction:**
  
  Cathedral Builders  
  Clayworks  
  Darrock and Brown  
  Jack in the Green - Traditional and conservation builders  
  JJ Sharpe  
  Mike Wye and Associates Ltd  
  Muddy Mortars  
  Ventrolla

We are aware of the work of the contractors above in historic building renovation. Other suitable contractors may be available.