Retrofit Archetypes

Background

This presentation is part of the LHEES Community Retrofit Pilot Project for Swinton, prepared by Southern Uplands Partnership for Scottish Borders Council in 2024. Whilst this was a standalone project, it links to the Energy Efficiency Supply Chain project by the same team which has been running since 2020. The project brief called for:

"Identification of potential pockets where property archetype, existing heating types, energy ratings and higher energy use may suit a small focussed retrofit project, and where the demographics may indicate that owner occupiers could be open to such a scheme."

This presentation looks specifically at Retrofit Archetypes for energy efficiency measures. The role of Decarbonising Heat including heat networks is covered by a separate presentation.

Retrofit Archetypes

As part of the net zero transition, every house needs to be made more energy efficient. **Retrofit** is the design and building process to make that happen for an individual house. It will involve a range of typical construction **Measures** (e.g. insulation, double-glazing, heat pumps) appropriate to the house. **Archetypes** is a way of grouping houses with similar characteristics (e.g. age, wall construction type, layout) where the same measures are likely to be appropriate.

For privately owned houses, each household will make their own choice about what measures to do, as and when they see fit. These decisions will be driven by a wide range of motivations, such as:

- Ability and willingness to invest
- Response to media and marketing
- Whether the level of disruption is manageable in daily life
- Occupancy patterns and behaviours
- Experiences of neighbours and family

LHEES Requirements

LHEES (Local Heat & Energy Efficiency Strategies) was introduced by the Scottish Government in 2022. It is an area-based approach to heat and energy efficiency planning and delivery, placing an obligation on all local authorities to prepare a strategy for decarbonising heat in buildings across their entire local area.

LHEES lists 6 categories to be considered in a decarbonisation strategy:

Heat decarbonisation

1. Off-gas grid buildings
2. On-gas grid buildings
3. Heat networks

Energy efficiency and other outcomes

4. Poor building energy efficiency
5. Poor building energy efficiency as a driver for fuel poverty
6. Mixed-tenure, mixed-use and historic buildings

Decarbonisation Strategy

Two separate but linked tasks:

1. **Energy Efficiency:** use less energy > increase insulation > Retrofit (Fabric First) > building works (measures) > individual house > Archetype classifications
2. **Decarbonised Heat:** replace fossil fuels with renewables > heat pump (Electrify Everything) > individual house or heat network (range of fuel options) > clusters of houses > whole community

Q. Balance between Fabric First v Decarbonising Heat?

- Fabric First: greater upfront £ + more disruptive but reduces whole life costs + enhance resilience.
- Decarbonising heat: simpler process + immediate CO2 reduction but no guarantee for future energy £.

Pilot Project

This is an LHEES Pilot Project that involved:

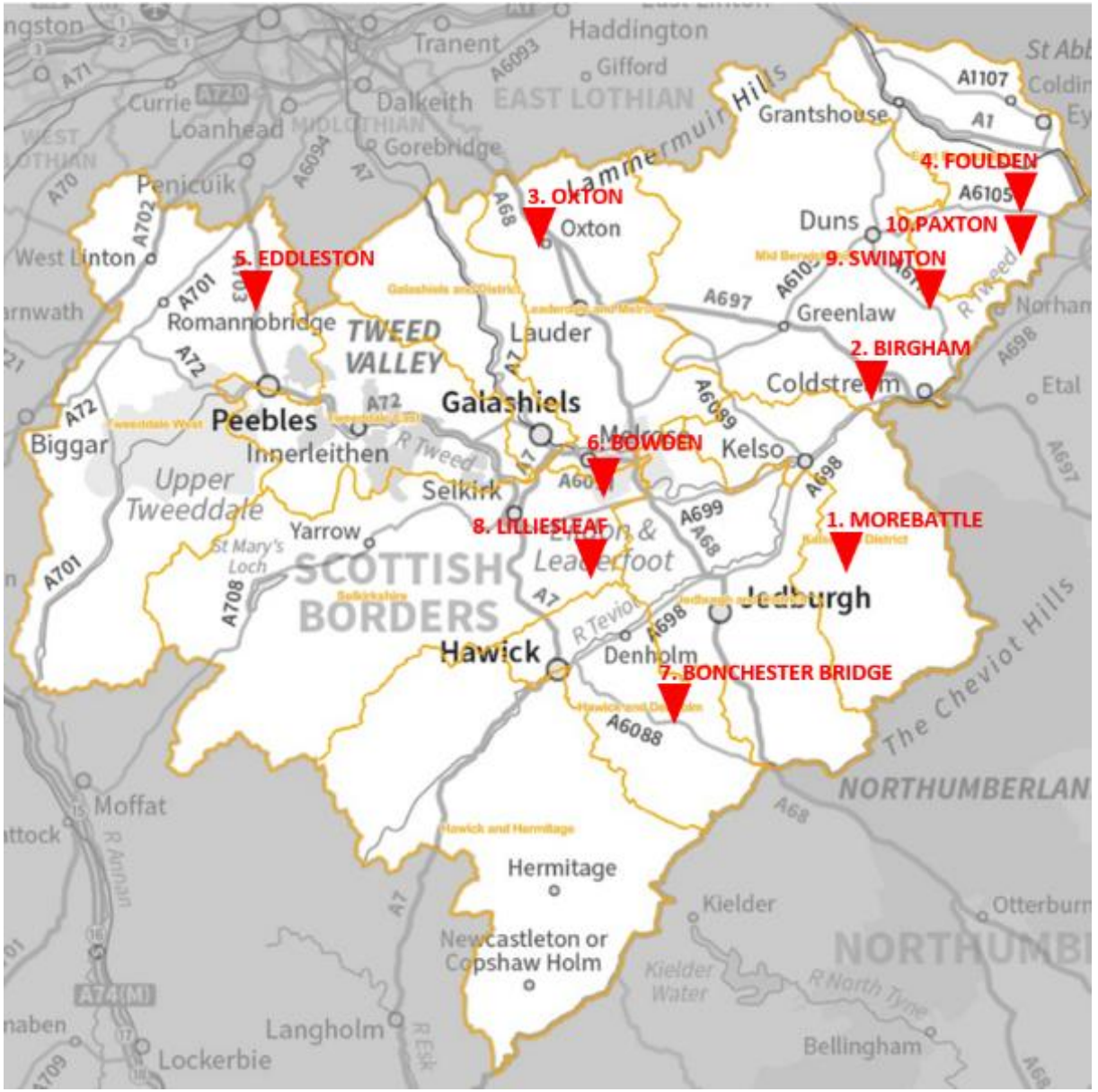
- Review Home Analytics Data (60,000+ houses)
- Our priorities for villages:
  - off-gas grid
  - 100-150 households
- Longlist of 10 villages in the Borders that met those priorities
- Shortlist of 5
- Swinton selected as most compatible with project criteria overall

This presentation is based on the findings of the Pilot Project and so contains information specific to Swinton, however most points will be equally applicable to all 10 villages on the Shortlist. The description of each ‘measures’ is fairly generic, with the intention they could be used as a starting point for discussion of Retrofit options for any house, not restricted to just these villages.

Pilot Project

Shortlist

1. Morebattle
2. Birgham
3. Oxton
4. Foulden
5. Eddleston
6. Bowden
7. Bonchester Bridge
8. Lilliesleaf
9. Swinton
10. Paxton



Pilot Project

Swinton Characteristics

Compared to Borders as a whole, Swinton houses are:

- 100% off-gas (35% Borders average)
- 76% EPC D or below (62%)
- 51% solid wall construction (36%)

Compared to rest of Shortlist, it has highest proportion of:

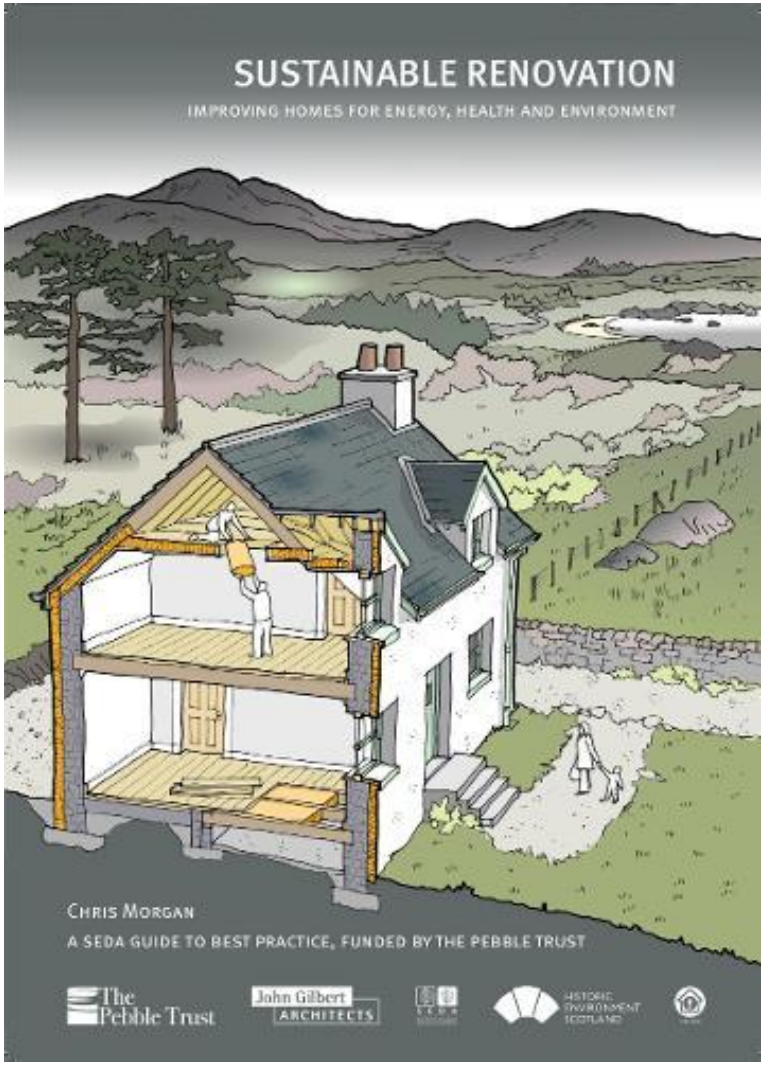
- attached houses (terrace/semi-det./flats)
- pre-1919 houses + heritage conservation area
- electricity storage/room-heaters or solid fuel heating
- LHEES category #3 (extensive retrofit works needed)*

* LHEES has defined Categories for the preparedness of a house for installation of a heat pump:

0. already installed
1. could be installed with no retrofit works
2. some retrofit works needed before installation
3. extensive retrofit works needed before installation

Retrofit

Retrofit refers to any work on an existing building to improve its energy efficiency, making them easier to heat (or cool), able to retain that heat for longer (resilient), and replacing fossil fuels with renewable energy (decarbonised).

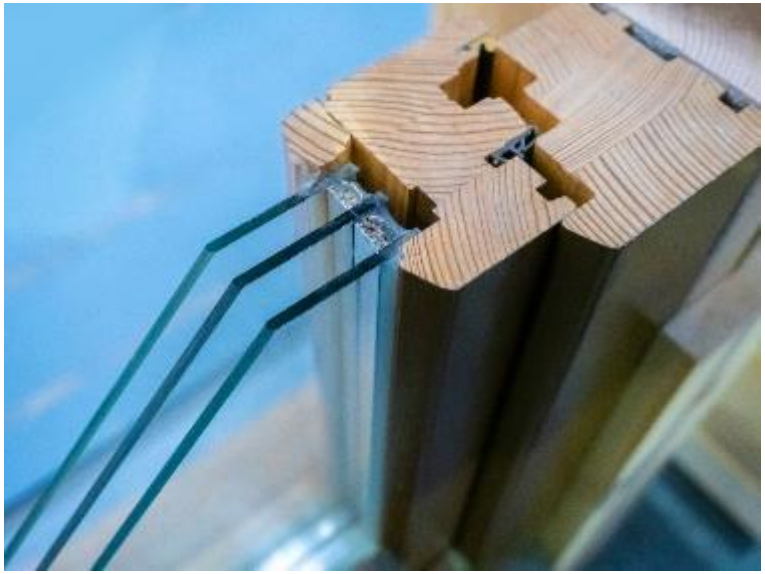


https://www.thepebbletrust.org/sustainable-renovation-guide/

Fabric First

Fabric First means reducing energy demand as much as possible before considering what the heating system should be, including:

- insulation to walls/floor/roof
- windows + doors
- ventilation + airtightness



Place

Community-based retrofit is not just about the practicalities of energy efficiency and decarbonisation, but part of a broader programme of:

- Placemaking: collaborative process for communities to shape the public realm to maximise shared value.
- Regeneration: supporting the reestablishment of local services and economic opportunities.
- Resilience: the ability to adapt and grow following adversity, in this context around climate change.

maps.nls.uk/view/74426551


coldstreamhistorysociety.co.uk/general/villages/


facebook.com/SwintonVillageEvents/photos/

Whole House Approach

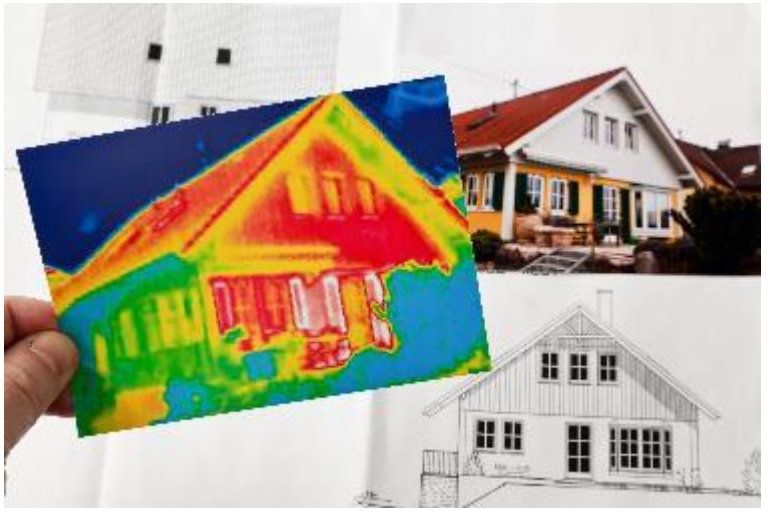
It is important that all parts of the retrofit process are coordinated to optimise energy efficiency and avoid unintended negative consequences. That is why a ‘whole house’ approach is preferred. The retrofit industry is guided by PAS 2035, a framework for the energy retrofit of domestic buildings. It details best practice for how a ‘whole house’ approach is delivered, including:

- Occupants and end users
- Each home individually
- Oversight of assessment, design, delivery and use

Whole House Survey

The first part of the retrofit process is to survey the existing house to better understand its construction and services. Building surveys can be done at different levels of detail, from a simple visual inspection through to opening up parts of the fabric to check what insulation has been installed.

Surveys can also include non-intrusive tests, such as Thermal Imaging and Airtightness tests, which help to identify and locate where heat is leaking from.



Archetypes

Archetypes categorise buildings based on key aspects of their construction that will affect which retrofit measures are relevant. The most typical characteristics are:

- property age
- wall construction
- built form and layout
- number of storeys

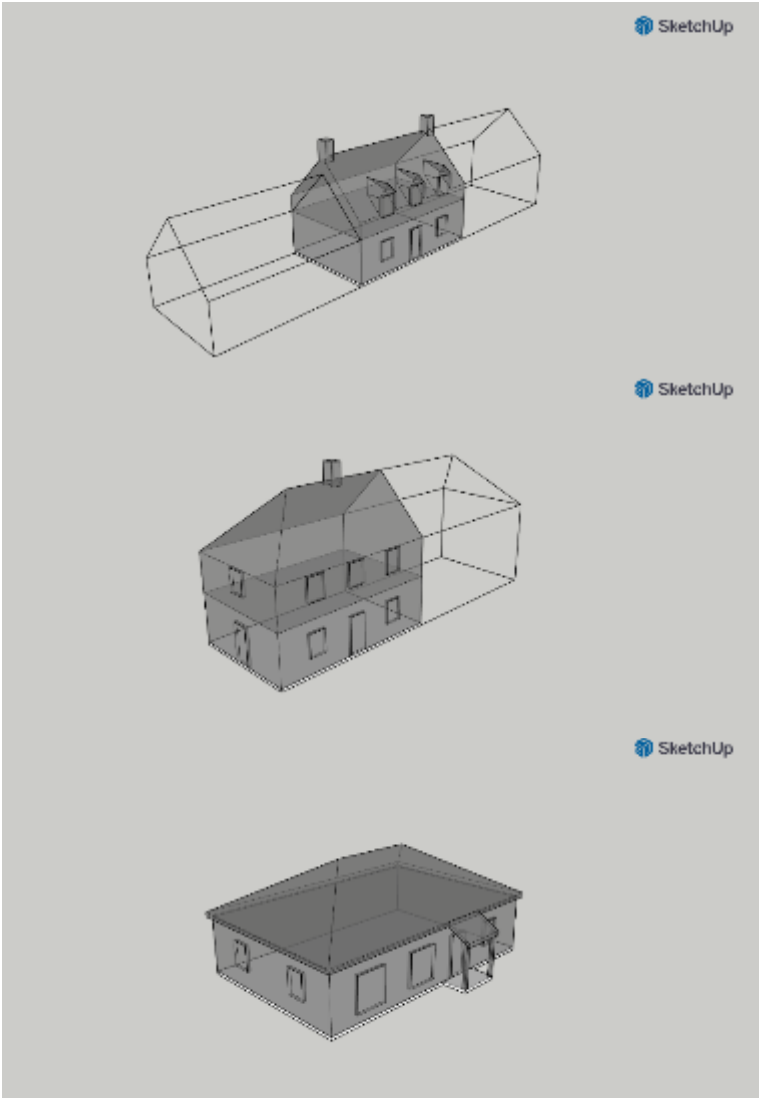
The definition of archetypes is about the building fabric. Existing services (i.e. heating/energy systems) are not a defining feature.

Archetypes are useful for high level planning by government and industry, and give homeowners a guide to what measures to consider, but it's important that each house is assessed individually to allow for unique aspects e.g. alterations, condition, occupancy patterns.

Archetypes

Archetypes used for this project include four types that represent the majority of houses in Swinton.

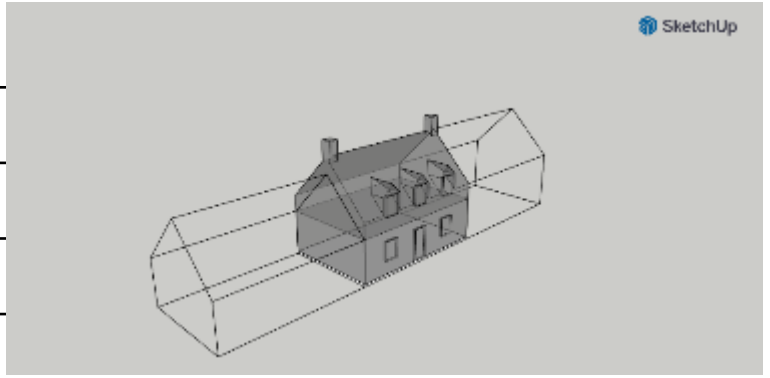
1. **A. Traditional terrace house**
   B. Traditional detached house
   solid wall, stone, room-in-roof
2. **Post-War semi-detached house**
   cavity wall, brick
3. **Modern detached house**
   timber frame wall



Archetype 1A. Traditional row house

Typical characteristics

Age	Pre-1919
Walls	Solid stone
Roof	Timber frame, dormers
Floor	Suspended, some solid
Windows	Original timber single glazed or UPVC double glazed replacements
Built form	Attached row houses, some with attics
Storeys	1 or 1½



Archetype 1A. Traditional row house

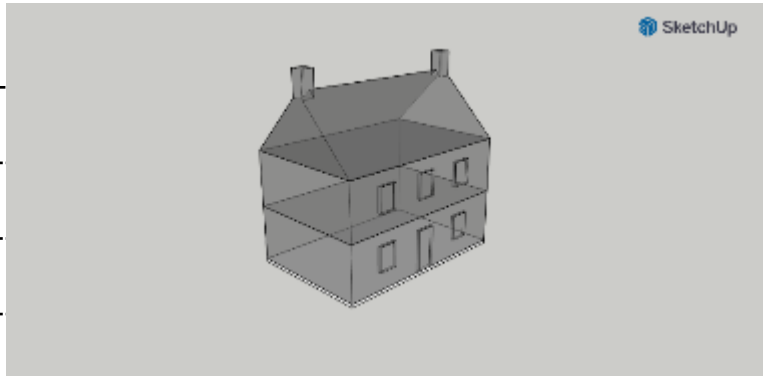
Building Fabric Measures

Walls	External wall insulation (rear only)	Exposed stone to street facade should be kept.
	Internal wall insulation	Solid stone walls need to be able to “breathe” which means any internal insulation must be hygroscopic (can absorb and release water).
Roof	Loft insulation	Top up to 350mm min.
	Room-in-roof insulation	Insulate coombs and dwarf walls.
Floor	Suspended floor insulation	Insulate from above, or below if accessible.
	Solid floor insulation	If height is restricted consider replacing floor in full, or use thermal underlay as a minimum.
Windows	A-rated glazing	New double or triple-glazed windows or upgrade existing windows, including heritage glazing.
	Insulate reveals	If there are no original shutters or linings, consider insulating reveals of all openings.
Doors	New insulated door	New insulated door or refurbish existing door.
Ventilation	Whole house ventilation strategy	Ensure adequate extract ventilation and compensatory ventilation.
	Airtightness	Improve airtightness of fabric where possible.

Archetype 1B. Traditional detached house

Typical characteristics

Age	Pre-1919
Walls	Solid stone
Roof	Timber frame
Floor	Suspended, some solid
Windows	Original timber single glazed
Built form	Detached houses
Storeys	2 or 2½



Archetype 1B. Traditional detached house

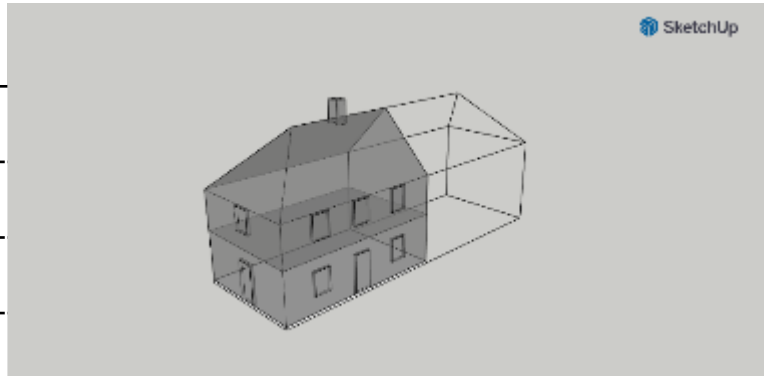
Building Fabric Measures

Walls	External wall insulation (rear + side)	Exposed stone to street facade and other decorative stone features should be kept.
	Internal wall insulation	Solid stone walls need to be able to “breathe” which means any internal insulation must be hygroscopic (can absorb and release water). Avoid disrupting cornices or decorative wall features.
Roof	Loft insulation	Top up to 350mm min.
	Room-in-roof insulation	Insulate coombs and dwarf walls and gable end walls.
Floor	Suspended floor insulation	Insulate from above, or below if accessible.
	Solid floor insulation	If height is restricted consider replacing floor in full, or use thermal underlay as a minimum.
Windows	A-rated glazing	New double or triple-glazed windows or upgrade existing windows, including heritage glazing.
	Insulate reveals	If there are no original shutters or linings, consider insulating reveals of all openings.
Doors	New insulated door	New insulated door or refurbish existing door.
Ventilation	Whole house ventilation strategy	Ensure adequate extract ventilation and compensatory ventilation.
	Airtightness	Improve airtightness of fabric where possible.

Archetype 2. Post-war semi-detached house

Typical characteristics

Age	1950-1983
Walls	Brick cavity
Roof	Timber frame
Floor	Suspended
Windows	UPVC double glazed replacements
Built form	Semi-detached houses
Storeys	2



Archetype 2. Post-war semi-detached house

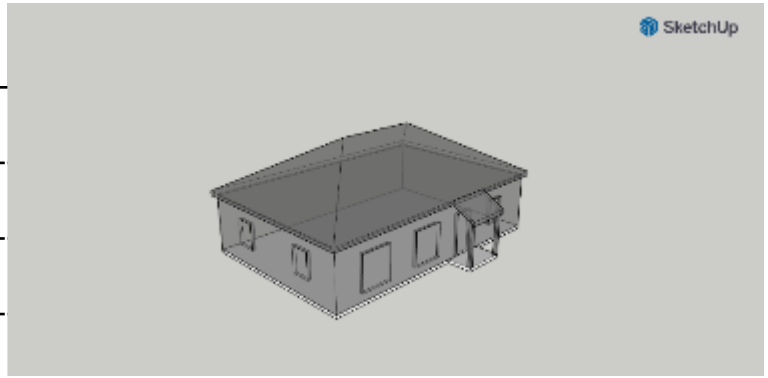
Building Fabric Measures

Walls	Cavity wall insulation	Ensure cavity is suitable for insulation.
	External wall insulation	Liaise with owners of attached house.
	Internal wall insulation	Alternative to the above but will reduce floor area.
Roof	Loft insulation	Top up to 350mm min.
Floor	Solid floor insulation	If height is restricted consider replacing floor in full, or use thermal underlay as a minimum.
Windows	A-rated glazing	New double or triple-glazed windows or upgrade existing windows.
Doors	New insulated door	Plain doors perform better but glazed doors may be preferred to allow daylight in entry.
Ventilation	Whole house ventilation strategy	Ensure adequate extract ventilation and compensatory ventilation.
	Airtightness	Improve airtightness of fabric where possible.

Archetype 3. Modern detached house

Typical characteristics

Age	1992-2002
Walls	Brick veneer, timber frame
Roof	Timber frame, dormers
Floor	Solid floor
Windows	UPVC double glazed
Built form	Detached houses
Storeys	1, 1½ or 2



Archetype 3. Modern detached house

Building Fabric Measures

Walls	Cavity wall insulation	Cavities with timber frame houses are best left clear.
	Internal wall insulation	Consider upgrading insulation within the timber to minimise reduction of floor area.
Roof	Loft insulation	Top up to 350mm min.
	Room-in-roof insulation	Insulate coombs and dwarf walls and gable end walls.
Floor	Suspended floor insulation	Insulate from above, or below if accessible.
Windows	A-rated glazing	New double or triple-glazed windows or upgrade existing windows.
Doors	New insulated door	Check rating of existing door.
Ventilation	Whole house ventilation strategy	Ensure adequate extract ventilation and compensatory ventilation.
	Airtightness	Improve airtightness of fabric where possible.

Archetypes + Energy Measures

Choices about appropriate energy system measures are typically not linked to generic Archetypes characteristics. Limiting factors are more likely to depend on things like the existing heating system, occupancy patterns, and local context.

This is especially true for rural villages like Swinton, where almost all houses have access to the same wide range of options with few practical constraints. In comparison, dense urban areas with a high proportion of flats will have more restricted options e.g. limited locations suitable for solar panels or heat pumps.

In all cases, adopting a Fabric First approach will reduce the overall energy demand, irrespective of the energy system adopted.

Archetypes + Energy Measures

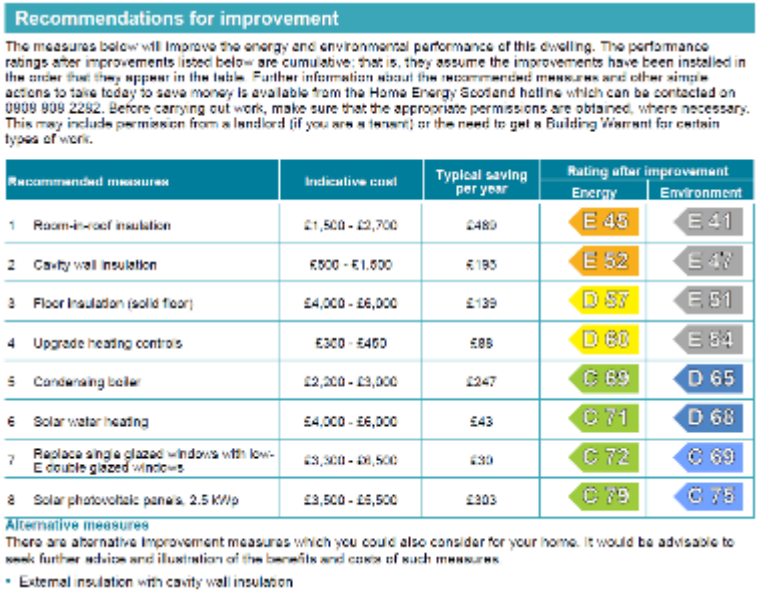
Possible limiting factors

- If the existing radiator system won't work at low-temperature and it would be too disruptive to upgrade, go for a high-temperature heat pump or biomass boiler, or connect to a Heat Network if available.
- If there are electricity grid capacity constraints in the area, it will not be possible for all houses in a community to install individual heat pumps (or electric vehicle chargers) until the grid is upgraded.
- If a local Heat Network is likely to be established in the near future, it would be prudent to hold off installing individual heat pumps, or ensure their installation is compatible for future connection.
- Combining a heat pump with a large array of solar panels and battery storage provides a high level of self-sufficiency.
- Where a cluster of houses already have shared ownership or access rights, consideration should be given to a shared borehole for GSHP.
- For small houses with a high level of insulation, heating demand will be low and storage heaters might be the most cost effective option.

Measures

The types of building work that Retrofit involves are often referred to as ‘measures’. Following are explanations of the most common measures that you will find referenced in Archetype guidelines, individual house surveys, and EPC certificates. We have grouped them into three categories:

- **Insulation**
  walls, floor + roof
- **Ventilation**
  windows, doors + ventilation
- **Energy**
  heat + electricity



Recommendations for improvement

The measures below will improve the energy and environmental performance of this dwelling. The performance ratings after improvements listed below are cumulative; that is, they assume the improvements have been installed in the order that they appear in the table. Further information about the recommended measures and other simple actions to take today to save money is available from the Home Energy Scotland hotline which can be contacted on 0809 909 2282. Before carrying out work, make sure that the appropriate permissions are obtained, where necessary. This may include permission from a landlord (if you are a tenant) or the need to get a Building Warrant for certain types of work.

Recommended measures	Indicative cost	Typical saving per year	Rating after improvement	
			Energy	Environment
1 Room-in-roof insulation	£1,500 - £2,700	£489	E 45	E 41
2 Cavity wall insulation	£500 - £1,500	£195	E 52	E 47
3 Floor insulation (solid floor)	£4,000 - £6,000	£139	D 57	E 51
4 Upgrade heating controls	£300 - £450	£88	D 60	E 54
5 Condensing boiler	£2,200 - £3,000	£247	C 69	D 65
6 Solar water heating	£4,000 - £6,000	£43	C 71	D 68
7 Replace single glazed windows with low-E double glazed windows	£3,300 - £8,500	£30	C 72	C 69
8 Solar photovoltaic panels, 2.5 kWp	£3,500 - £5,500	£303	C 79	C 75

Alternative measures

There are alternative improvement measures which you could also consider for your home. It would be advisable to seek further advice and illustration of the benefits and costs of such measures.

- External insulation with cavity wall insulation

Measures: Insulation

Thermal insulation is any material that blocks the movement of heat. To make our homes more energy efficient we need to increase the amount of insulation of the building envelope: the walls, floor and roof. Every little bit helps to improve the overall performance of the house. Insulation is part of the ‘fabric first’ approach.

Wall
- Cavity Wall Insulation
- External Wall Insulation
- Internal Wall Insulation

Floor
- Solid Floor Insulation
- Suspended Floor Insulate
- Thermal Underlay

Roof
- Flat Roof Insulation
- Loft Insulation
- Room-in-roof Insulation

Thermal Bridging
- Insulation cold bridges

Measures: Wall Insulation

Cavity Wall Insulation

Many cavity walls can be insulated by injecting insulation material into the cavity. A specialist company will drill holes in the outside walls, inject insulation through the holes and then seal them. The insulation material is usually mineral wool or polystyrene beads.

Source: Energy Saving Trust

Cavity walls have separate inner and outer skins of brick or block with a ventilated gap between. Filling the cavity must be done in a way that maintains the ventilation and does not allow moisture to cross the gap. There have been problems with cavity wall insulation methods in the past, but current practices are considered appropriate.

Measures: Wall Insulation

External Wall Insulation

External wall insulation involves fixing a layer of insulation material to the outside of the wall, then covering it with a special type of render or with cladding. The finish can be smooth, textured, painted, tiled, panelled, pebble-dashed, or finished with brick slips.

Source: Energy Saving Trust

If walls are already rendered or painted the new finish can be made to match, but any exposed stone or brick will be concealed. If the appearance of the facade to the street can't be changed, side and back walls only can be done.

Measures: Wall Insulation

Internal Wall Insulation

Internal wall insulation is done by fitting rigid insulation boards to the wall, or by building a stud wall filled with insulation material such as mineral wool fibre.

Source: Energy Saving Trust

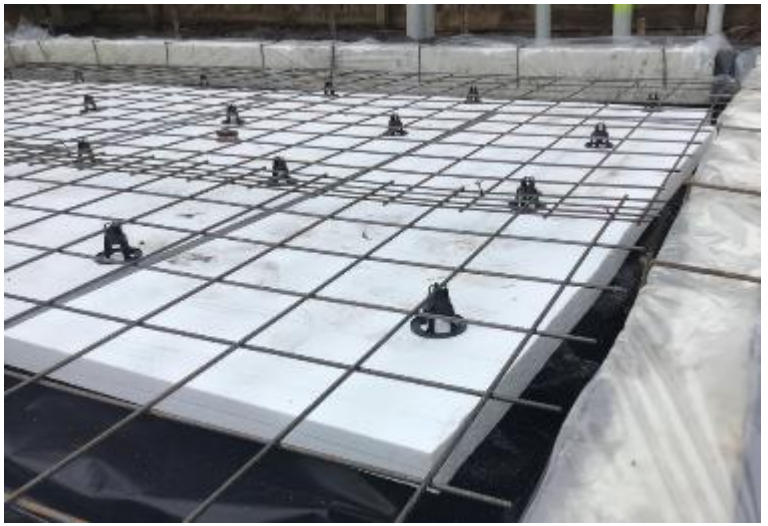
If walls are solid masonry the insulation must ensure the building can still "breathe" and allow the movement of moisture, so the insulation material must be hygroscopic or it must be fitted in a frame clear of the wall surface. Cavity brick or timber framed walls aren't affected. IWI will reduce the floor area, and may impinge on historic cornices or decorative wall finishes.

Measures: Floor Insulation

Solid Floor Insulation

Rigid insulation can be laid on top of an existing solid floor, with new flooring placed over it. This will raise the level of the floor so doors will need to be trimmed shorter. If solid floors need to be replaced in full, rigid insulation foam can be fitted either above or below the concrete.

Source: Energy Saving Trust



Solid floors are the hardest item to insulate. There are slim-profile but high-performance insulation materials where even 20-40mm can significantly improve energy efficiency, but you may lose another 40-60mm in height for a screed and floor coverings on top of this. If the floor is in poor condition it is worth considering replacing it in full. Whilst that is very disruptive it does provide the best long term outcome, and means underfloor heating can be added.

Measures: Floor Insulation

Suspended Floor Insulation

The most effective way to insulate a suspended floor and improve its airtightness is to retrofit insulation between the floor joists. This usually involves lifting the floorboards. If the floor is accessible from below (basement or crawl space) insulation can be fitted from underneath.

Source: Ecological Building Systems

Stopping draughts can be just as useful as the added insulation for improving the energy efficiency of suspended floors. Ventilation of the subfloor space has to be maintained so air vents etc. must not be blocked. Work can be coordinated with installing new pipes for radiators, or underfloor heating can be fitted on trays between the joists.

Measures: Floor Insulation

Thermal Underlay

Thermal underlay is a type of underlay for carpets or engineered timber floors. Aside from offering all the usual benefits of underlay, its primary job is to create an insulating barrier between the subfloor and your carpeting.
Source: Simply Underlay

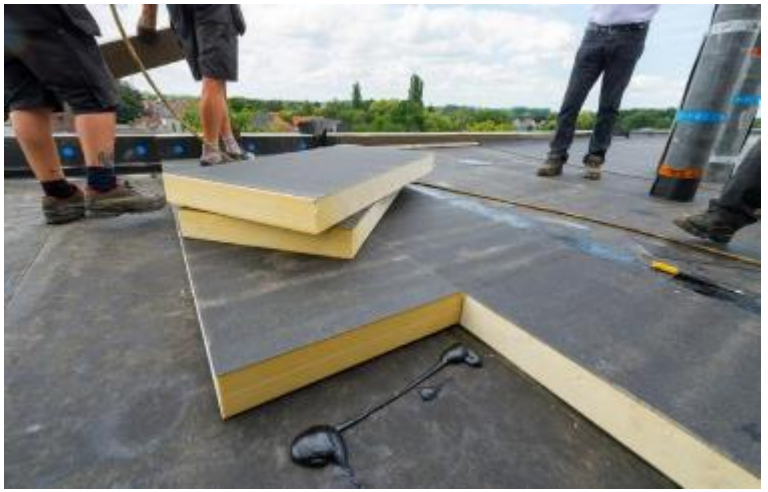
When more substantial insulation on either a solid or suspended floor is not possible, a thermal underlay can make a worthwhile contribution to insulation levels. Products range from 3-15mm in thickness so have minimal impact on door heights etc.

Measures: Roof Insulation

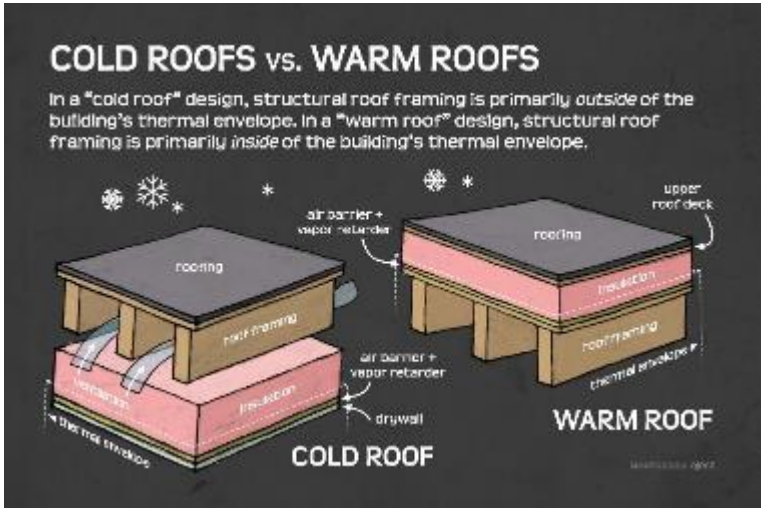
Flat Roof Insulation

Flat roofs are best insulated from above. A layer of rigid insulation board can be added with a new weatherproof layer on top. This is best done when the roof covering needs replacing anyway. It is possible to insulate a flat roof from underneath, but this can lead to condensation problems if not completed correctly.

Source: Energy Saving Trust



Uninsulated flat roofs are one of the biggest sources of heat loss. If insulation is placed directly under the weatherproof layer it is called a ‘warm roof’ because the timber roof frame is fully within the heated envelope. It is called a ‘cold roof’ if the insulation is fitted between or below the roof joists, leaving the frame partially outside the heated envelope, and a ventilation gap must be left to disperse any condensation.



Measures: Roof Insulation

Loft Insulation

A quarter of heat is lost through the roof in an uninsulated home. If your loft is easy to access and has no damp or condensation problems, it should be easy to insulate. If you plan to use the loft for storage, you can raise the level of the floor, making sure you don't squash the mineral wool when you fit the floor boards.

Source: Energy Saving Trust

Even if your house has some loft insulation already you can probably install more, with 350mm commonly recommended. That means it will have to be laid on top of the ceiling joists, not just between them. If these extra layers get squashed it reduces their insulation value. Adding a small area of raised flooring for maintenance access is helpful, even if you don't plan to use the whole loft area for storage.

Measures: Roof Insulation

Room-in-roof Insulation

If you use your attic space for rooms, you need to make sure all walls and ceilings between heated and unheated spaces are insulated. Sloping ceilings (coombs) can be insulated in the same way as a flat roof ('warm' or 'cold'). Vertical walls can be insulated in the same way. Flat ceilings can be insulated like a standard loft. Make sure you insulate all round dormers.

Source: Energy Saving Trust

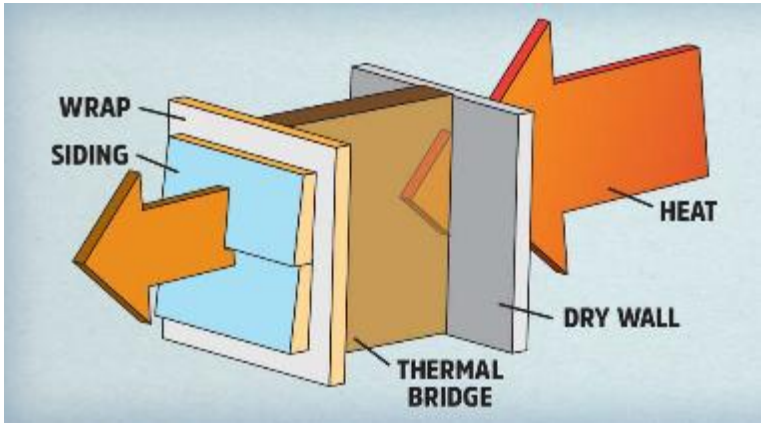
Attic rooms are one of the trickiest areas to insulate because you need to use different methods for the different parts. Coombs and dormers are a big sources of heat loss because there is so little separation between the inside and outside. Coombs are typically a 'cold roof' and maintaining a ventilation gap is critical, which also requires vents at the eaves and ridge.

Measures: Insulation Cold Bridges

Thermal bridging

Thermal bridging is an increasingly recognised problem when insulating older buildings. A thermal bridge results when the inside and the outside are directly connected by elements that are more thermally conductive e.g. screws or timber joists passing through insulation layer. Where thermal bridging occurs, condensation is a major concern and the overall thermal performance of the building is reduced.

Source: Greenspec



The higher the level of insulation, the greater the risk for concentrated areas of condensation at any cold bridge. Window reveals are a major concern, also wall/ceiling junctions. Providing a continuous layer of insulation across the structural frame is a simple way to avoid this.

Measures: Ventilation

Good ventilation is essential for indoor air quality and to prevent mould, but it's also important for ventilation to be controlled so that our houses don't leak heat. Windows and doors have always been the main way we control ventilation, but to boost energy efficiency we need to improve their performance and consider other ventilation options. Ventilation is also part of the 'fabric first' approach.

Windows
- A-rated glazing
- Heritage glazing
- Secondary glazing
- Refurbish existing windows
- Window shutters
- Insulate reveals

Doors
- New insulated doors
- Refurbish existing doors

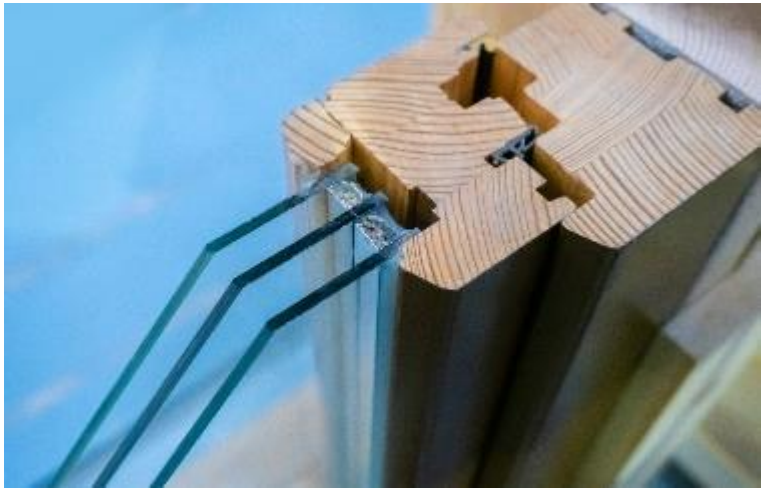
Ventilation
- Airtightness
- Condensation
- Whole house ventilation
- Heat recovery ventilation

Measures: Windows

A-rated glazing

Energy efficient windows are made of 2 or 3 glass panes with air gaps sealed in a single unit, surrounded by a frame made from UPVC, wood, or other material. Window manufacturers show energy efficiency using a rating from A++ to E.
Source: Energy Saving Trust

Old double-glazed units (U=2.5)* perform half as well as newer units (U=1.2) and triple-glazed is better again (U=0.8), that's why some level of window upgrade is almost always recommended to improve energy efficiency. Overall window performance is affected by the type of frame, how tightly openings seal, and various special treatments to the glass and glazing unit, all of which can be adjusted to achieve an A-rating.



* U-value is a measure of how effective a material is an insulator, the lower the number the better the performance. The figures quoted are typical but will vary.

Measures: Windows

Heritage glazing

The windows of a historic building are important in defining its character. Double-glazing may be acceptable where the new windows will match the original, or where it can be incorporated within the original joinery.

Source: Historic Environment Scotland

There is debate about the merit of replacing traditional single-glazed windows, whether for energy efficiency or aesthetics, but options are available. ‘Slim Profile’ double-glazed units have a very narrow air gap which mean they can be fitted in existing timber frames, but still perform well (U=1.5)*. ‘Vacuum Glazing’ is even thinner, where the glass panes are separated by tiny beads and the air gap is vacuum sealed (U=0.7).

* U-value is a measure of how effective a material is an insulator, the lower the number the better the performance. The figures quoted are typical but will vary.

Measures: Windows

Secondary glazing

Internal secondary glazing can reduce heat loss by 60% and has the advantage of leaving the original window untouched. Normally comprises glass in thin aluminium or timber frames set on the internal window framing. Care is needed to allow ease of use for both opening and cleaning.
Source: Historic Environment Scotland

Secondary glazing is a cost effective option for improving energy efficiency, especially if the existing windows* are in good repair and it would be a 'waste' to replace them, or if they have unusual shapes and details that would be difficult to replicate. Panes are simple and quick to install, creating minimal disruption. They can also improve acoustic insulation in noisy areas.

* Secondary glazing can also be suitable for rooflights.

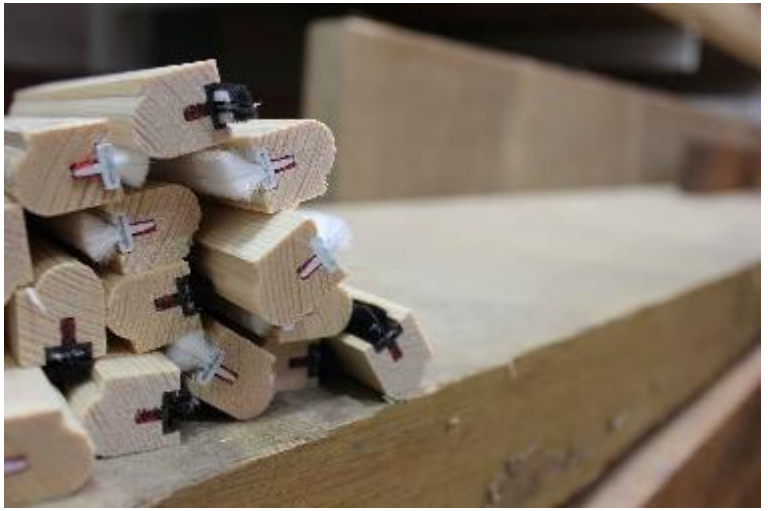
Measures: Windows

Refurbish existing windows

Repaired and adapted, older windows can be as energy efficient as new ones. Repairs usually cost less, and it is more environmentally sustainable to repair than to replace.

Source: Historic England

Provided the frame is still in good condition, most windows can be refurbished to improve their energy efficiency. This applies to better quality UPVC windows as well as traditional timber windows. Works can include: replacing seals and making sure opening sashes close tightly; upgrading the glazing units (see previous slides) and; making sure there are no gaps around the edges of the window frame and wall.



Measures: Windows

Window shutters

Interior shutters add a layer of insulation to cold windows. Edinburgh World Heritage Trust used thermal imaging cameras to show the most effective ways to avoid heat loss. Reinstating shutters is a cost-effective solution if closed tightly at night and when the room is not in use.
Source: The Shutter Shack

Shutters are a simple and traditional way to manage heat flow around windows: opened wide when the sun is shining for heat gain, closed tight at night to keep he heat in. Joiners can old shutters working again, and make repairs if they are warped or have gaps. Insulation of the concealed side is sometimes possible, with thin-profile products such as ‘Aerogel’ blanket.

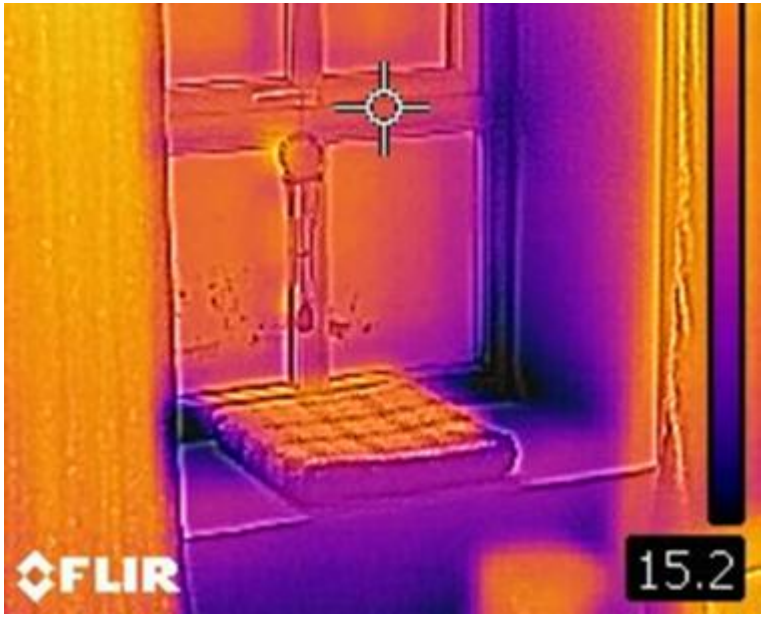
Measures: Windows + Doors

Insulate reveals

Where the wall is very thin, heat is able to leak around the window frames. This is very typical of solid walled buildings, and is the cause of common mould and mildew patches around windows. The best way to prevent heat loss in window reveals is to insulate them.

Source: Heritage House

This includes the top, bottom and sides of door and window openings. The thicker the wall, the more reveal is exposed, the greater the heat loss. Modern building regulations require reveals to be insulated and similar methods can be used in existing buildings. Methods include: insulation-backed plasterboard; fitting thin-profile products such as 'Aerogel' blanket behind joinery; using an insulating plaster (lime-based).



Measures: Doors

New insulated doors

Like any other part of the home, doors can be insulated and draught-proofed to prevent heat escaping. New external doors now generally contain integrated insulation to reduce heat loss and an effective draught-proofing system.

Source: Energy Saving Trust

Most new doors are not solid timber but made of 'composite' construction with a variety of materials, including an insulated core. Whether timber or composite, they will have integrated seals on all sides to prevent draughts. Plain doors perform best (U=1.0)* but doors with double or triple-glazing are available (U=1.4).

* U-value is a measure of how effective a material is an insulator, the lower the number the better the performance. The figures quoted are typical but will vary.

Measures: Doors

Refurbish existing doors

Draught-proofing external doors can stop a lot of heat from escaping, and won't cost you much. Internal doors also need draught-proofing if they lead to a room you don't normally heat.

Source: Energy Saving Trust

Similar to windows, the performance of doors can be significantly improved with tight-fitting seals arounds all edges. It also helps to remove or provide airtight covers for letter slots and keyholes. On traditional panelled doors, thin-profile insulation such as 'Aerogel' blanket can be fitted on the internal face of panels (because the panels are generally thinner than the main body) without changing the external appearance.

Measures: Ventilation

Airtightness

Airtightness is aimed at stopping uncontrolled movement of air by closing gaps and cracks in the building fabric, in windows and doors, or around cables and pipes, through which warm air can escape and cold air get in.

Source: Homebuilding & Renovating

Airtightness goes beyond draught-proofing, it's about minimising gaps in every part of the fabric. Behind skirting boards and cornices, the edges of window and door frames, around power sockets or cables, all are common points of failure. Even a skim coat of plaster on walls and ceilings can help. Airtightness is measured using 'blower door' and 'smoke pen' tests. Old houses tend to be very leaky testing at 15 'air-changes' or higher, while new homes typically test at 5 - 7. The highly efficient Passivhaus standard requires 1 or lower.

Measures: Ventilation

Condensation

After adding a warm layer of insulation to your home, moisture from daily household activities (bathing, drying clothes, cooking, and breathing) is now trapped inside. This excess moisture could cause condensation in any cooler area which has potential to lead to mould and health problems. To avoid this, you should install effective ventilation to allow your home to breathe.

Source: Changeworks

Increased risk of condensation and mould is the downside of better insulation and airtightness, the importance of which is often overlooked during the retrofit process. It is exacerbated by many modern building materials that don't 'breathe' (allow the free passage of moisture). Traditional solid-walled buildings were designed to allow moisture movement so need special care.

Measures: Ventilation

Whole house ventilation

A whole house ventilation system may include intermittent extract fans, mechanical ventilation with heat recovery, combined with background ventilators. These systems ensure extraction of moist air and supply of fresh air, crucial for maintaining indoor air quality and preventing condensation after energy efficiency retrofits.

Source: Airflow quoting PAS2035 Ventilation Assessment

Making sure there is adequate ventilation can involve simple measures: ‘intermittent extract fans’ means cooker hoods and bathroom fans; ‘background ventilators’ means trickle vents or windows that can be cracked open. Good cross ventilation, including high-level windows or rooflights to vent hot air, help to ‘purge’ stale air overnight and prevent overheating. The point is this needs to be planned, it doesn’t just happen.

Measures: Ventilation

Heat recovery ventilation

Heat recovery ventilation extracts stale humid air from 'wet' rooms (bathrooms, kitchen, utility) and passes it over a heat exchanger that recovers 80% of the heat. Another duct draws fresh air from outside, filters it, then passes it over the heat exchanger, to supply warmed fresh air to living areas and bedrooms.

Source: Homebuilding & Renovating

This mechanical ventilation system is often used in buildings with very high levels of airtightness (e.g. Passivhaus) where natural ventilation is not adequate to ensure air quality, and to maximise energy efficiency, but it can be used in any house. It has added benefits of distributing heat evenly through all rooms, stopping mustiness, filtering pollutants and pollens, and allowing windows to stay closed in noisy locations.

Measures: Energy

Alongside ‘fabric first’ measures we need to overhaul our energy systems, making sure we use energy as efficiently as possible and decarbonising energy supply. The way we use energy in our homes is still largely derived from the expansion of the national electricity grid and the introduction of gas or oil boilers in the 1950s & 60s, but that is now rapidly changing with modern technology and renewable energy.

Renewable energy

- Renewable electricity
- Decarbonised heat

Energy management

- Heating controls + insulation
- A-rated light fittings + appliances
- Energy tariffs

More detail about heating options are provided in a separate presentation:
Decarbonising Heat

Measures: Renewable Energy

Renewable electricity

If you generate renewable electricity at home, you can use it to power electrical appliances, or even an electric vehicle. This lowers the amount of electricity you import and pay for. Combining renewable energy with energy storage means you make more use of the energy you generate.

Source: Energy Saving Trust

For many households, ‘electrify everything’ will be the best approach: heat pumps, induction cookers, electric vehicles, all require electricity. Solar panels can make a major contribution to that energy use, especially if the system includes a battery to store electricity generated during the day for use at night. Solar panels are often on the house roof but can be on outbuilding roofs or ground based frames. A standard single-phase grid connection can take up to 4kW generation.

Measures: Renewable Energy

Decarbonised heat

Heating is central to our lives. We rely on it for comfort, cooking and washing. It is the biggest reason we consume energy in our society. Less than 5% of home heating is currently low carbon.
Source: Energy Systems Catapult

Heat pumps will be the obvious choice for many houses, especially if it can be connected to existing central heating radiators, but there are alternatives. Smaller well-insulated houses could use electric storage heaters, whilst larger older 'leaky' houses might be better with a biomass boiler. There are also 'heat batteries' or 'solar thermal' panels that can help with hot water supply. At the community level, Heat Networks are expected to be used in 20% of UK houses by 2050 with heat supplied from a local energy centre via underground pipes.

Measures: Energy Management

Heating controls + insulation

Heating controls includes timers, thermostats, plumbing and electronic components. They help manage when the heating should be on and what temperature rooms should be. Heating controls are improving all the time, but research shows that few people understand their controls.
Source: Energy Saving Trust

Even if you are not replacing the current heating system it may be worth updating controls, and learning how to use them: just turning down the central heating flow temperature can make a big difference. Modern systems allow a higher level of control, including responsive to the weather and remote operation. Meanwhile, better insulation of hot water cylinders and pipes ensures heat is not wasted, which will reduce energy demand.

Measures: Energy Management

A-rated light fittings + appliances

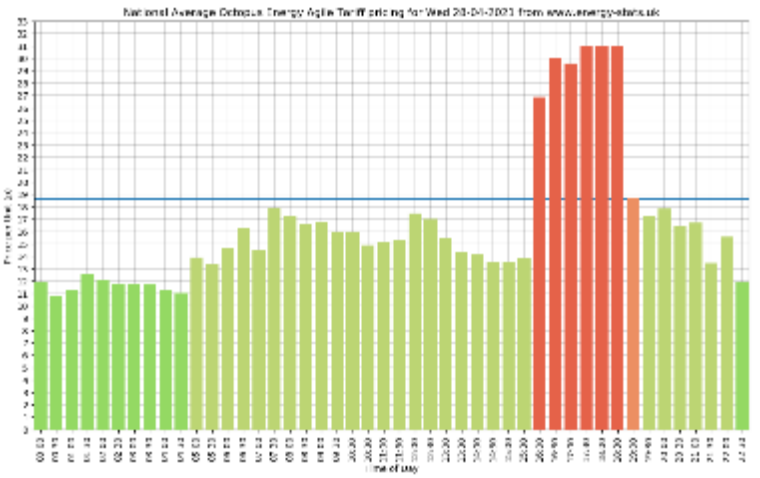
Energy efficient lighting helps lower electricity bills and carbon dioxide emissions, all without reducing the quality of light in our homes. You can also use sensors or timers on external lights, so they are only on when they need to be.
Source: Energy Saving Trust

Even if you are not upgrading the insulation of your house, you can reduce energy use by installing light fittings and appliances with high energy efficiency ratings. For lighting that simply means swapping incandescent bulbs for LED, though sometimes the fitting is best replaced. For cooking, install an induction hob and fan-forced or microwave oven. Even within those products there is a wide range of efficiency levels so check the rating labels.

Measures: Energy Management

Energy tariffs

The biggest savings for people with heat pumps can be made by switching to a time-of-use-tariff or a heat-pump-tariff. Your savings will come more quickly if you're using a dedicated tariff.
Source: WHICH magazine



Because we are changing the way we use energy it makes sense we reconsider how we pay for it. Heat pumps should be left running 24/7, electric vehicle charging is best done in the middle of the night, but solar panels will be generating most on a hot summer day. Does someone have a health condition that needs a constant high temperature, or do you travel for work and are rarely home? Energy companies are starting to offer deals aligned with these different customer needs. The right tariff can significantly reduce the payback period for some measures.

Measures: Cost Estimates

The HEEP software operated by the Energy Saving Trust was used to model data for this project. These are the cost estimates it provided for a range of measures based on the 'best estimate' scenario* averaged across all houses in the village.

Source: Energy Saving Trust

Measure	*Cost £*
Cavity wall insulation	1,434
External wall insulation	10,797
Internal wall insulation	8,136
Solid floor insulation	6,820
Suspended floor insulation	1,853
Loft insulation (top up)	877
Room-in-roof insulation	5,127
A-rated glazing	14,235
New insulated doors	1,525

Measure	*Cost £*
Solar panels (2.5kW)	5,860
Air source heat pump	14,195
Ground source heat pump	22,463
Oversize radiators**	5,558
Storage heaters	2,242
New hot water cylinder**	1,095
Heating system controls + valves	860
Additional insulating jacket for HWC	62
Replace lightbulbs with LED	18

* The HEEP software allows different 'scenarios' to be run based on different variables e.g. cost, carbon, insulation-only or heating-only works, hence this 'best estimate' scenario is just an example. The measures have not been 'ground truthed' for individual houses, nor have the cost estimates been checked against local construction rates, so these should be taken only as 'order of magnitude' or indicative costs.
** Oversized radiators and new hot water cylinder may be required as part of a heat pump installation, especially if replacing a combi boiler.

Next Steps…

Scottish Borders Council will continue to explore opportunities that will help to decarbonise buildings through the use of manufacturing and emerging technologies and are happy to provide key contacts to allow communities and businesses to identify solutions.

Council encourage communities to develop their own decarbonisation ideas and explore options for individual properties, businesses and community solutions. Once a range of options have been identified, communities have access to range of resources to assist them in taking these forward.

See contacts and useful links at the end of this document.

Glossary

LHEES	Local Heat and Energy Efficiency Strategy, the Scottish Government policy that requires all Local Authorities to develop a strategy for decarbonising buildings in their area.
Net Zero	Cutting carbon emissions to a small amount of residual emissions that can be absorbed by nature, or Carbon Capture and Storage (CCS), leaving zero change in atmospheric levels.
Retrofit	Where new features and technologies are added to existing buildings. To achieve Net Zero that means anything that will make buildings more energy efficient or climate resilient through measures such as better insulation and installing renewable energy equipment.
Passivhaus	Certification scheme for buildings that provide very high levels of energy efficiency through things like insulation and airtightness. This can reduce the need for space heating to the extent that a conventional heating system is not needed.
Airtightness	A measure of how well sealed the building fabric is. Airtightness is measured by how many air changes per hour occur when all doors and windows are closed.
Blower Door	The Blower Door test is a way to measure airtightness. A fan is temporarily fitted across an external door opening and sucks air from the house, with the fan rate adjusted until incoming and outgoing air flow is balanced.
Smoke Pen	This is a small pen-like device that burns a wick to release smoke (similar to an incense stick). This is used during an Airtightness test to locate points of air leakage.
Thermal Image	Special cameras can be used to identify the location and level of heat loss from building fabric. The test has to be done during cold weather with the house heating system on in all rooms to create a heat differential with the outside, and is done at dusk or early evening.

Useful links

- For information about the Scottish Borders Local Heat and Energy Efficiency Strategy and Delivery Plan please visit: scotborders.gov.uk/lhees
- To view information and guidance on community engagement provided by Scottish Borders Council please go to: scotborders.gov.uk/say/community-engagement or email the team at communityengagement@scotborders.gov.uk
- South of Scotland Enterprise (SOSE) provide a range of services for enterprising communities, see: southofscotlandenterprise.com/community
- Scotland's Heat Network Fund overview and guidance for communities, see: gov.scot/publications/heat-network-fund-application-guidance/
- Heat in Buildings Strategy, see: gov.scot/publications/heat-buildings-strategy-achieving-net-zero-emissions-scotlands-buildings/pages/2/
- Home Energy Scotland (HES) energy and funding advice for homeowners: homeenergyscotland.org
- Business Energy Scotland (BES) offers business support: businessenergyscotland.org
- Local Energy Scotland (CARES) provides support for community schemes: localenergy.scot

Thanks to our partners

During the course of this project, we have consulted with various organisations, government agencies and private businesses that could help to progress a decarbonised heat strategy for Swinton. We would like to take this opportunity to thank them all for their invaluable advice and assistance.

We would also like to thank the community of Swinton for allowing us the opportunity to explore community-based decarbonisation solutions for this pilot project.

This document was produced as part of the LHEES Community Retrofit Pilot Project undertaken by Southern Uplands Partnership for Scottish Borders Council in 2024.

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