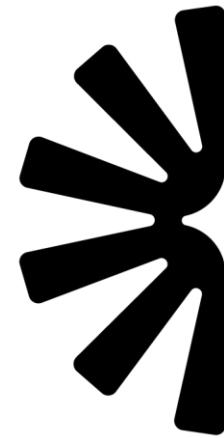


Introduction to retrofit



Who are we?

- Energy charity based in Bristol
- Focused on ending the suffering caused by cold homes and combating the climate crisis
- We support people in fuel poverty through our advice line and retrofit team
- We support community organisations on energy, fuel poverty, retrofit and local and central government with decarbonisation and energy plans
- We are supporting the SiB ERF application process with technical buildings advice



**Centre for
Sustainable
Energy**





Subjects covered today

- Reasons to retrofit
- Key principles when planning to retrofit
- Types of audits and surveys
- Building fabric retrofit measures and considerations

Retrofit

Building energy retrofit refers to any improvement work on an existing building to improve its energy efficiency.



Reasons to retrofit



Reasons to retrofit

- Reduce energy bills / overall running costs
- Improve comfort for building users
- To open up unused space
- Trigger points – e.g. boiler breaks
- Building maintenance is needed
- Duty holder regime / compliance with legislation
- Protection of unique characteristics in heritage buildings
- Strategic priorities (e.g. reputation; carbon savings; community resilience)
- Local community need (e.g. warm/cold hubs, emergency shelter)
- Longer term resilience against energy costs, improved financial viability



Resilience and the built environment

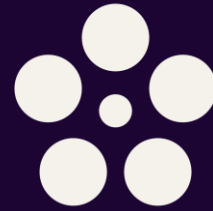
Adapting our community buildings and making them resilient in a changing climate may include a wide range of interventions, for example:

- Energy efficiency improvements in a building's operation
- Flood prevention and/or mitigation – both coastal and ground water
- Measures that mitigate increasing exposure to wind driven rain
- Upgrade of rainwater goods and drainage to cope with increased rainfall
- Measures to mitigate increased overheating risks – particularly to south facing glazing
- Ventilation measures in response to increased relative humidity and risk of mould growth



Current building stock

The most sustainable buildings are often those which already exist. Retrofitting existing structures is often better than new construction.



2050 buildings

An estimated 80% of the buildings we will have in 2050 are already built today.



Heritage value

Successful interventions lead to the continued use and care of buildings, preserving heritage features.



Embodied carbon

Retrofitting existing buildings reduces waste and avoids emissions which would have come from new construction.

Key principles



Do no harm



Assessment & monitoring



Repair & maintenance



Whole building approach



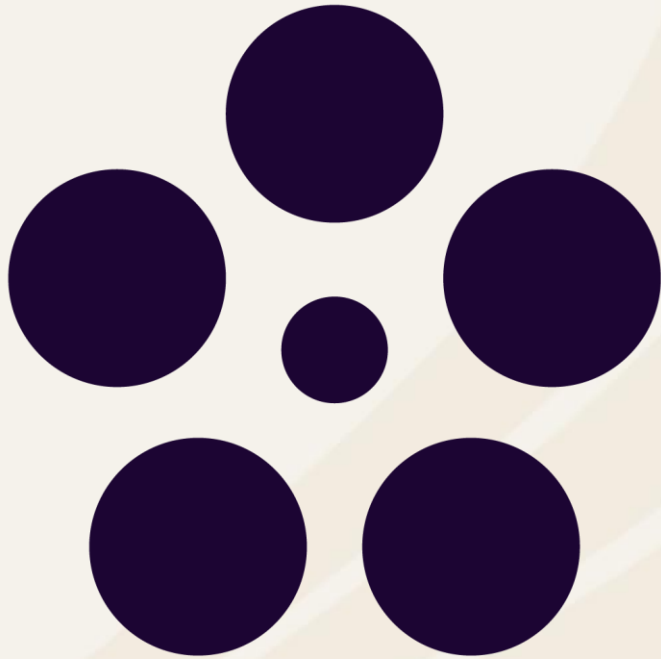
Fabric first

Key principles to consider in building retrofit





1. Do no harm



In a climate emergency many people want to **do something**.

But not all interventions are good.

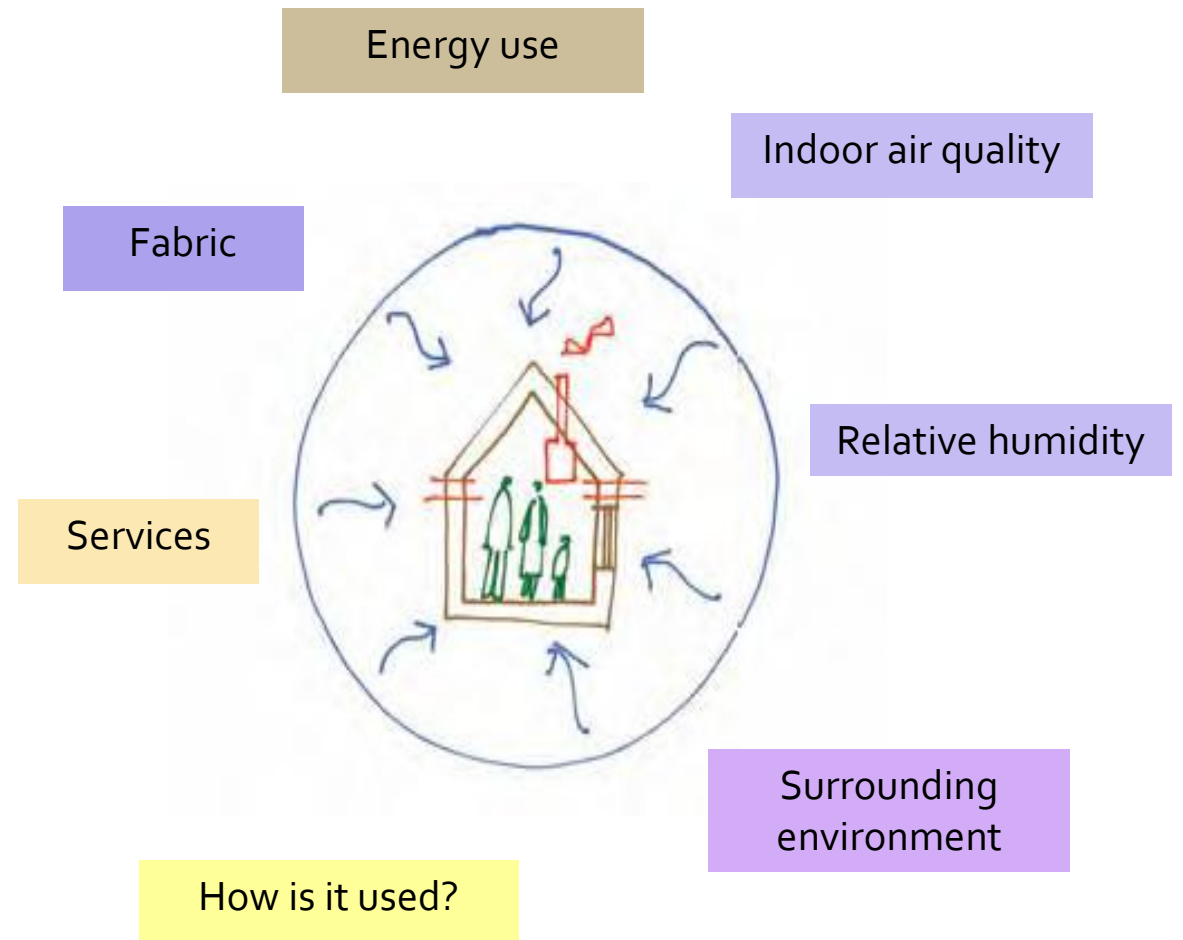
Retrofit is not rocket science, but how heat and moisture move through buildings is poorly understood.

Understand the risks before taking action.

2. Assessment & monitoring



- Assessing a building condition, age, method of construction, location, and site specifics.
- Monitoring (how a building is used, energy use, indoor air quality, relative humidity and carbon dioxide levels).
- Understand what you have, how it's used, and the potential impacts of a changing climate.
- Understand causes and possible solutions for issues such as damp and mould.
- Remember, every building is different (no matter how similar they appear).



3. Repair & maintenance



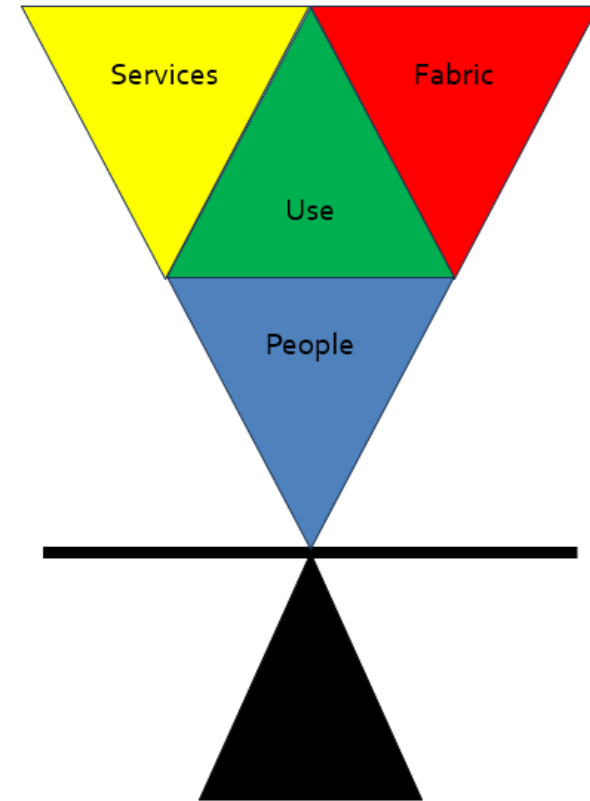
“Maintenance, periodic renewal, and conservation-focused refurbishment have the potential to save between 30% and 50% of carbon emissions and... save up to 40% in energy consumption”.

Maintenance makes a building ‘retrofit ready’ and should be done before undertaking larger measures.



4. Whole building approach

- Focuses on the whole system, not individual elements.
- Deals with specific situations (as opposed to generalities).
- Opportunities and constraints can vary widely even if the buildings appear similar.
- Building and site-specific approach to find a bespoke, balanced solution.
- Helps to highlight and resolve uncertainties, reconcile conflicting aims, and manage the risk of unintended consequences.



Individual elements in a building do not work in isolation but as part of a wider whole system. The actual performance of a building is often a balancing act.

5. Fabric first



Fabric first does not mean that we must cover all our buildings with polystyrene, as this may not be appropriate, practically possible, or even a good idea.

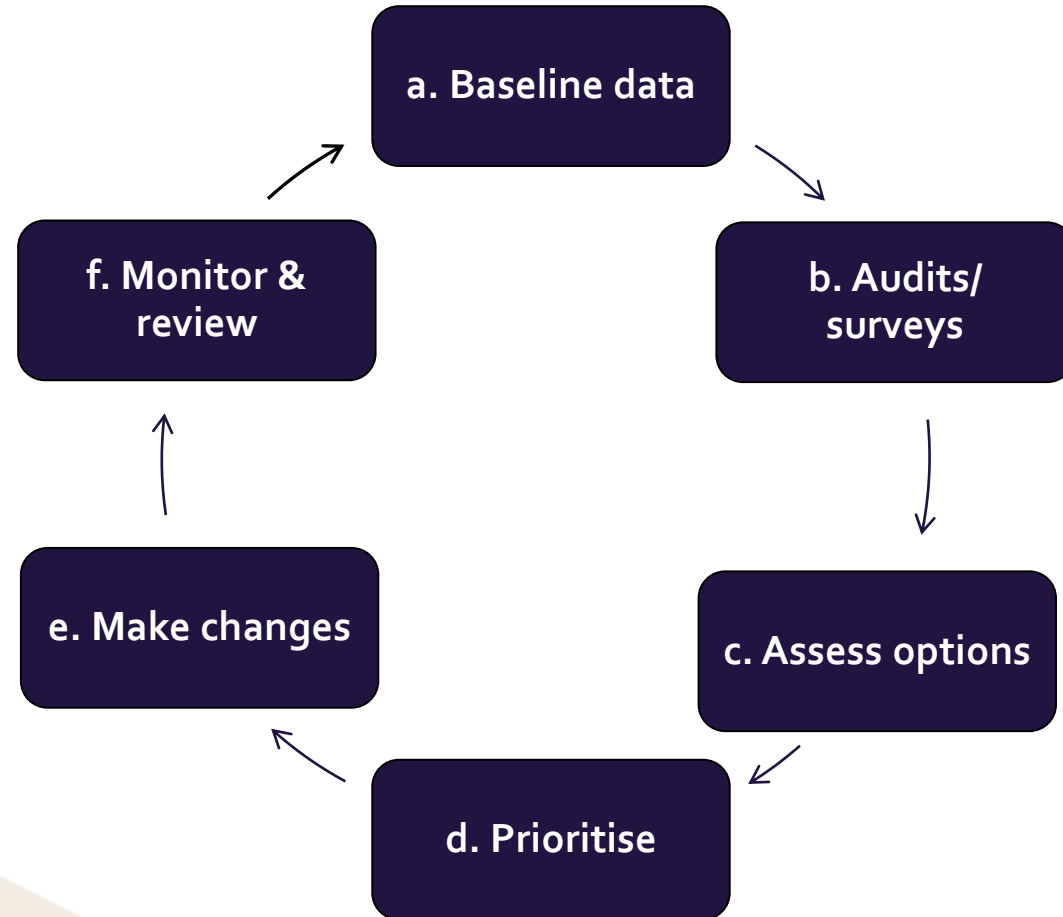
Fabric first does mean that it is sensible to make targeted improvements where appropriate, safe, and practically possible... in areas such as lofts, bay windows, etc.

A buildings fabric should be assessed for installing fabric measures before installing any new mechanical systems. Reducing energy demand first will lead to reduced energy use.

Audits and surveys



The retrofit process



Types of audits and surveys

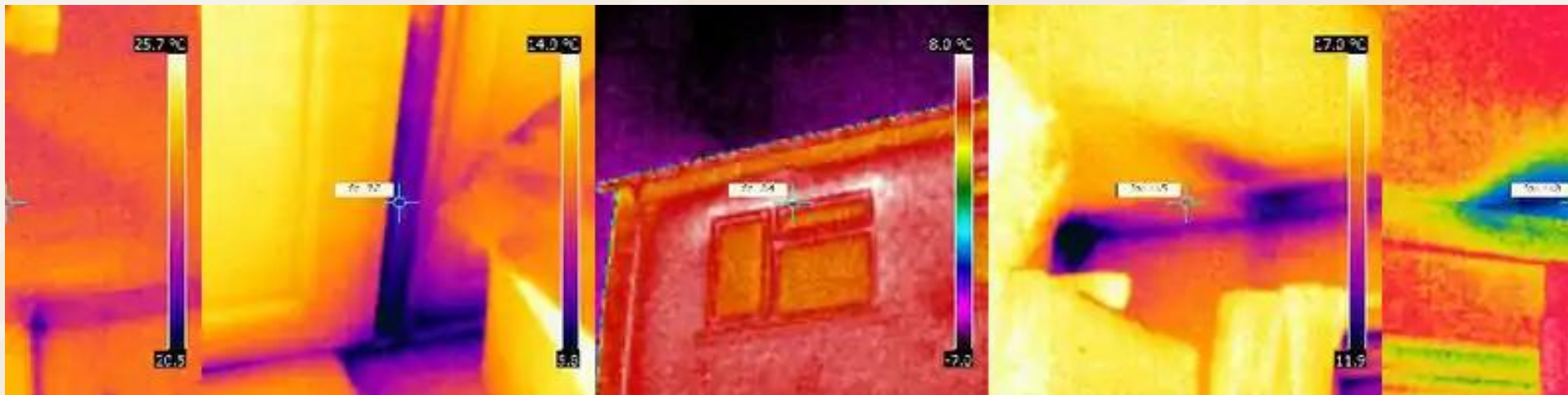


- Non-domestic Energy Performance Certificate (EPC)
- Display Energy Certificate (DEC)
- CSE's walk-around DIY survey
- Energy audit
- Carbon audit
- Thermal imaging survey
- Building condition survey
- Heating survey
- Solar PV survey



Thermal imaging

- Can get dedicated thermographic survey or part of a condition survey
- Most useful during winter months
- Identify cold bridges, draughts, insulation gaps
- Building users can have their own camera / loan a camera and track impact of changes





Building condition survey

- Expert visual assessment of the “condition” of a building to identify maintenance needs, priorities and cost
- Looks at structure, roof, walls, windows and doors, electrics, asbestos, utilities, sewage, fire safety
- **Who?** Different professionals can carry out, depending on building complexity: Chartered Building Surveyors; some construction professionals; some energy assessors

Condition grading

- A** – good (as should be)
- B** – satisfactory (minor deterioration)
- C** – poor (major defects)
- D** – bad (serious risk of failure)

Priority grading

- 1** – urgent (immediate/within year)
- 2** – essential (1-2 year)
- 3** – desirable (3-5 year)
- 4** – long term (5+ years)



Heating survey

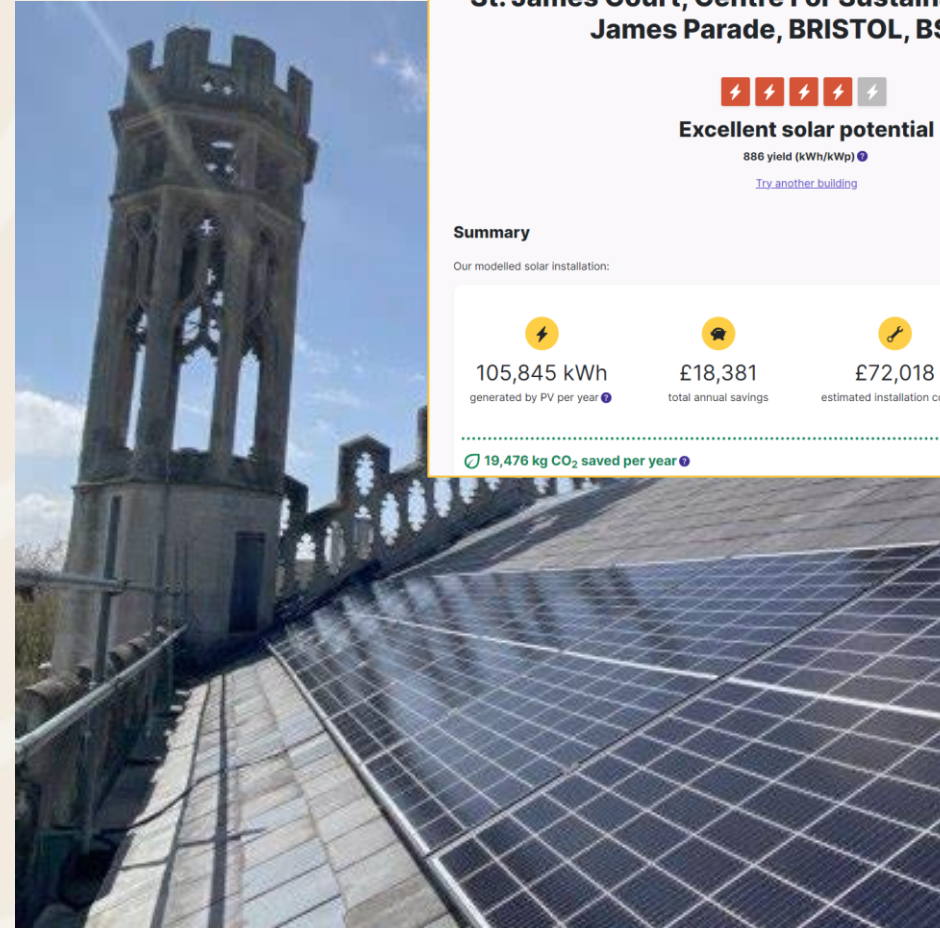
- Looks at existing systems (condition, performance, efficiency) and can recommend alternative options, such as upgrades or replacements.
- Carried out for maintenance, efficiency assessment, safety, performance.
- Critical when considering changing a heating system.
- **Who?** A heating engineer





Solar PV assessment

- High level: online software and tools available (can be desk-based), e.g. solarwizard.org.uk
- Looks at roof size, orientation, tilt, amount/angle of sun, shading
- Additional detail: structural survey
- Things to consider
 - Energy use profile
 - Who owns/connects the solar
 - Building permissions



Solar Wizard Home About Solar Wizard About Rooftop PV Try the Wizard Local authority login

St. James Court, Centre For Sustainable Energy, St. James Parade, BRISTOL, BS1 3LH

⚡⚡⚡⚡⚡

Excellent solar potential
886 yield (kWh/kWp) [Try another building](#)

Summary
Our modelled solar installation:

⚡ 105,845 kWh generated by PV per year	💰 £18,381 total annual savings	🔧 £72,018 estimated installation cost	🕒 4 year payback period
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🌱 19,476 kg CO₂ saved per year

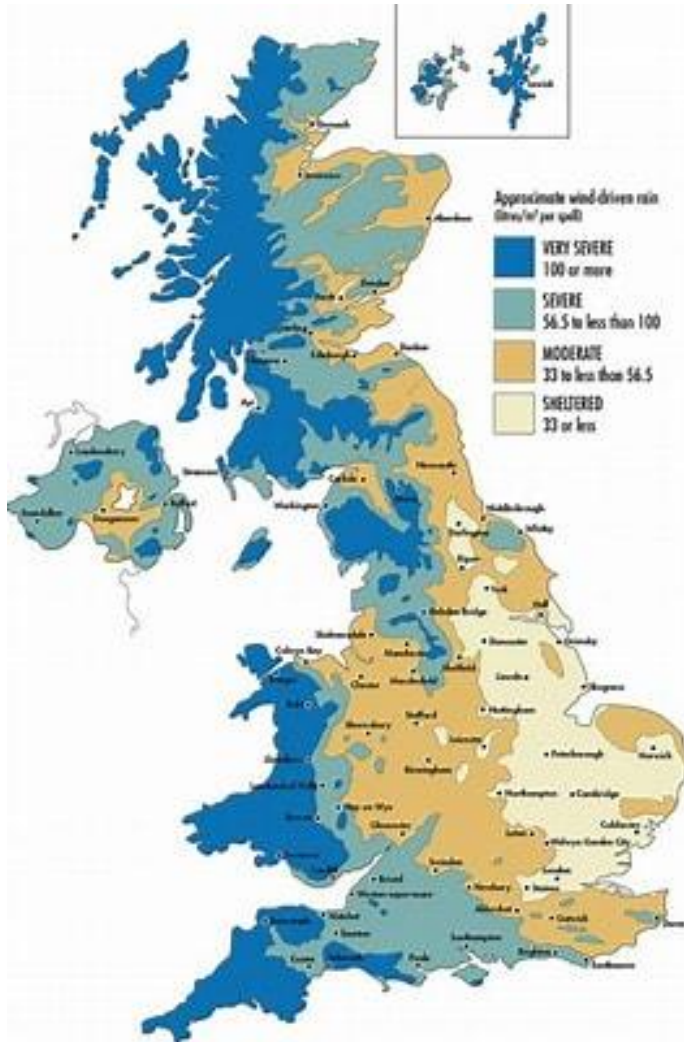


Key points

- Critical to involve staff in the audit process
- Importance of maintenance plans, and planned preventative maintenance
- The nature of the audit will depend on the organisation's priorities and motivations
- Nature of funds / fund requirements will shape nature of audit
- Audits are a step in a journey – they are a part of a puzzle in assessing your building options
- We need to be looking more at climate risks & adaptation

Retrofitting building fabric

Location and local climate



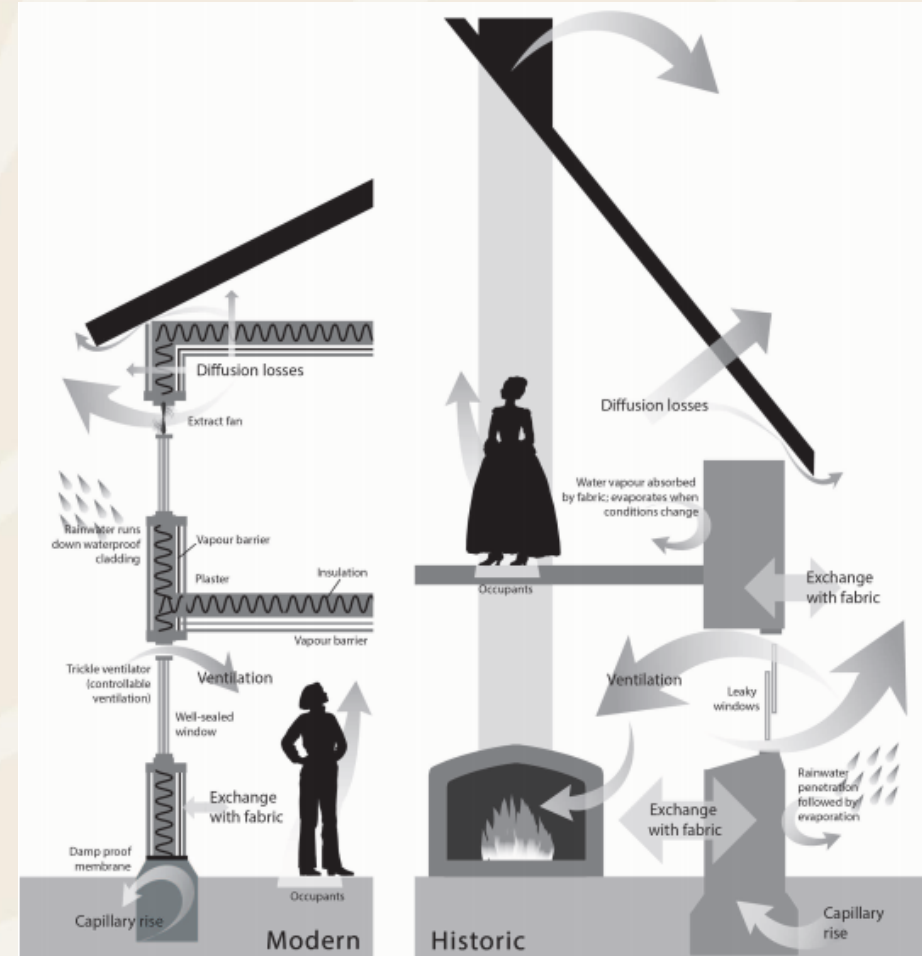
Every building performs differently according to location, orientation, design, construction, services, use pattern and condition.

Construction type plays a key part in this – traditional vs modern



Building fabric

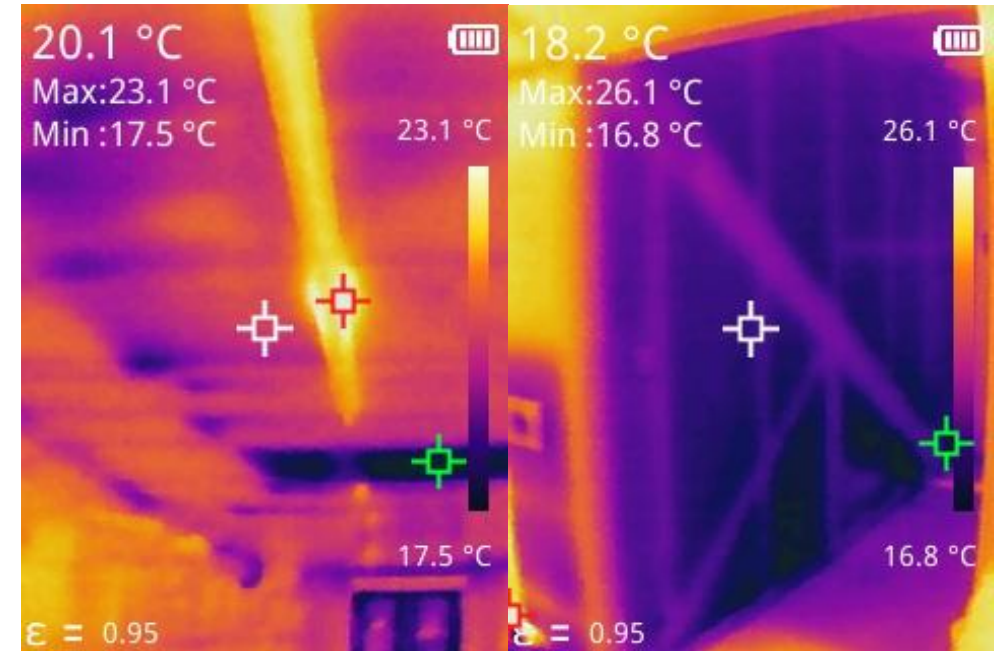
- Building fabric = the components and materials that the building itself is made of – walls, floors, roof, windows and doors
- Traditional: generally pre-1919
- Modern: changes over time, 1970's fuel crises led to insulation standards





Insulation

- Adding insulation fundamentally changes the way heat and moisture move through a building.
- Adding insulation won't solve damp problems.
- Some places are relatively simple – others practically difficult and risky.
- Adding less but doing it continuously is better than adding more and leaving gaps – 1mm gap can lead to 10% reduction in performance.
- Common issues around junctions and service penetrations.





Insulation materials



Things to consider:

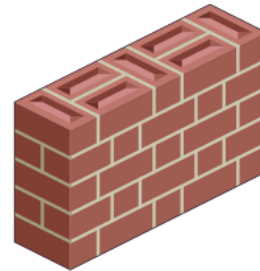
- Environmental impact
- Moisture related properties
- Performance & suitability
- Stability & durability
- Application process
- Fire safety and toxicity
- End of life impact





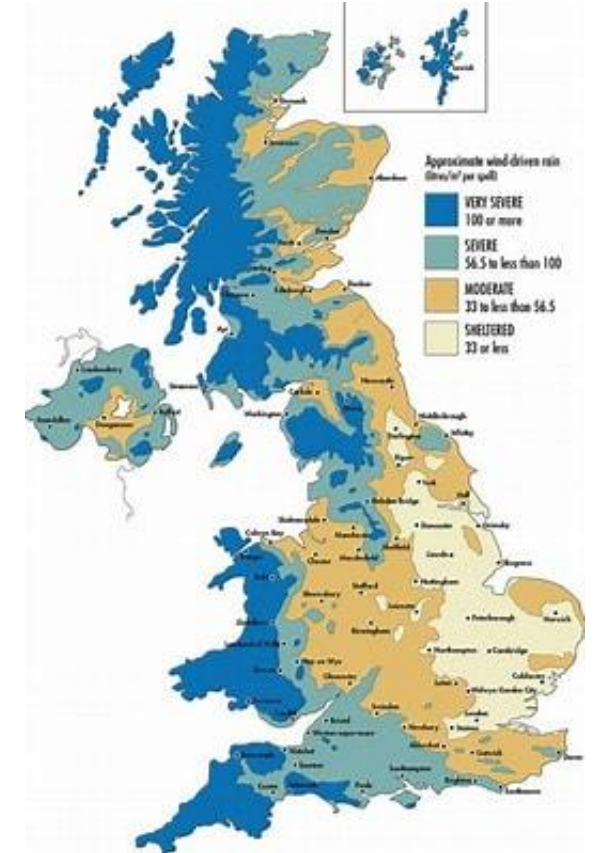
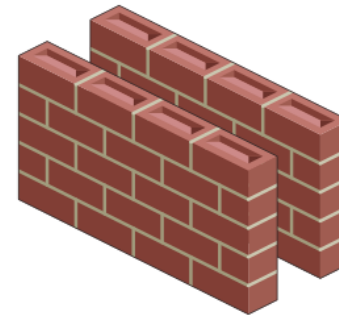
Insulating walls

- Wall insulation can be applied internally, externally, or in a cavity.
- Most solid walls are traditionally built – require suitably trained people and appropriate materials.
- Geographic location & local exposure is a key factor.
- Not all cavities are suitable for filling.



Solid Wall
Typical in pre 1920 properties.
'Thick'-'thin' brick pattern.

Cavity Wall
Typical in modern homes.
Even brick pattern.



Insulating roofs

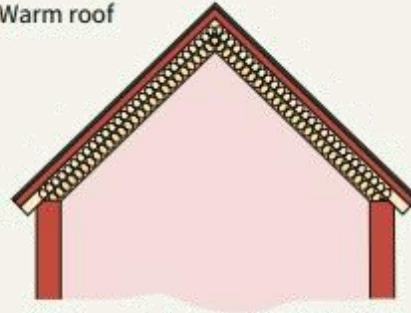


- Generally considered easy to do. Actually, it's easy to get wrong.
- Need to understand why and how timber roofs are ventilated.
- Flat ceilings are fairly simple.
- Sloping ceilings and room-in-roof more complicated.

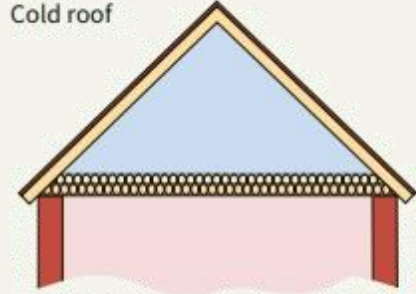
Warm Roofs and Cold Roofs

In this guidance the term 'cold roof space' or 'cold roof' is used to describe a pitched roof with insulation at the level of the horizontal ceiling of the uppermost floor, leaving an unheated roof space (attic or loft) above the insulation. In contrast a 'warm roof space' or 'warm roof' has insulation between or just under or over the sloping rafters, so that the whole of the volume under the roof can be heated and used. Some buildings have combinations of these two arrangements.

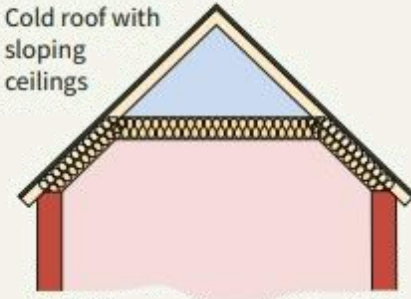
Warm roof



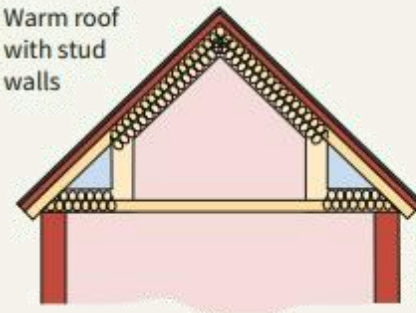
Cold roof



Cold roof with sloping ceilings

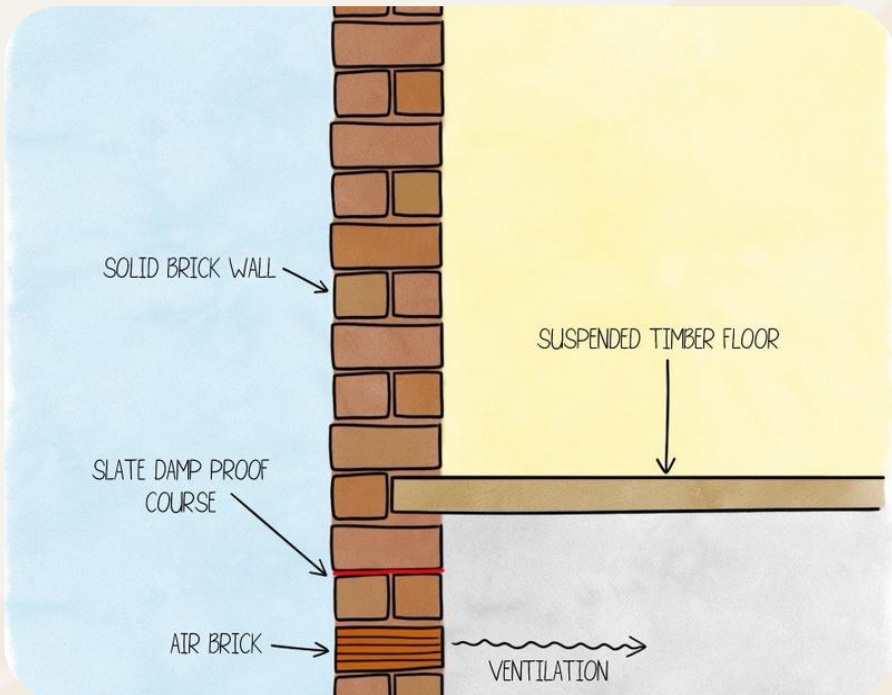


Warm roof with stud walls





Suspended floor insulation



- Floor timbers should be dry - moisture levels tested
- Gap of at least 150mm between insulation and ground
- Timbers dry and in good condition.
- Airbricks present and functioning, not covered or blocked.
- Draughtproofing the floor and laying a thick carpet can be a good alternative.



Windows & doors

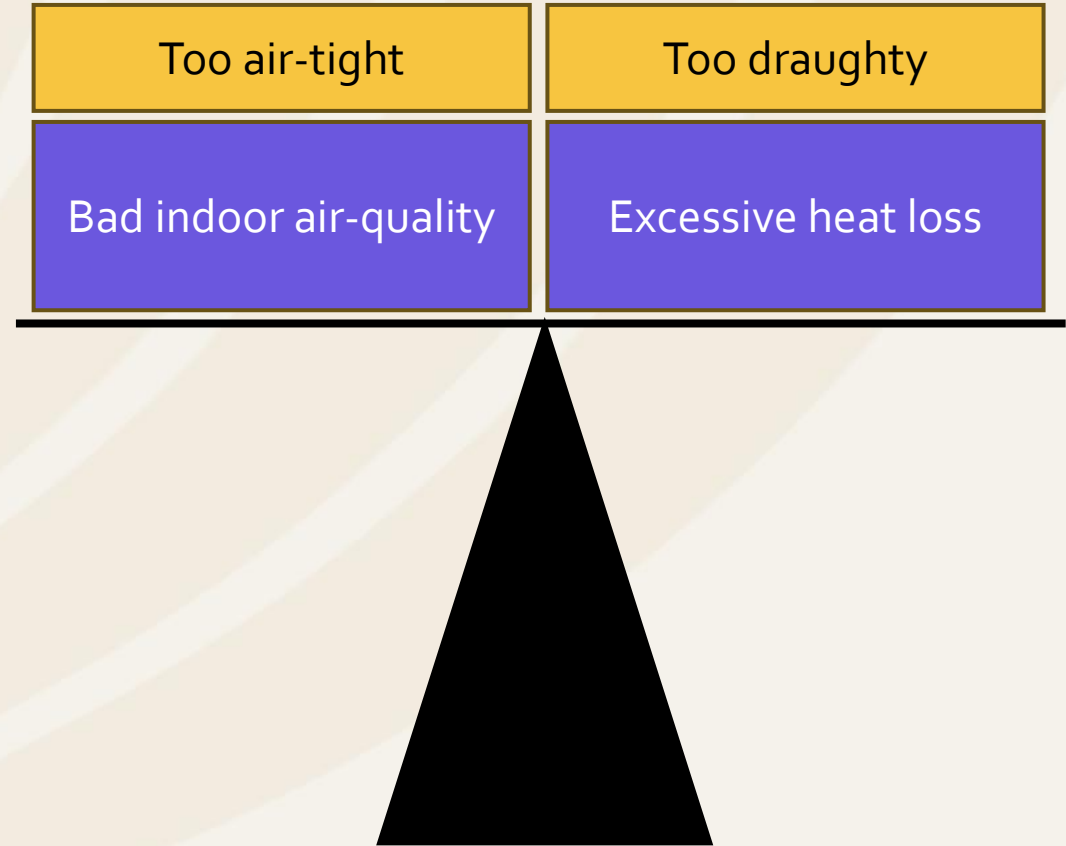
- Renovate + repair before replacing
- Curtains + shutters – effective and affordable
- If changing windows and doors → explore viability of wall insulation
- New – various options in terms of material and U-values.
- Should consider embodied carbon of options
- How well installed greatly impacts thermal performance.
- Enclosed entrances where practical (vestibule or lobby)

Improvement Method	Reduction in Heat Loss	U-value W/m ² K
<i>Unimproved single glazing</i>	-	5.5
<i>Fitting and shutting lined curtains</i>	14%	3.2
<i>Closing shutters</i>	51%	2.2
<i>Modified shutters, with insulation set into panels</i>	60%	1.6
<i>Modern roller blind</i>	22%	3.0
<i>Modern roller blind with low emissivity plastic film fixed to the window facing side of the blind</i>	45%	2.2
<i>Victorian pattern roller blind, with plain fabric</i>	28%	3.2
<i>A "thermal" honeycomb blind</i>	36%	2.4
<i>Victorian blind and closed shutters</i>	58%	1.8
<i>Victorian blind, shutters and curtains</i>	62%	1.6
<i>Secondary glazing system</i>	63%	1.7
<i>Secondary glazing and curtains</i>	66%	1.3
<i>Secondary glazing and insulated shutters</i>	77%	1.0
<i>Secondary glazing and shutters</i>	75%	1.1
<i>Double glazed pane fitted in the existing sash</i>	79%	1.3

Draughtproofing



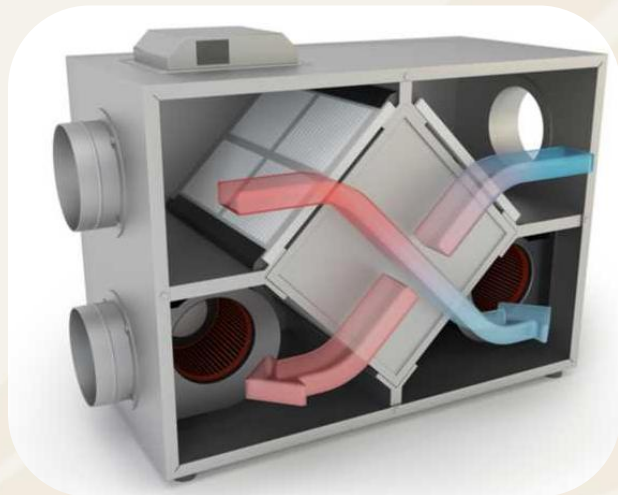
- Often said that draught proofing is more effective than adding insulation as it's far simpler, usually cheaper, and practically easier
- Can reduce heat-loss by up to 20%
- Balance required as ventilation is essential





Moisture & ventilation

- Importance of this when modifying the fabric of a building
- Different fabrics manage moisture in very different ways
- You're aiming for a moisture balance
- Monitoring humidity and CO₂ is a useful indicator



Ventilation and indoor air quality



Why?

- Affects our health and wellbeing.
- Retrofit changes can affect air quality (positively and negatively).

May include:

- Air temperature
- Relative humidity
- CO₂
- VOCs
- Different methods
- A centralised system that displays/logs data
- A portable device





Stronger community assets

Improved energy performance, resilience, useability and comfort of community buildings, through reduced energy costs



Warm welcome spaces

Community buildings as nodes for energy advice, training and demos, supporting wellbeing of users and normalising energy conversations.

Any questions?



Centre for
Sustainable
Energy



We're a charity supporting people and organisations across the UK to tackle the climate emergency and end the suffering caused by cold homes.

[cse.org.uk](https://www.cse.org.uk)