Part 2b

Mansion Blocks | A retrofit guide for residents

September 2024 | Rev R

ESSA your conservation association

Edwardes Square, Scarsdale and Abingdon Association (ESSA)

The Royal Borough of Kensington and Chelsea

Funded by RBKC NCIL

Levitt Bernstein People.Design

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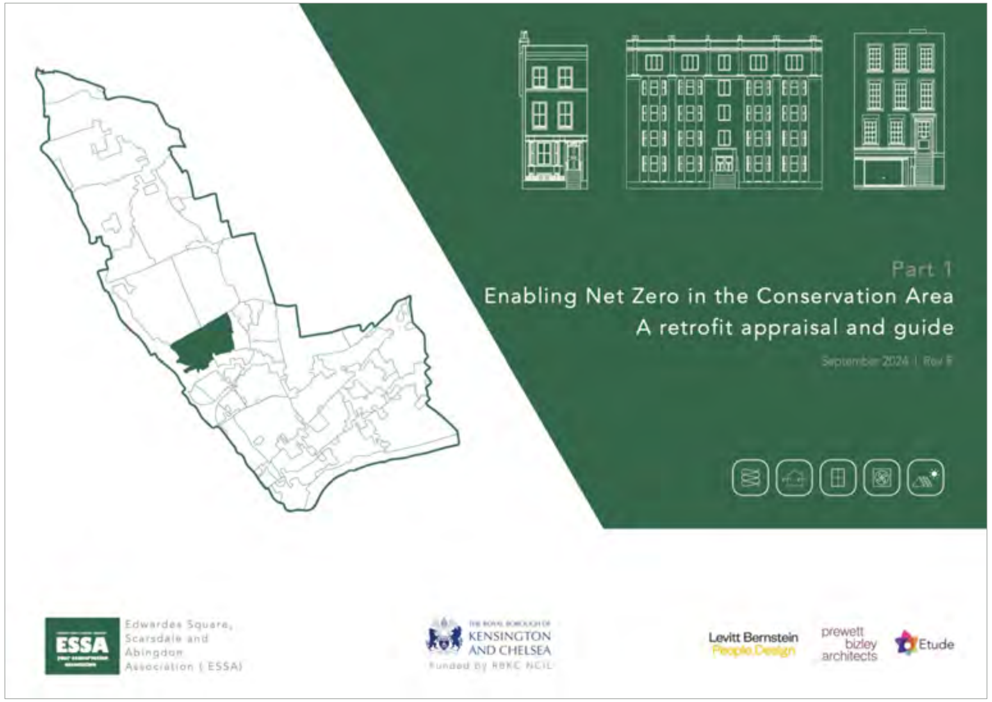
Etude

Retrofit guidance developed for the ESSA Conservation Area

This guidance document is part of a suite of four documents developed by Levitt Bernstein, Prewett Bizley and Etude for the ESSA Conservation Area association. These documents have been developed in order to explain what retrofit means and how residents in the area can improve their homes while reducing its carbon emissions by more than 90%.

The ESSA conservation area association and the authors of these documents are very grateful for the support of the Royal Borough of Kensington and Chelsea.

Important note: *These documents will hopefully provide a helpful starting point for residents. However, the words and other content provided in these documents are not intended and should not be construed as specific professional advice for their homes. When residents decide to undertake any type of retrofit work to their homes, they should consult with an appropriately qualified building professional and develop a specific retrofit plan.*



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How to use this guide?

Simple graphical summary pages

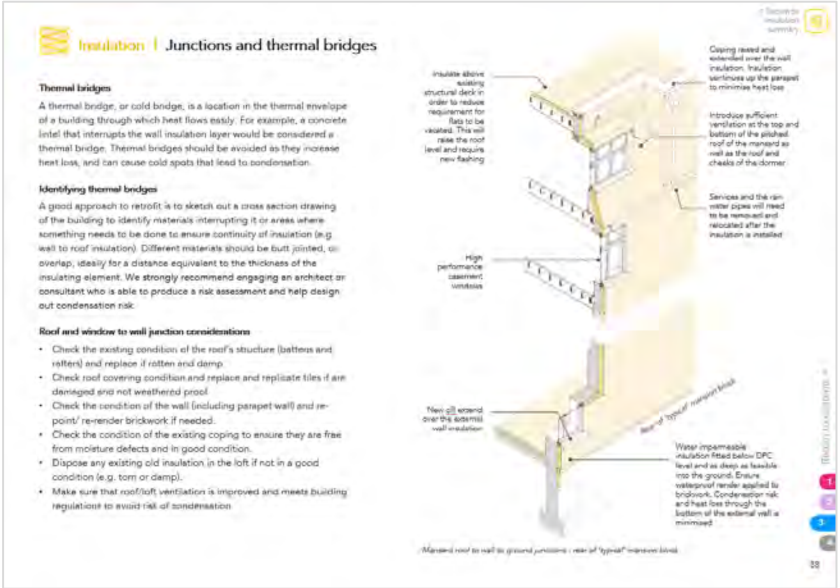
Section 2.0 is a visual guide to retrofit solutions for the archetype. It will help you to understand, on a theme by theme basis, the key retrofit measures that are possible to improve your home and put it on track to Net Zero.

Summary page on windows (from Section 2.0) explaining which window improvements should be considered.

Additional information

If you want to find out more about any of these measures, you can go to Section 3.0.

Further guidance and information is also signposted in Section 4.0.



Summary page on insulation (from Section 3.0) focusing on junctions and thermal bridges

Interactive navigation

It is easy to navigate between the different sections and pages of this report. Please use the links at the top and right hand side of the page to explore this guide like a website!

A return to contents button is also available >

1.0

Introduction to retrofit and this guide for residents

Retrofitting our homes over the next 30 years is crucial to mitigate their impact on climate change and move away from fossil fuels. It will also help our homes to become better, more comfortable and healthier.

Before explaining what can be done in section 2.0, this section introduces the concept of retrofit and how this guide was designed to be useful to you.

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Why retrofit?

Decarbonising our homes is key to Net Zero

England currently has some 25 million homes. Between now and 2050 another six million new homes will be built. This means that 80% of the homes that will be present in 2050 have already been built.

If we are to successfully decarbonise housing, retrofitting is essential: we need to increase our homes' energy efficiency, change their gas or oil heating system for a low carbon heating system (e.g. heat pump) and generate more renewable energy on their roofs.

Reducing fuel bills alongside carbon emissions

Whilst decarbonising homes is important to mitigate climate change, it is not the only reason to retrofit. Much lower energy bills are possible. Retrofit will help avoid wasting money too.

Health and wellbeing

Improving the energy efficiency of a home is also likely to significantly increase thermal comfort (both in summer and in winter) and improve indoor air quality through better ventilation. This will have a positive impact on everybody, but especially small children, the elderly and those with respiratory conditions.

Better homes

All homes need regular maintenance and retrofitting will help with this. Poorly maintained windows, brickwork and roofs all represent weak points which retrofit will address.

Adding value to your home

It is likely that a poor energy efficiency rating or the use of a fossil fuel heating system will gradually impact a property value over the next few years. More positively, there is growing evidence that buyers are now ready to pay a premium for energy efficient, comfortable and low carbon homes.

Residents and organisations in the ESSA Conservation Area have a key role to play in putting their homes and buildings on track to Net Zero, and mitigate their impact on climate change

The United Kingdom is legally committed to achieve Net Zero by 2050. The Climate Change Committee provides useful supporting information on how this should be achieved (e.g. Future of Housing report, 2019). Other organisations promote the large scale retrofit of our homes in the next 20-30 years (e.g. Construction Leadership Council's Greening our existing homes publication)

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Introducing the retrofit measures

Energy efficiency

Our homes use energy for heating, hot water, ventilation, lighting, cooking and appliances. The efficient use of energy reduces running costs and carbon emissions. It also facilitates a transition to low carbon heating system, and it reduces a building's impact on the wider energy supply network by lowering demand.

Improving energy efficiency relies on the improvement or the replacement of windows with more efficient ones, a better level of insulation and airtightness for the building fabric and the integration of controlled ventilation, ideally with heat recovery, to ensure air quality and avoid condensation issues.

Low carbon heating

Low carbon sources of heat are an essential feature of Net Zero carbon buildings. Existing buildings need to start to undergo a complete transition away from fossil fuel heating, in particular gas boilers. The most likely solutions will use electrical heating systems, such as heat pump systems, electric radiators or storage heaters.

Gas hobs should also be replaced with cleaner lower carbon induction hobs.

Renewable energy generation

While the increasing proportion of renewable energy generation in the UK's electricity mix is one of the success stories in recent years, the roofs of buildings should be utilised to install solar photovoltaic panels (where possible) to contribute to an even greater generation of renewable energy. This will also directly benefit residents through lower energy bills.

Demand flexibility

With electricity being used more and more to meet heating demand and with more renewable electricity being generated locally, the ability of a dwelling to manage demand with more flexibility is becoming important.

Category	Example of retrofit measure
Windows	• Triple glazed casement windows • Triple glazed 'mock' sash windows • Evacuated glazing • Advanced secondary glazing • Double glazed casement windows • Double glazed sash windows
Airtightness & Ventilation	• Draughtproofing and airtightness • Mechanical extract ventilation • Mechanical supply and extract ventilation with heat recovery
Insulation	• Loft insulation • Cavity wall insulation • External wall insulation • Internal wall insulation • Ground/basement floor insulation
Low carbon heat	• Heat pumps • Direct electric heating • Hot water cylinder
Solar PVs	• Solar panels on roofs

Key potential retrofit measures generally used to improve energy efficiency, decarbonise heat, generate renewable energy on-site and use energy more flexibly.

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Making retrofit simpler through the use of archetypes

This document is for anyone living within the ESSA Conservation Area who is interested in making their home more energy efficient, less carbon intensive and more comfortable and healthy.

Which retrofit measure is right for my home?

The large number of potential retrofit measures can be overwhelming for residents. This is why this guide has been developed for three different archetypes (see adjacent diagrams).

We have identified and grouped together the solutions which are likely to be suitable for each archetype in order to provide residents with a useful starting point. Our associated analysis also shows the magnitude of change that these retrofit measures can make. It is written as far as possible in non technical language and aims to demystify what can feel like a daunting complex subject.

The three retrofit archetypes in the ESSA Conservation Area

ESSA identified three typologies within the Abingdon Ward, which were used to develop the retrofit archetypes and their associated retrofit templates. Although our work has been based on visits to specific dwellings (homeowners in the area have kindly opened their doors to us), it is important to note that these archetypes should be considered as 'typical'.

All homes are individual

While these archetypes cover the key differences that are found in the conservation area, it is not expected that they will match your home entirely of course. Each home is different due to its original design, its type of construction (e.g. solid wall or cavity wall), subsequent extensions and other alterations, the degree of repair/maintenance undertaken, its building services such as heating system and how it is occupied. Listed buildings also have specific constraints. It is therefore very important to consider this document as general guidance and to develop a specific retrofit plan for your home with building professionals.

Retrofit archetype 1

Victorian house archetype

Retrofit archetype 2

Mansion blocks archetype

Retrofit archetype 3

Modern house archetype

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Which retrofit archetype is the right starting point for your home?

The adjacent retrofit archetype map identifies which retrofit archetype is likely to be the closest match to the retrofit archetype for your home.

Retrofit archetype 1

Victorian house archetype and properties likely to require similar solutions to this archetype

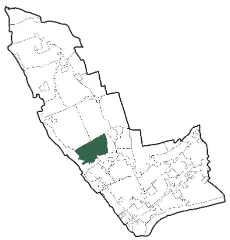
Retrofit archetype 2

Mansion block archetype and properties likely to require similar solutions to this archetype

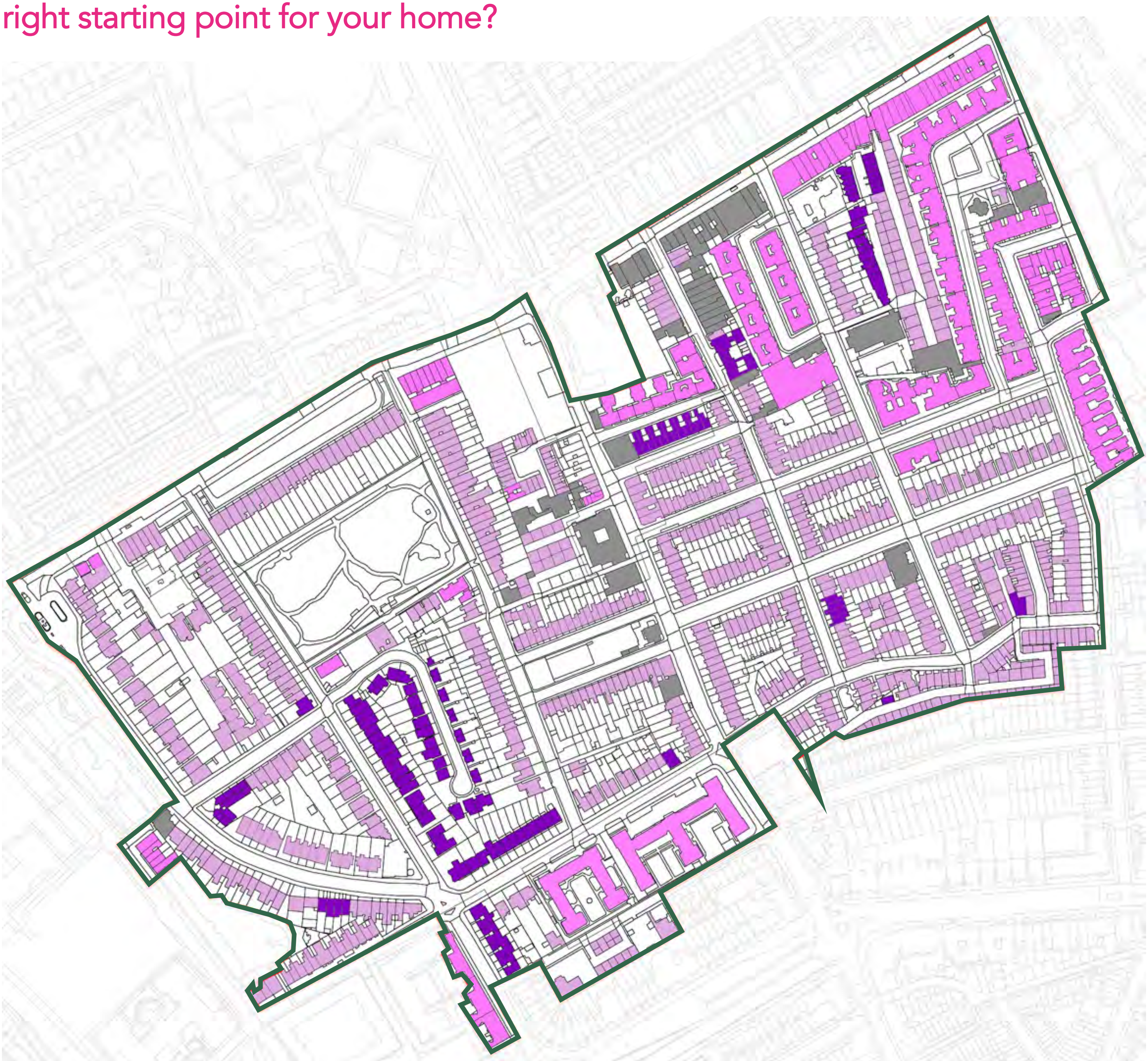
Retrofit archetype 3

Modern house archetype and properties likely to require similar solutions to this archetype

Non-residential



The ESSA Conservation Area in the Royal Borough of Kensington and Chelsea



The retrofit archetypes provided on this page are indicative only, based on best judgement. Homes should be independently assessed.

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Archetype 1 | Victorian house

A variety of characteristics and constraints are common to houses which form Archetype 1. This means that this archetype covers a range of different types of houses which may not look similar.

Residents are encouraged to use this guide as a starting point in understanding and planning their retrofit, rather than a prescriptive roadmap. The recommendations of this guide will have to be tailored to each house.

For example Pembroke Mews fall under Archetype 1 but the ground floor will require a different approach from other more typical Victorian houses in the area.

Lexham Mews

Pembroke Road

Warwick Gardens

Warwick Gardens - rear

Stratford Road

Earls Court Road - rear

Pembroke Mews

Pembroke Road

Abingdon Villas

Abingdon Road

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Archetype 2 | Mansion blocks

A variety of characteristics and constraints are common to blocks of flats which form Archetype 2, but this archetype covers a very wide range of different types of blocks of flats. As it can be seen from the images below, they do not share a similar appearance or style. They have been grouped into Archetype 2 as they are likely to require the same retrofit solutions.

Residents are encouraged to use this guide as a starting point in understanding and planning their retrofit, rather than a prescriptive roadmap. The recommendations of this guide will have to be tailored to each block of flats.

Pembroke Road

Pembroke Road

Pembroke Square

Pater Street

Wrights Lane

Wrights Lane

Cromwell Crescent

Abingdon Villas

Cheniston Gardens

Kensington High Street

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Archetype 3 | Modern house

A variety of characteristics and constraints are common to houses which form Archetype 3, which covers a wide range of different types of houses which may not look similar.

Residents are encouraged to use this guide as a starting point in understanding and planning their retrofit, rather than a prescriptive roadmap. The recommendations of this guide will have to be tailored to each house.

Cromwell Crescent

Pembroke Gardens

Warwick Gardens

Pembroke Gardens

Pembroke Road

Warwick Gardens

Cope Lane

Cope Lane - rear

Abingdon Road

Abingdon Road

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The whole house retrofit plan | A coherent sustainable vision for your home

What is a whole house retrofit?

A whole house retrofit is a comprehensive plan for the improvement of a house of a flat. Key issues such as air quality, damp, mould growth and ventilation are likely to be managed much more appropriately when retrofit is delivered as part of a structured plan instead of through a series of ad hoc interventions.

What are the main considerations?

It is now commonly agreed that retrofit should be done in a holistic manner which addresses the following key objectives:

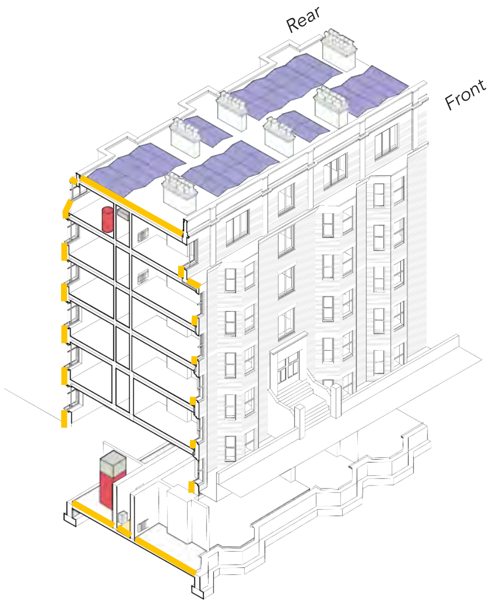
- Addressing existing building defects.
- Providing a continuous insulating layer.
- Developing a clear approach to interfaces, edges and junctions.
- Having a clear winter and summer ventilation approach.
- Providing a low carbon heating and hot water system.

What are the benefits?

The success of retrofit relies on ensuring improvements are undertaken in an organised, sensible order that complement each other and avoid unintended consequences. If you decide to develop a whole house retrofit plan for your home, you can expect to obtain an energy efficient and low carbon home that is in good repair, with very good ventilation and absence of damp.

Taking into account historic characteristics

A whole house retrofit needs to respond sensitively to historic characteristics. Not all measures may be appropriate in heritage terms in any given building.



Defining the end result instead of working out the next step of retrofit each time is one of the key objectives of a whole house retrofit plan.

It will help to maximise opportunities and reduce the risk of later improvements being made difficult by earlier work.

A whole house retrofit plan is a useful tool to prepare and provides a pragmatic and coherent way to deliver this ambition.

An example of a house fitted with various enhanced retrofit measures, including new double-glazed sash windows on the second floor, secondary glazing to the first and new double glazing into old frames on the ground.

Air tightness was implemented as part of the improvements, in this case along with window installation.

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How to start your journey

Delivering whole house retrofit, potentially in phases

Achieving all retrofit goals may take a number of different steps and they do not all have to be done at once, but it is very important to start with a map or 'pathway' of all the work that needs to be done. This is another benefit of the whole house retrofit plan.

A bespoke sequence of work

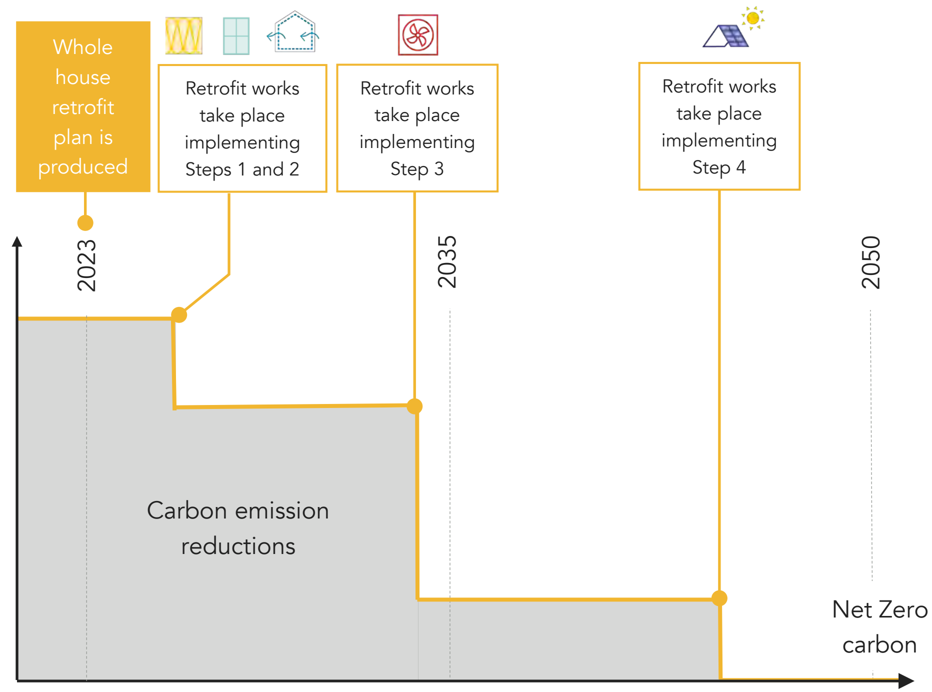
Each home is different, and each homeowner is unique, so each individual whole house retrofit plan will be bespoke. The steps needed may be similar, but the choices about what to do when may be influenced by financial, practical or maintenance considerations.

For instance, a busy family may want to do as much as possible at one time to avoid long term on-going work ongoing, but a couple on a fixed income may need to space the work out over a longer period to make it affordable. An equipment reaching the end of its life represents another example: if the boiler is very old and likely to fail, the heat pump work may be done earlier than where the boiler is fairly new.

Phasing improvements as part of coherent whole house plan

It may not be possible to implement all retrofit measures at once, but it is important to plan ahead so that packages of work are coherent and complementary. The preparation of a whole house plan is recommended to help in that planning. To lay it all out may seem quite daunting, but it helps to have thought about the bigger aims when planning each small part of the work, so you can check that what you do does not make it more difficult to do the next part.

Typical simple retrofit plan		Sequence factors	Cost considerations
Step 1	Insulate loft	Needs to precede step 4	Grants may be available
Step 2	Replace windows and improve ventilation	Ideally before step 3	High cost step so may not be afforded at the same time as step 3
Step 3	Swap boiler for a heat pump	Ideally after step 2	High cost so may not be afforded at the same time as other measures
Step 4	Install PV on the roof	After loft insulation is done	Smart meters should be installed at the same time to get access to the best tariffs



Note: the expected decarbonisation of the grid is not represented for simplicity but will also contribute to the reduction of carbon emissions over time.

Grasping the opportunity

A clear vision… with a pragmatic start

Planning the long term phased retrofit of your home may seem daunting but it does not have to be. The whole house retrofit plan is more about starting to see our homes and the work which they will require over time in a different way than about planning a long and disruptive journey.

Help and advice from retrofit professionals

The best way to plan the retrofit journey is to work with retrofit professionals. There is a range of help available from retrofit advisors, retrofit coordinators and architects with expertise in retrofit. These professionals will also be able to recommend the type of survey and energy audit you need to inform your retrofit plan.

Think about the work you need to do for maintenance

All homes need maintenance work from time to time, such as replacing a broken boiler or leaky windows, and we all carry out various improvement works when we can, such as upgrading a bathroom or replacing the kitchen. Each time you are considering this type of work, look at the overall plan and consider whether you can bring some part of it into the work at hand.

The importance of quality

Quality control is important at all stages of your retrofit, and the details of the product specified will be required for planning. PAS 2035 is the key document in a framework of new and existing standards on how to conduct effective energy retrofits of existing buildings, it covers how to access dwellings for retrofit, identify improvement options, design and specify energy efficiency measures and monitor retrofit projects.

Maintenance item/ Trigger point	Retrofit measures to action or consider ☐ Critical (move away from fossil fuels) ☐ Desirable
Boiler replacement	• Replace with a compact heat pump system (or direct electric heating if not feasible). No new gas boiler. • Plan improvements required to reduce the amount of heat needed to keep the home warm.
Cooking	• Replace gas cookers with an induction hob and all electric cooking. No more gas cooking. • Replace the cooker hood with one that works with the type of ventilation planned for the home.
Windows & door replacement	• Upgrade windows* with the best type available – this needs to be consistent with the other windows in the block. • Replace your front door with an insulated one if the corridors are not heated and/or insulated. • Make sure that windows* and doors are installed with very good seals with the wall around them.
Roof repair (tiles, flat roof)	• If the roof needs works, discuss with your neighbours and the managing agent the option of adding more roof insulation and installing a PV system* to generate electricity.
External insulation	• Discuss with your neighbours and the managing agent the option of installing external wall insulation* – this may only be possible for some walls (e.g. rear elevation). • If external insulation* is possible, discuss with your neighbours and the managing agent the possibility of upgrading windows* while there is access.
Replastering wall or ceiling	• Add internal wall insulation to external walls where external insulation is not allowed while the room is cleared and before redecorating. • Check for draughts and seal any gaps.

** These measures are likely to require planning permission.*

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The particular challenge of retrofit in a block of flats

A more complex decision making process

In blocks that have multiple occupants, it could be more difficult and time consuming to achieve a consensus on priorities and sequences of work, or even on the principle and overall aims of retrofit. There will be different parties with differing concerns involved. These will often include tenants, leaseholders, freeholders and managing agents.

Making the most of existing processes for decision making

Blocks of flats generally have decision making structures and processes in place for the maintenance and repair of the building. There is often a management organisation with a long-term view of the building and with the ability to manage all the different residents' interests and obligations. A retrofit plan should not be seen as outside those processes, but as a part of the ongoing repair and maintenance of the building. This allows the work to be overlaid and coordinated and avoids potential conflicts and abortive work that can occur if these are treated as separate.

Whole building plans with a mix of individual and collective actions

The existing management organisation can employ an appropriate professional to create an overall 'whole building plan' for the retrofit works needed, in the same way as they would a surveyor for other types of works, such as roof repairs. This plan would be bespoke for the block and would recognise the unique constraints and opportunities each building has, including the pattern and diversity of residents and ownership, and will put the building on the right track to Net Zero Carbon.

Each part of the overall plan can be defined as work that could happen **independently** in different demises (e.g. internal wall insulation), **individually but in a consistent way** (e.g. replacement windows) and work that has to happen once for the whole block (e.g. roof insulation).

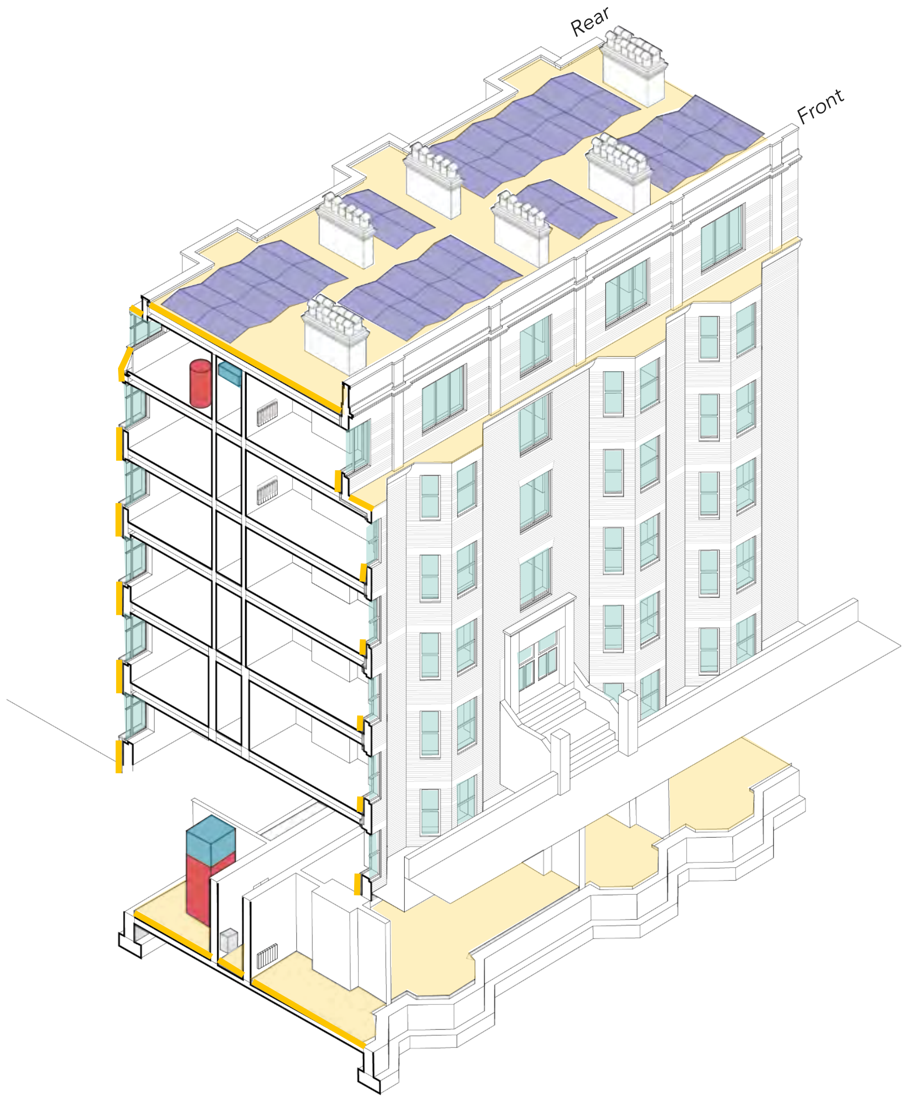

Diagram of an apartment block showing that some measures impact on multiple dwellings: e.g., roof insulation, PV, external wall insulation.

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Mansion block retrofit archetype:

Key retrofit measures

The following pages summarise the likely weaknesses of mansion blocks in terms of energy and carbon performance, and which retrofit measures are likely to be suitable to put them on track to Net Zero while improving comfort (temperature and noise) and air quality.

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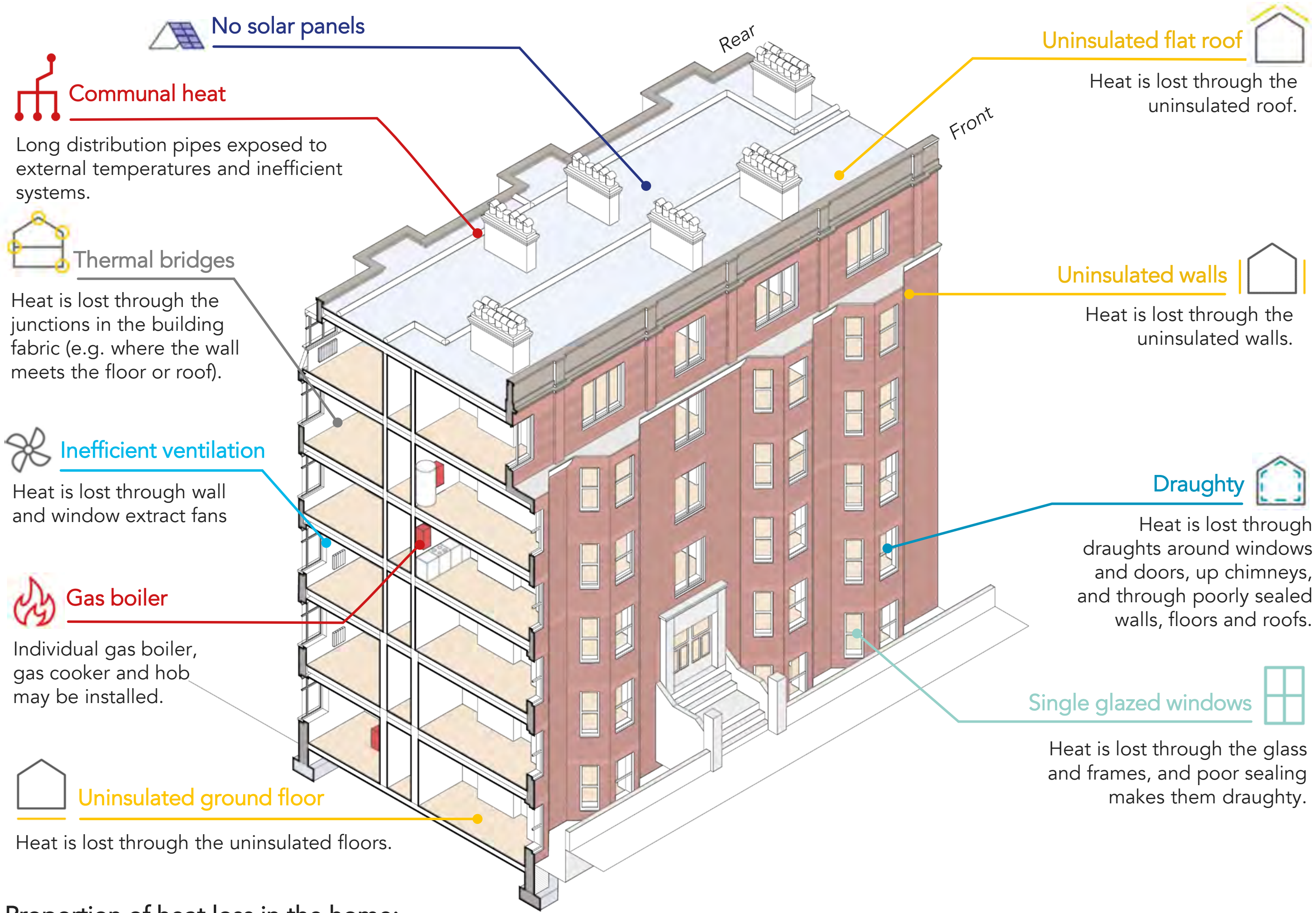
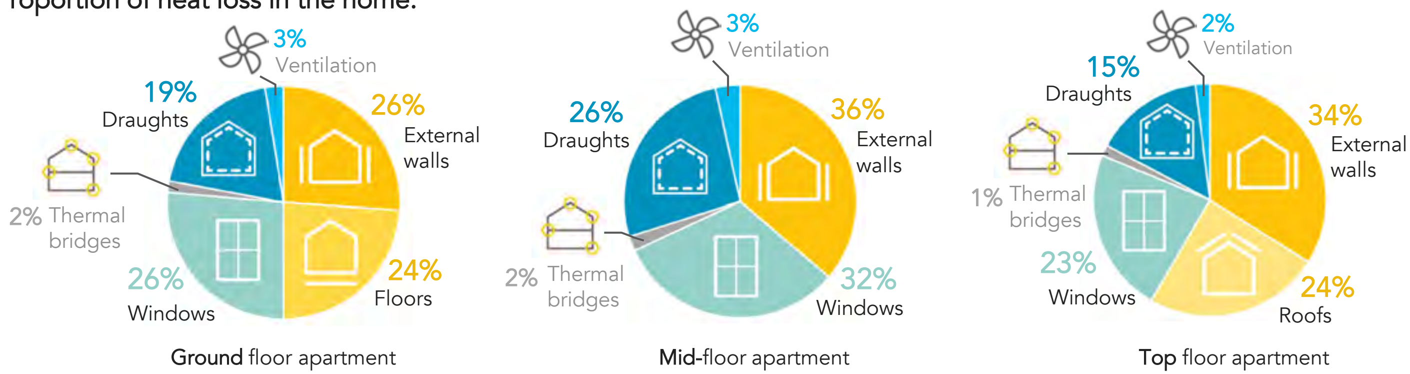
Existing mansion blocks

Reasons to consider retrofit:

- The apartment can feel cold in winter with high heating bills, due to poor insulation, inefficient windows and draughts.
- Poor ventilation leads to high humidity levels and a risk of condensation and mould growth on windows and walls.
- Gas (used by individual or communal gas boilers) is a fossil fuel and therefore not a green/clean source of energy. It also contributes to local air pollution.
- Where existing communal heating and/or hot water systems are installed they can be poorly insulated and inefficient to run.
- No renewable energy on-site – a missed opportunity to save money on energy bills.



Proportion of heat loss in the home:



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Better, healthier and more comfortable Mansion blocks on track to Net Zero

To put your apartment block and home on track to achieve Net Zero, reduce energy bills and improve comfort, the following interventions are recommended:

Landlord works

Insulate the roof with 200-300 mm of insulation. Consider **externally insulating back elevations**.

Upgrade or decommission inefficient communal systems. Allow residents to install their own individual (electric) system for heating and hot water when the heating distribution system is inefficient. Upgrade electrical infrastructure if necessary.

Install solar photovoltaic panels on the roof to generate electricity. Carry out works as soon as roof access is available or as part of roof repairs and insulation.

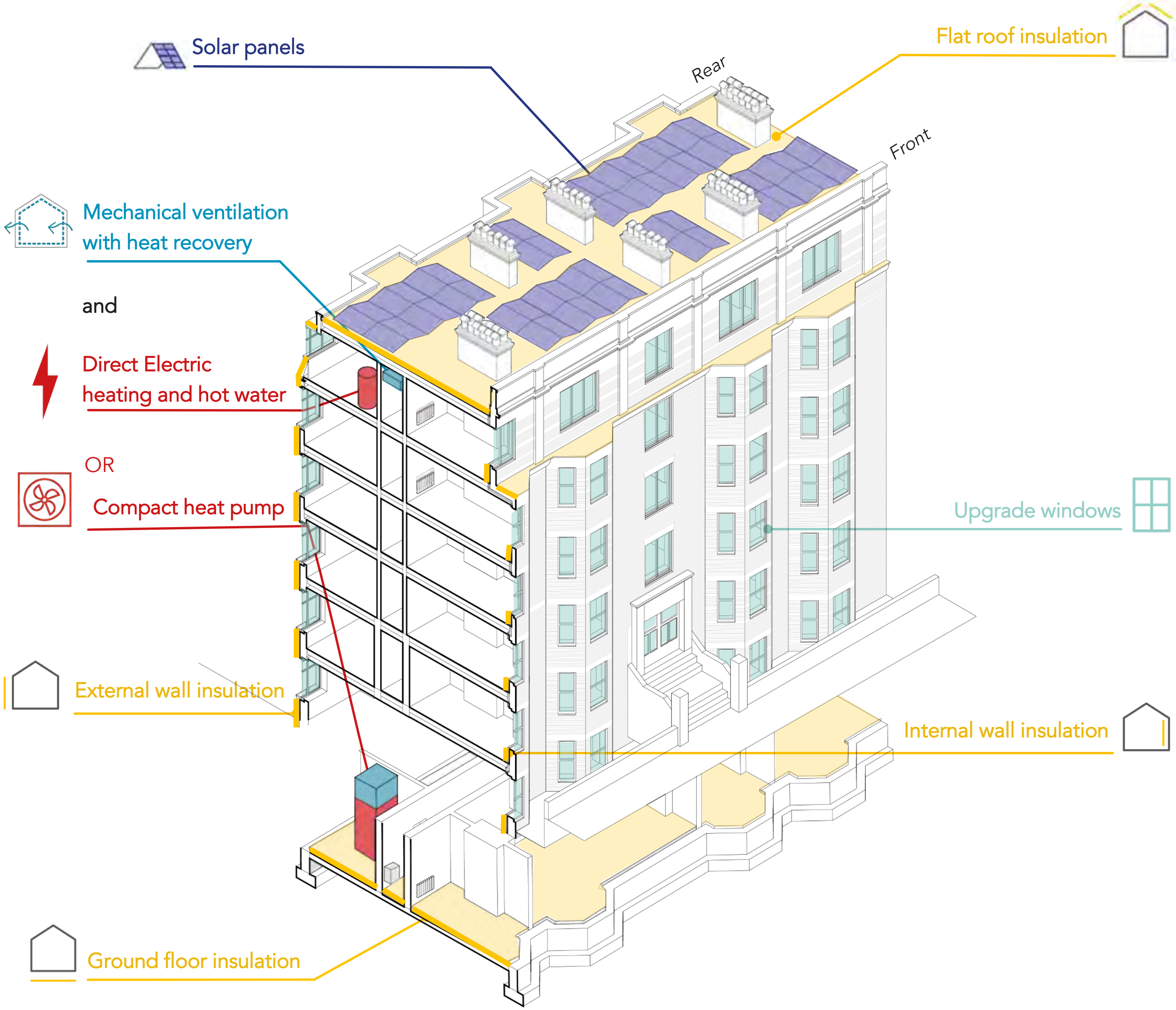
Leaseholder works

Replace single glazed windows with the best upgrade possible. Liaise with managing agent, neighbours and the Council to find a solution which is coherent with the rest of the block.

Reduce air leakage and introduce effective ventilation to ensure air quality and prevent condensation and mould.

Install individual heat pump or direct electric (where heat pumps are not possible) for heating and hot water. Install an induction hob/cooker in the place of the existing gas hob/cooker.

Insulate walls internally to improve energy efficiency further (if external insulation not possible). Ideally insulate the ground floor.



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Better, healthier and more comfortable Mansion blocks on track to Net Zero | Numbers

Retrofit can have a transformational impact:

Energy use can be reduced by 80%.

Solar panels on the roof can roughly generate 12% of the total block annual energy use.

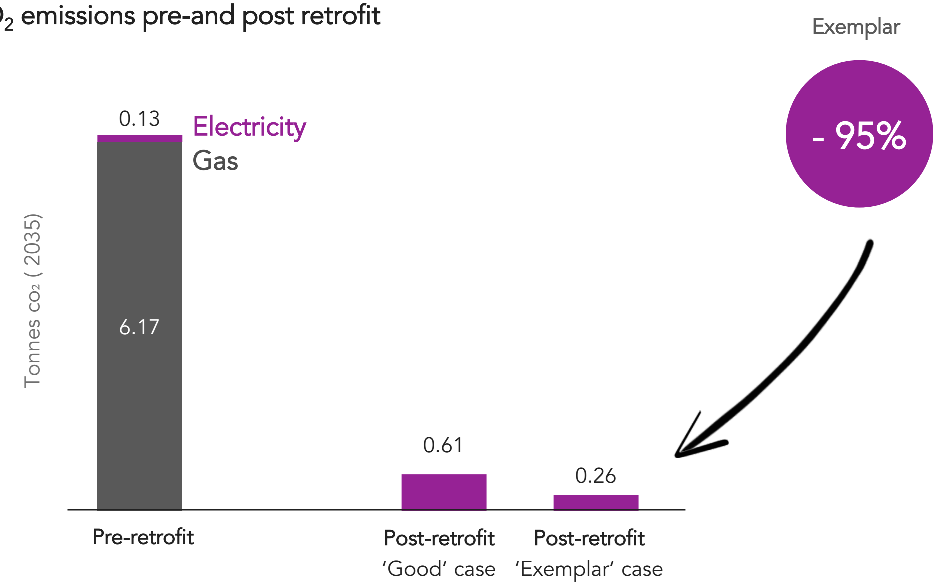
Carbon emissions can be reduced down to nearly zero.

The block of flats can be disconnected from the gas grid, moving away from fossil fuels.

Improved thermal comfort, healthier indoor environment and reduced overheating risk can be achieved.

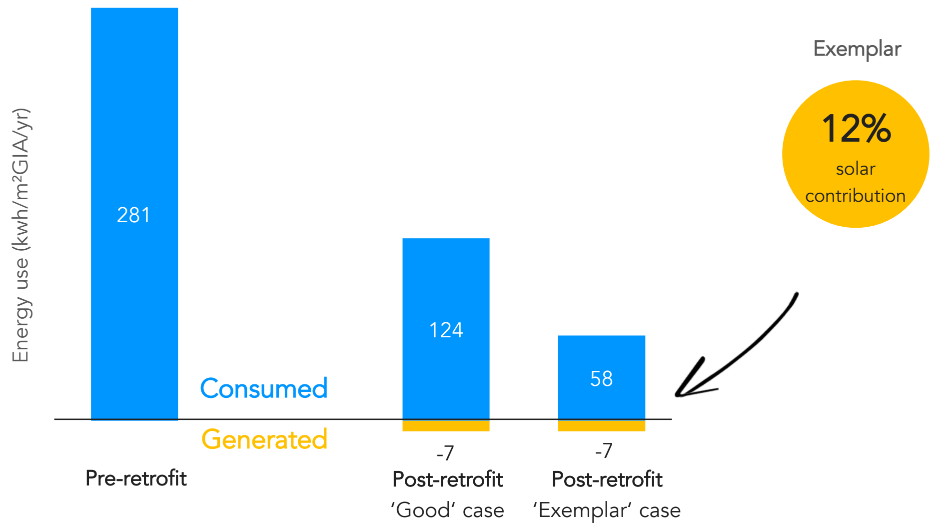
The cost of retrofit is likely to be between £50,000 and £110,000.

CO_2 emissions pre-and post retrofit



The reduction in energy use shown below combined with the move away from gas heating and the introduction of solar panels has a huge impact on the CO_2 emission savings.

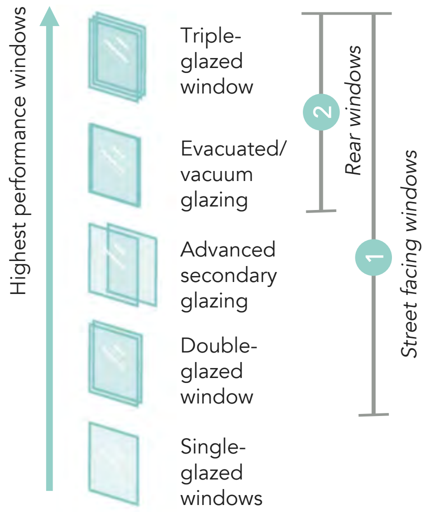
Energy use pre- and post-retrofit



Windows and doors | Potential retrofit measures

Replace windows

Seek permission from the landlord and the Council to replace existing single glazed windows with triple glazed or the highest performance window possible/ practical, to improve comfort and reduce energy bills.



Improve ventilation

Ventilation must be improved when existing windows are replaced.

See 'airtightness and ventilation' section for more information on how to improve airtightness and ventilation while preventing mould and condensation.

When considering wall insulation

See 'insulation' section for more information on insulating around windows, and increasing window sill depths.

2 Rear windows

Replace rear single glazed windows with triple glazing.

Consider casement windows as opposed to sash. Casement windows generally have a better energy performance and airtightness.

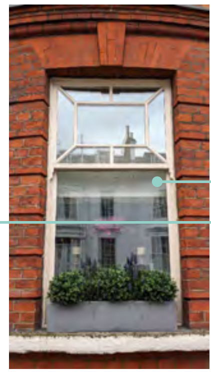
Consider simplifying windows by reducing the number of panes/mullions.

Leaseholders should work with the landlord and other leaseholders to agree replacement window design and apply for planning permission.

Heritage features

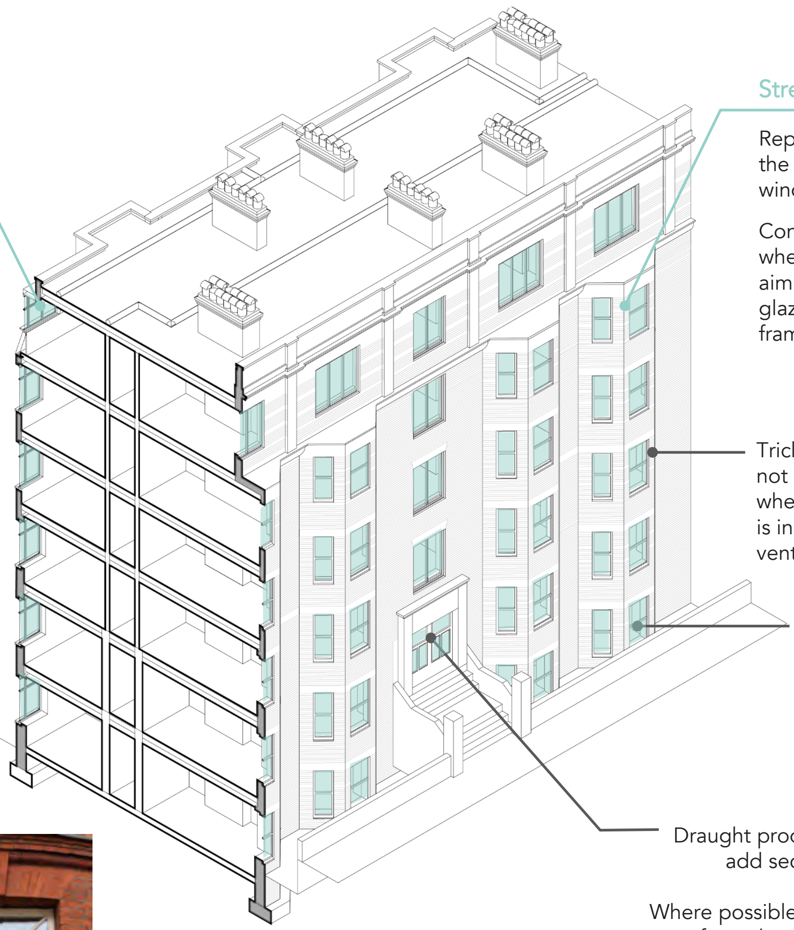
Particularly for street facing windows, match the original window details as closely as possible - two examples from ESSA:

Before (single glazed)



After (double glazed)

Frame profiles, slenderness and proportions can be matched before and after



Street facing windows 1

Replace single glazing with the highest performance window possible.

Consider triple glazing, where this is not possible aim to install evacuated glazing in new or existing frames.

Trickle vents or fans in glass will not be required in windows where heat recovery ventilation is installed. See 'airtightness and ventilation' section.

After windows are replaced, seal well around windows (junction between window and wall) using air-tightness tape.

Draught proof around existing doors and add secondary glazing to fan lights.

Where possible consider replacing existing front door with new insulated and well sealed door.

KEY:

Replace single glazing with the highest performance new windows as possible

The advice provided on this page is indicative only and is not intended to be used for construction. Homes should be independently assessed prior to retrofit.

Insulation | Potential retrofit measures

More on insulation >

Wrapping the block to keep it warm

Insulating parts of the building will benefit each apartment differently. Therefore, insulation works will need to be carried out by landlords and leaseholders:

Landlord works

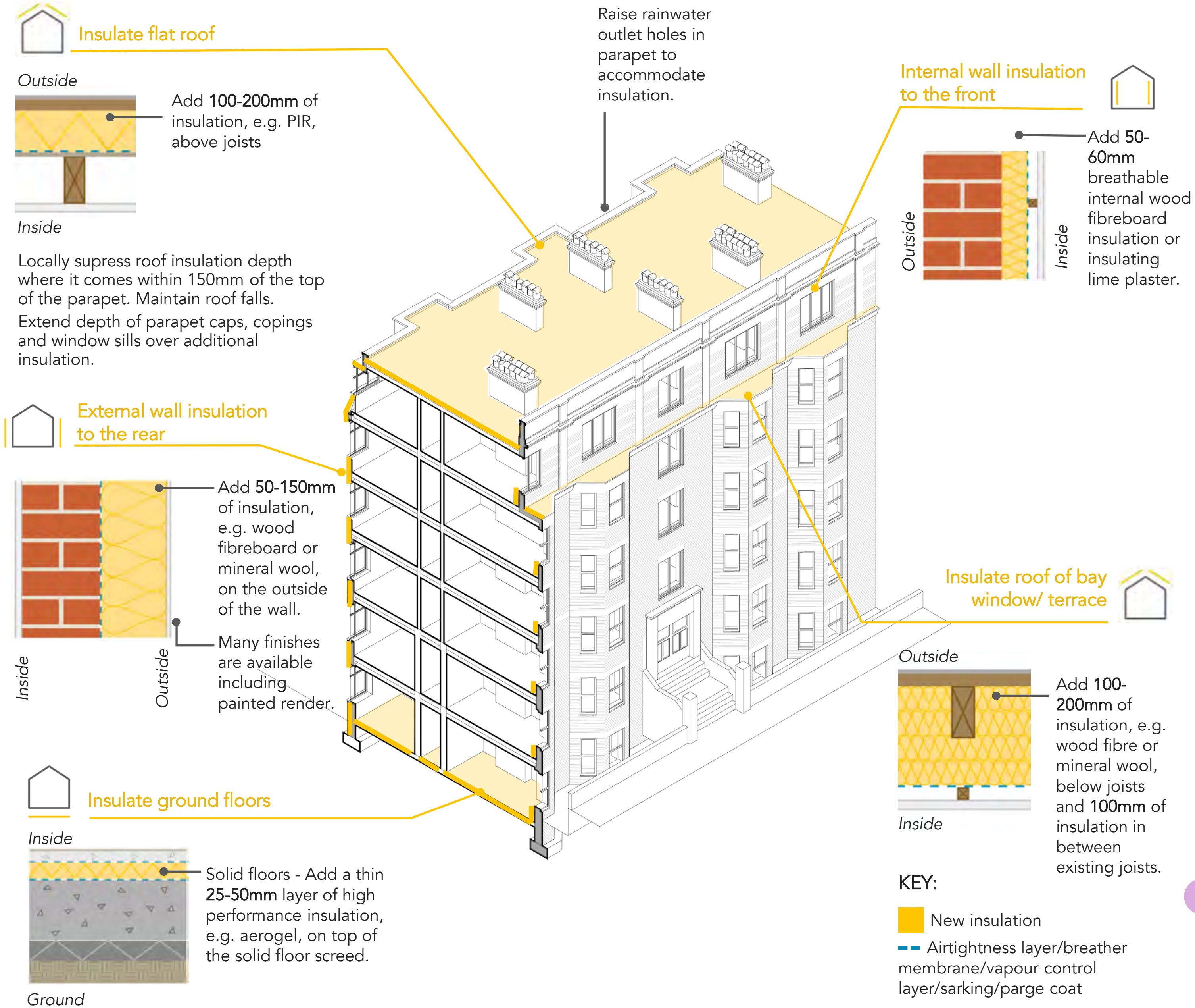
- Insulate the roof as part of maintenance, repairs and waterproofing works.
- Insulate terrace roofs.
- Seek opportunities to externally insulate the rear of apartment blocks (subject to planning permission).

Leaseholder works

- Insulate the ground floor where possible.
- Apply internal wall insulation to street facing walls and encourage the landlord to insulate externally on the rear. Insulate internally if not possible.

Practicality tips

- Assess the building for damp and remediate before installing wall insulation.
- Remove and refix copings, flashings, guttering and downpipes after installation of external roof insulation.
- Re-point external brick work with lime mortar (including chimneys) to prevent water ingress.
- Move and refit fitted furniture, radiators, plug sockets and internal detailed ceilings during the installation of internal wall insulation.



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Airtightness and ventilation | Potential retrofit measures

Well sealed

Begin by reducing draughts and heat loss by improving the airtightness of the home. Common areas of air leakage are around windows and doors, as well as from junctions between walls floor and roofs.

Well ventilated

Once airtightness is improved install a ventilation system, ideally mechanical ventilation with heat recovery (MVHR). MVHR systems provide constant background ventilation which has a positive effect on indoor air quality and reduces humidity levels. MVHR can sometimes be combined with a heat pump, referred to as 'compact heat pump unit'.

Where adequate space for MVHR cannot be found, install continuous mechanical extract ventilation (MEV) with trickle vents instead.

Airtightness and background ventilation should be improved at the same time to reduce condensation forming on internal surfaces and mould growth.

Considerations

- MVHR's outside air intake or exhaust ducts should be insulated and airtight.
- Preferably avoid locating the MVHR in bedrooms, alternatively purchase a very quiet MVHR.

See 'low carbon heat' section for more information on compatibility of heating and hot water systems.

MVHR unit

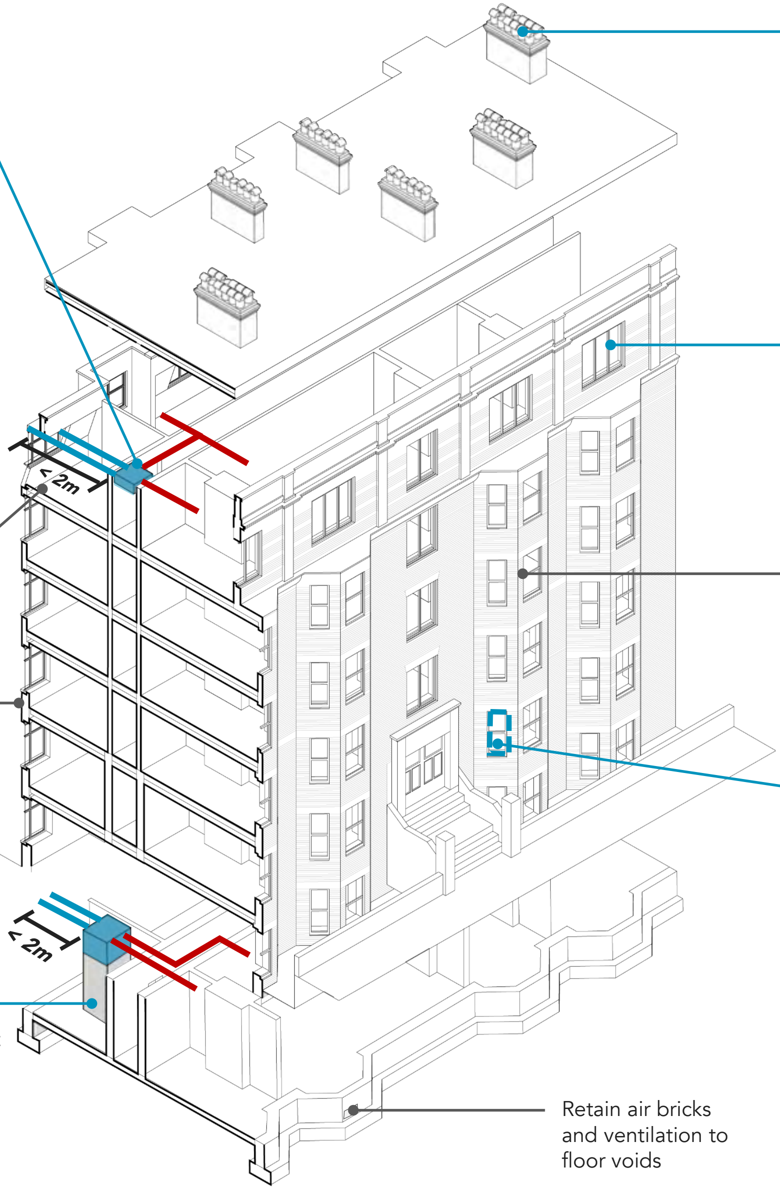
Where direct electric or another system is used to provide heating and hot water - Install a mechanical ventilation with heat recovery (MVHR) system to provide energy efficient background ventilation.

Install MEV where MVHR is not possible.

Drop the ceiling in the home hallway to accommodate the MVHR and ductwork

Install the MVHR system ideally within 2m of an external wall where possible to improve it's efficiency.

Block up existing wall ventilation grilles when installing an MVHR.



Compact unit

Where a compact heat pump unit is installed, the MVHR should be integrated inside.

Cap chimneys

Where fireplaces are disused - cap the chimney pots with pepper pot chimney lids to keep the rain out.

Upgrade windows

Block-up or seal existing trickle vents or fans in glass and/or upgrade windows before installing an MVHR.

Windows will still be used to mitigate overheating during the summer.

Minimise draughts

Seal around windows and doors and junctions between walls, floors and roofs to improve airtightness and reduce draughts.

After windows are replaced, seal well around windows (junction between window and wall) using air-tightness tape.

Retain air bricks and ventilation to floor voids

The advice provided on this page is indicative only and is not intended to be used for construction. Homes should be independently assessed prior to retrofit.

Low carbon heat/heat from electricity | Potential retrofit measures

Use electric systems

The ultimate goal is to disconnect the building and its flats from the gas grid and use electrical systems instead.

Landlord works

- Where on-site communal heating systems are very inefficient and cannot be significantly improved (due to long and difficult to access pipework runs, or no adequate plant space for heat pumps) – allow/enable residents to disconnect and install their own.
- Alternatively, replace communal boilers with heat pumps and significantly improve the efficiency of existing heating distribution. Provide residents with individual heat meters.

Leaseholder works

Hierarchy of heating and hot water system options, based on efficiency:

1. Disconnect from communal system. Install a compact heat pump.
2. Alternatively, install a direct electric immersion hot water cylinder and direct electric panels or modern electric storage heaters for heating.

Compact heat pumps are more efficient than direct electric heating. They capture excess heat from the inbuilt mechanical ventilation with heat recovery unit, increase the temperature with electricity, and then move it to the hot water cylinder and radiators.

Direct electric

Select direct electric for heating and hot water provision, when:

- The windows have been replaced with triple glazing or the highest performance window possible
- The home has been insulated as far as practically possible
- The airtightness of the homes has been improved
- A mechanical ventilation with heat recovery system has been installed.

Install or replace the hot water cylinder with a more efficient insulated one, with a direct electric immersion.

Install direct electric panel heaters or modern 'smart' storage heaters.

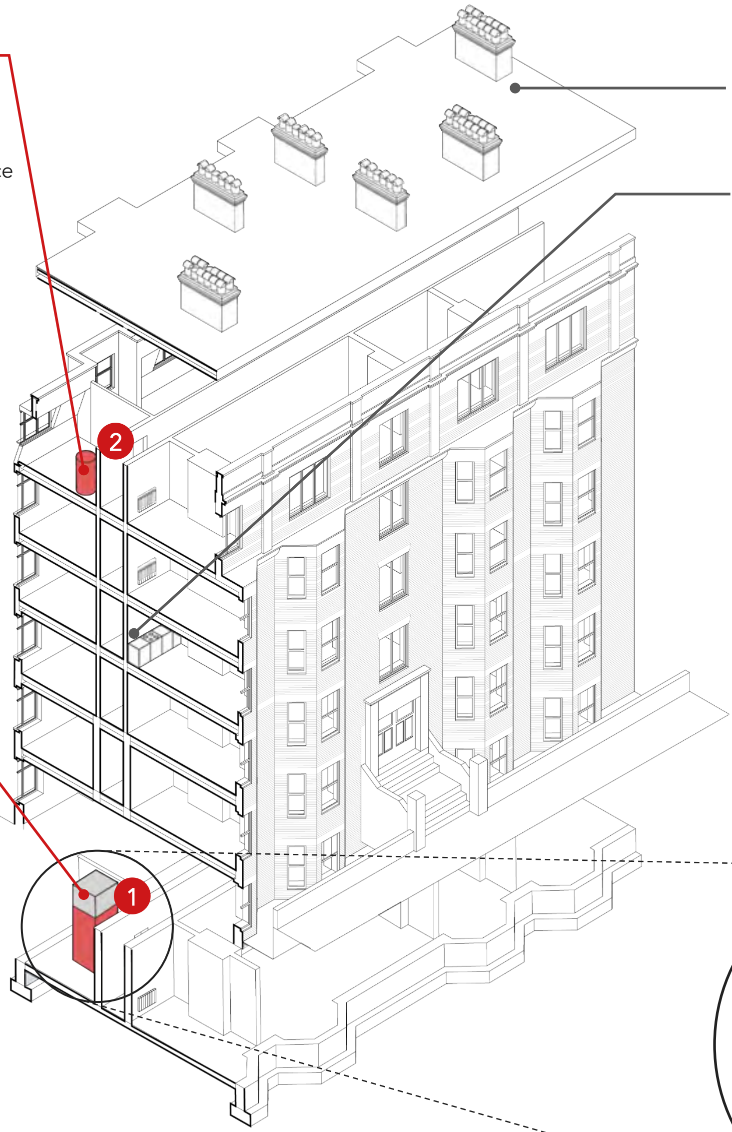
Compact heat pump

Select a compact unit to provide hot water only or hot water and heating, when:

- The windows have been replaced with triple glazing or the highest performance window possible
- The airtightness of the homes has been improved
- Easy to access areas have been insulated.

The compact heat pump unit will provide hot water.

Select a compact unit that can also provide heating and connect it to the existing radiators. Or install direct electric panel heaters.



Decommission and remove existing inefficient communal heat network and enable residents to install their own systems.

New induction hob to replace gas hob.

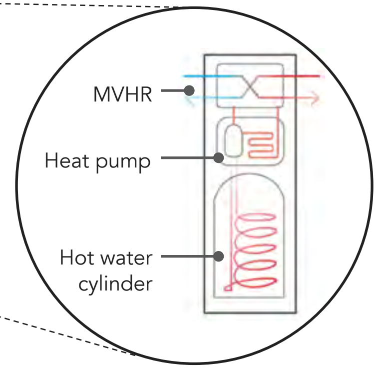
Compact heat pumps

The size of the heat pump will depend on the size of the home. Seek independent and professional advice for location and size of heat pump.

Heat pumps operate at lower temperatures than gas boilers, therefore, some radiators may need to be increased in size if other retrofit measures (such as insulation and window improvements) are not made.

Position the compact heat pump:

- A maximum of 2m from an external wall ideally.
- In a room other than a bedroom.



The advice provided on this page is indicative only and is not intended to be used for construction. Homes should be independently assessed prior to retrofit.

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Solar PVs | Potential retrofit measures

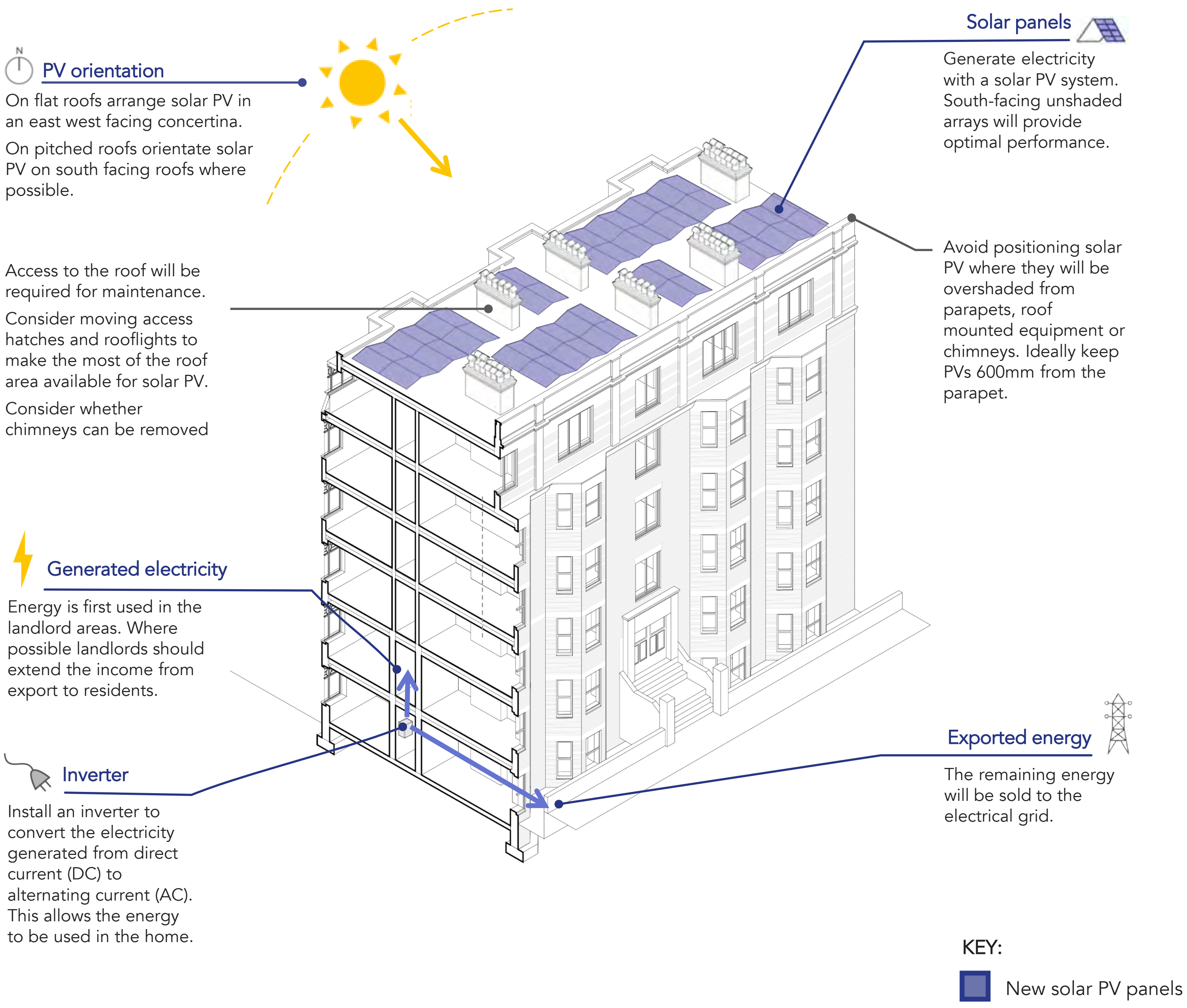
Solar photovoltaic (PV) panels generate 'free' electricity from the sun and can be installed on existing roofs. They are a simple, reliable and durable technology and landlords/ leaseholders can benefit from a reduction in electricity bills.

Landlord works

- Install PV as an east/west facing concertina on flat roofs. For pitched roofs south facing is a preference, but east and west facing roofs may be appropriate too.
- Confirm the roof can take the additional weight loadings and wind forces.
- Maximise energy generation and explore two possibilities:
  - Connect each apartment individually to the system, to receive the direct benefit.
  - Connect to a landlord supply and extend the benefit to occupants through a service charge reduction.

Practicality tips

- Avoid shading from existing objects on the roof, such as chimneys, parapets, equipment and overhanging trees. If partial shading is inevitable, install power optimisers to increase output and monitor individual panel's performance to be increased.
- Consider access to the roof and the solar PV panels for maintenance.
- Invest in a monitoring system to increase the reliability of the system. This will allow immediate identification of any issues.



The advice provided on this page is indicative only and is not intended to be used for construction. Homes should be independently assessed prior to retrofit.

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Cost

How much will it cost to retrofit?

It is notoriously challenging to provide an accurate assessment of the cost of retrofit, even more in the case of mansion blocks, where the responsibility for undertaking the works and associated costs could be split between the individual owner and the building management.

There is a significant difference in the size and complexity between buildings and between apartments (e.g. size, location within the building) which will produce variance in the costs – more for some and less for others. It depends obviously on the specific building's characteristics and on which works are required.

To establish an approximate cost across the whole Mansion block, we have combined the costs per representative unit (individual) and the average costs per flat of those improvements benefitting the whole building like upgrades to roof, external walls and heating system (building management).

A list of indicative costs for 'energy' retrofit measures is provided on this page. They are expressed per measure and should not be added together as they are based on different measures and units.

An indicative guide for all measures combined (covering the whole retrofit plan) for a **typical flat of 163m² GIA in a Mansion block** is **£50-80k for a 'good' retrofit**, through to **£90-110k for an 'exemplar' retrofit**. These can be delivered at the same time or over a long period, e.g. 10-20 years.

Contractor's overheads and profits, preliminaries costs, systems' decommissioning, ancillary work, contingencies and design fees will all vary but also need to be taken into consideration, as well as planning fees, building control fees and, very importantly, VAT.

The cost of upgrading and future proofing the apartment

Improved comfort, health and lower fuel bills are all valuable and important outcomes of retrofit. For example, a MVHR system will improve indoor air quality and new windows will reduce external noise. More generally, most retrofit costs can be considered as 'modernisation' costs that contribute to futureproofing the flat.

Indicative costs of a range of retrofit measures

Individual flat cost (blue)
Building management cost (purple)

	Measures	Cost (low)	Cost (high)
Windows & doors	Advanced secondary glazing with refurbishment of existing window (per m²)	£900	£1,400
	Evacuated glazed sash (per m²)	£900	£1,600
	Double glazed sash (per m²)	£900	£1,500
	Double glazed casement (per m²)	£800	£1,200
	Triple glazed 'mock' sash (per m²)	£1,300	£1,500
	Triple glazed single casement (per m²)	£900	£1,300
Airtightness & ventilation	Improved draught proofing - New window sealing, filling cracks and taping junctions	£500	£1,000
	Mechanical ventilation system - MEV with associated ducts	£1,200	£2,800
	Mechanical ventilation with heat recovery - MVHR with associated ducts	£5,000	£10,000
Insulation	Front façade - 40-80mm internal insulation (77m²)	£9,000	£25,000
	Rear façade - 100-200mm external wall insulation (average per flat)	£6,000	£13,000
	Flat roof 100-200mm insulation (average per flat)	£1,600	£2,500
	Suspended floor - 100mm insulation (average per flat)	£2,000	£5,000
	Solid floor - 25-50mm insulation (average per flat)	£600	£12,000
Low carbon heat	Exhaust source heat pump and new hot water tank (per flat)	£10,000	£16,000
	Direct electric and new hot water tank (per flat)	£5,000	£7,000
	Fit new time and temperature control on heating system	£150	£250
Solar PV	Photovoltaic panels, 1.3 kWp array (3 panels per flat)	£2,800	£3,500

The above cost estimate (Q3 2023) are only indicative estimates per flat. A specific cost plan must be undertaken for each retrofit.

Energy use and comfort pre- and post-retrofit

Energy use and space heating demand

The individual impact of each measure on the total energy consumed by the flat as well as on its predicted space heating demand are shown on the adjacent graphs. They have been calculated using PHPP, a predictive energy use modelling software. A typical basement, intermediate and top floor flats have been modelled and the results reflect their area weighted average.

- Roof insulation, replacement of windows, airtightness improvements, integration of an efficient ventilation system (MVHR) and wall insulation have a decisive impact on space heating demand, facilitating the move away from a gas boiler towards a direct electric solution. In turn, this move helps to significantly reduce energy use and energy bills are likely to reduce, despite the higher cost of electricity.
- The final energy efficiency measures help to reduce energy (and running costs) further, improve comfort, and get to a point where some part of the annual energy use can be generated by solar PVs on the roof.

Comfort

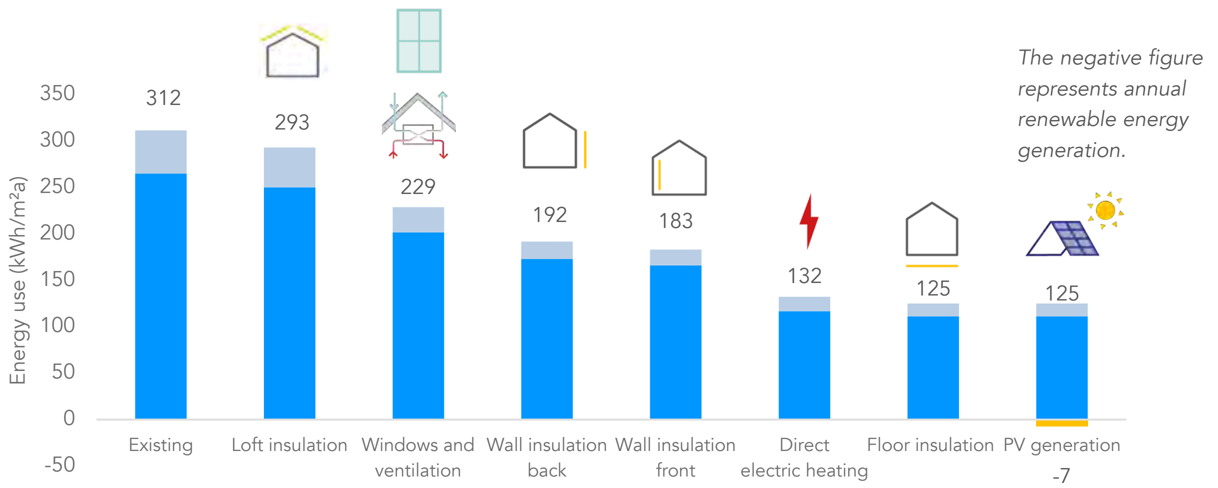
It is common for existing homes to be 'under-heated' as it can be difficult and/or costly to heat the flats to a more comfortable temperature. As energy efficiency improvements are installed, comfort is likely to increase as it becomes easier and cheaper to heat the flat. Comfort will become more consistent across the flat too.

This is why the adjacent graphs report energy use intensity and space heating demand at two different average temperatures.

Upgraded window specifications and improved ventilation will also improve indoor air quality and reduce noise pollution from outside.

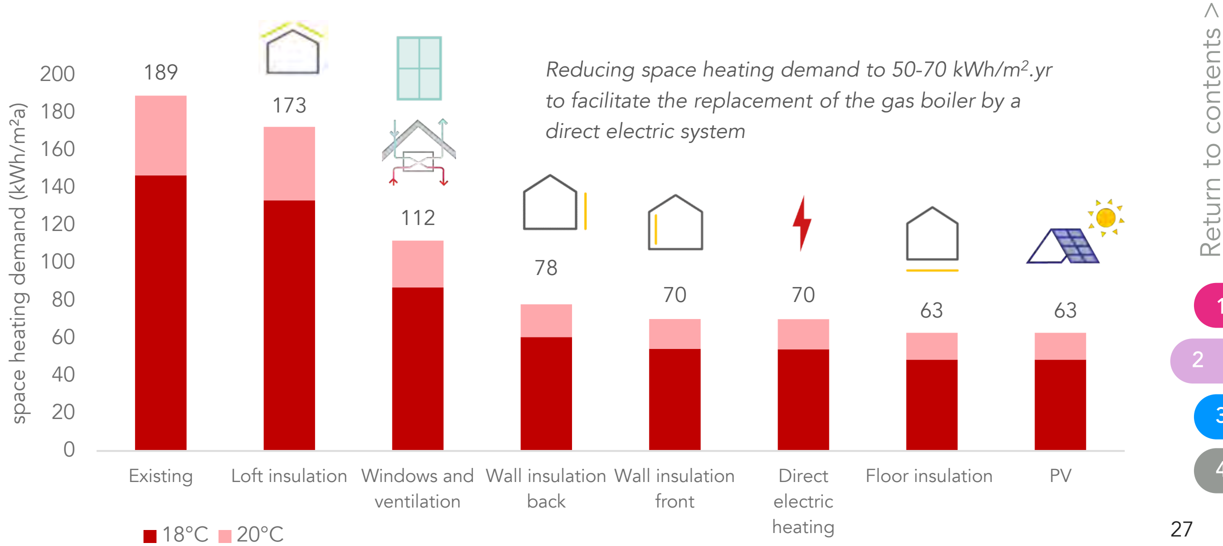
Energy use intensity for a 'typical' mansion block

Impact of measures (exemplar retrofit)



Space heating demand for a 'typical' mansion block

Impact of measures (exemplar retrofit)



How to approach your retrofit journey

Watch points

Carrying out any retrofit work should be done with care and a clear roadmap with the end goal and staging points along the way. As you develop your specific retrofit plan (probably with a professional) it is important to ensure that you:

- Identify any issues which are specific to the house.
- Are clear about whether the retrofit will be phased and consider appropriate sequencing.
- Consider building fabric and services together at once and ensure that they area adequately coordinated.
- Correct any existing defects at the start.
- Develop a robust 'moisture plan' (e.g. include ensuring all pipework is free of leaks) and take care that new materials are compatible with original ones particularly in the way they deal with moisture.
- Ensure that adequate ventilation is provided and the building is made less draughty and leaky.

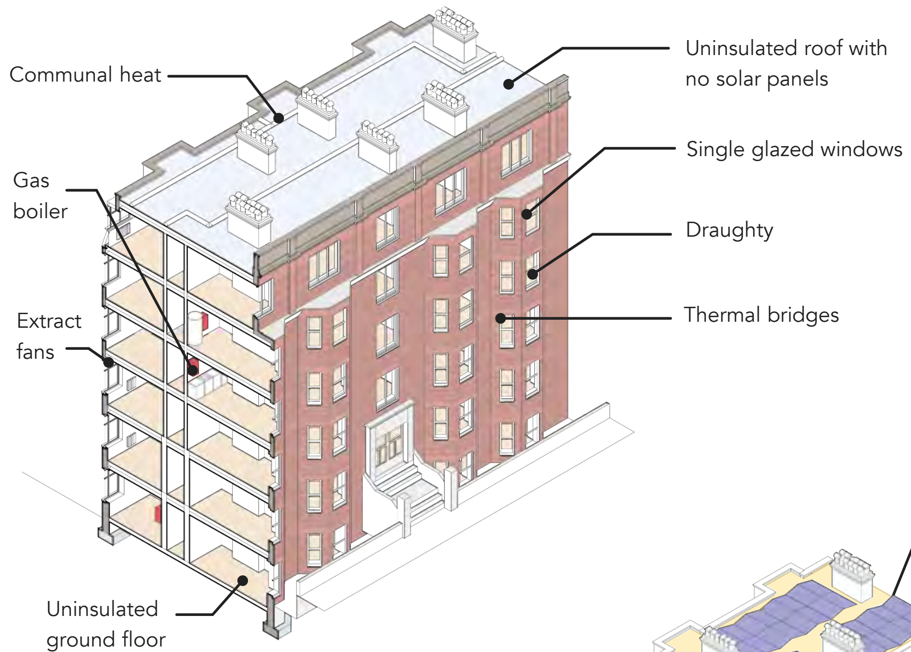
Develop a whole house plan before you start

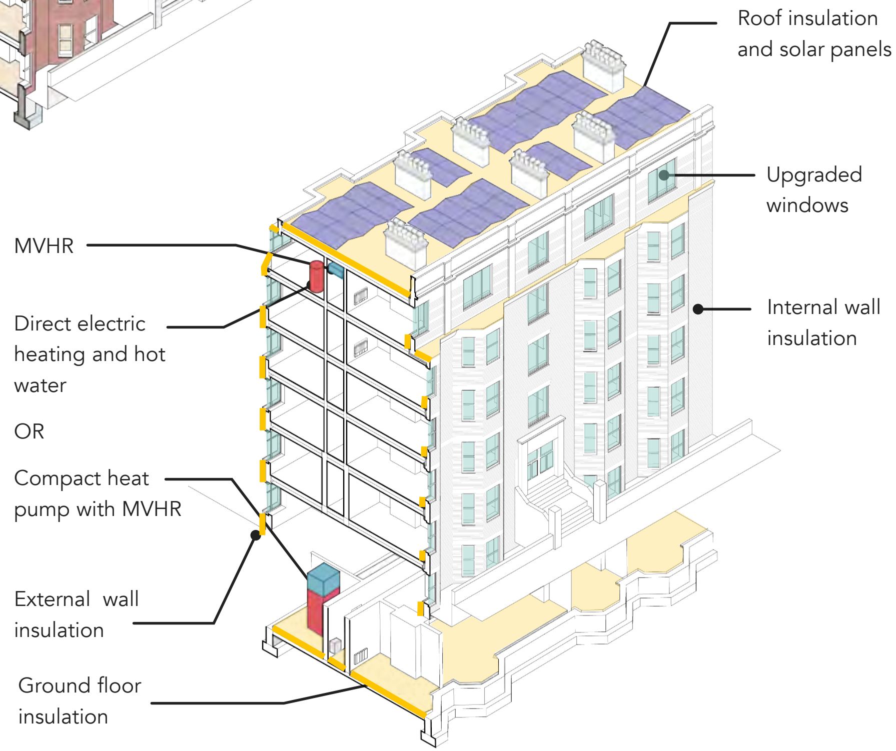
This should include all measures that are envisaged in the medium to long term, so that they can be planned in a coordinated manner. The drawings alongside shows how important it is to consider the measures in 3 dimensions.

The plan should ideally be underpinned by some energy use analysis of the current level of energy performance as well as an estimate for future use so that the project can be measured against a stated goal in due course. A pre-retrofit airtightness test and thermographic survey may also be useful.

If the project is carried out in stages then it is important to ensure that at each stage the risks are managed and the living environment is improved (e.g. air quality and moisture balance). A key to this is ensuring that as airtightness is improved, the ventilation system/approach is adequately considered and upgraded.

Identifying current issues





Whole house plan, considered in three dimensions

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Work that can be done without planning permission

For buildings that are not listed, the following work does not need planning permission:

- Loft insulation
- Advanced secondary glazing
- Draught proofing
- Internally insulating walls (IWI)
- Central ventilation systems (extract or balanced ventilation with heat recovery can be installed but you may need permission for new grilles in the walls)
- Floor insulation

Work that can be done 'Permitted Development'

If you live in a flat, there are currently no 'permitted development' rights, so the above work would require a planning application to be made*.

All other retrofit measures will require planning permission

This will require a set of drawings to be submitted to the Council's planning department along with an explanation of how the design has been carried out in accordance with planning rules. For some applications, additional technical information may be needed and/or required by the Council.

If your building is listed (10% of buildings in the ESSA Conservation Area)

Any works which affect the special architectural and historic interest of the building are likely to require listed building consent. These would include changes to the external appearance, and internally changes to layout, historic fabric or surviving feature such as joinery or decorative plasterwork. The work will also require planning permission if it affects the exterior of the building.

A listed building application has to include an assessment of the historical significance of the house, and the impact on that significance that the proposals will have.

The application process for planning permission, listed building consent or a Certificate of Lawfulness

It is important to accompany proposals with drawings of what you want to do and a clear supporting statement. This statement might include:

- A description of how the building works now (before the work is done).
- Calculations showing the carbon savings the work will achieve.
- A plan showing that the work will be done thoughtfully in relation to your neighbours and the Conservation Area.
- Images of the products you intend to use.

Other approval/permission required

It is likely that any works affecting the external appearance of your flat and affect any clause of the lease agreement will require approval/permission from the management company or the Freeholder.

** An exception to this are solar panels in some instances. If an external change makes no material impact on the appearance of the building, then it does not constitute development, so there may be scope for some of the other changes to flats. It is recommended to check with the Council through RBKC's pre-application advice service.*
PV panels on grade II and II listed buildings must meet the PD criteria and are subject to the requirements of the Royal Borough's Local Listed Building Consent Order (LLBCO) for the installation of solar panels. This includes the need for the details of the position, size, fixing, colour and finish, associated equipment, and any minor strengthening works to the roof to be submitted to and approved in writing by the Local Planning Authority before works commence.*

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Beyond energy and carbon, what other retrofit measures should be considered?

A retrofit may also be the opportunity to reduce the mansion blocks' wider impact on the environment and contribute positively to the Council's efforts to make Kensington & Chelsea a more sustainable borough. This page introduces key environmental areas and suggests ideas for further consideration.

- **Water** is a precious resource and pressure on water supplies is increasing. Using less water is possible at a low cost and with no adverse impact.
- Alongside the reduction of building regulated emissions, **transport** represents a significant opportunity to achieve Net Zero.
- Although the options for improving **biodiversity** 'at home' may be limited, a retrofit may be the opportunity to consider how individual interventions can contribute to the Council's Biodiversity Action Plan.
- Better internal **waste** recycling storage facilities (recyclables, food waste) will contribute to better recycling. The retrofit process itself should also seek to minimise waste through the design, sourcing and selection of building and construction materials. And construction waste from the retrofit process should also be managed carefully during the retrofit itself, with options for local re-use explored.
- Upfront **embodied carbon** includes the carbon emissions associated with the extraction and processing of materials, energy use in the factories and transport. Retrofit will involve balancing the benefits of a retrofit measure with its embodied carbon.

Water

- Consider replacing your fittings (e.g. showerhead, taps) with more efficient fittings . The AECB water standards provides clear guidance on sensible flow rates.
- If you are replumbing your home, seek to reduce pipe distribution and insulate hot water pipes well.
- If you are updating your bathroom(s) or adding a new one, consider installing waste water heat recovery systems in shower drains - A simple technology that recovers heat from hot water as it is drained.
- Utilise rainwater collection for irrigating your garden.
- Utilise permeable surfaces in the garden wherever possible.

Transport

- Provide secure, easy to access cycle parking.
- Design in a space that can be used as a home office.

Biodiversity

- Select diverse native species of planting (incl. trees) in your garden

Waste

- Design kitchen and/or utility areas to include convenient, adequately sized recyclable and food waste storage.
- Consider options for re-use.

Embodied carbon

- If you think that a particular retrofit measure may have a limited impact in terms of operational carbon, while having a significant embodied carbon 'cost', do more research.

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3.0

Additional information

This section provides additional information on the retrofit measures summarised graphically in Section 2.0. Examples are also provided.

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Windows and doors | Additional information

Why are windows so important?

The sheer level of improvement that current glazing technology can now achieve, and the fact that all upgrade can take place with residents staying at home, make this fabric measure the most attractive and impactful from an energy saving perspective. The high window-to-wall ratio in the ESSA Conservation Area reinforces this conclusion.

Improving the windows will also deliver additional benefits to the residents such as better thermal comfort (the window pane will be warmer), less cold draughts and better acoustic insulation, making it a more attractive and likely proposition than other retrofit measures.

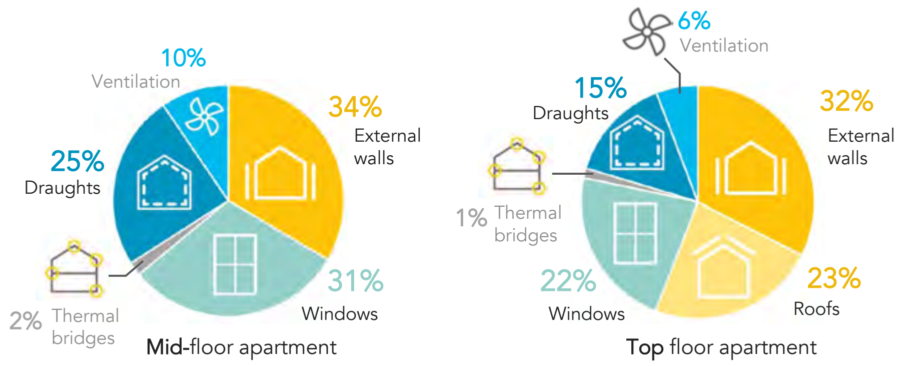
Finally, for many homes in the ESSA Conservation Area, an appropriate window upgrade can provide such a significant reduction in space heating demand that it will unlock the ability for a successful replacement of the existing gas boiler by a heat pump. This will enable a a move away from fossil fuel heating and a radical carbon emission reduction of more than 80%.

Wall insulation and floor insulation can take place in future steps.

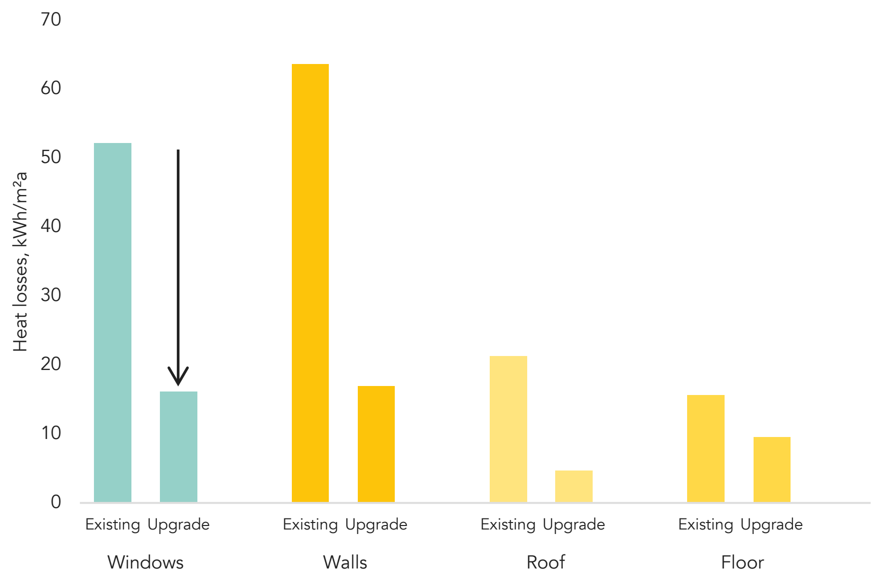
Window improvements: for a 'Best possible' approach

Altering windows is expensive and likely to only occur once every few decades, especially if embodied carbon is being considered, so it is crucial that changes are made with a view to optimising performance as much as possible but also meeting the statutory requirement to preserve or enhance the character or appearance of conservation areas. The bar is higher for listed buildings. A targeted energy performance with a U-value of 1.0 W/m²·K is proposed. This can be achieved by the following available solutions: **triple glazing, best quality evacuated glazing, advanced secondary glazing.**

These solutions can deal with most of the windows within ESSA Conservation Area without affecting the special character of the area. Timber windows should be favoured. Aluminium windows may be acceptable at the rear. uPVC is not a sustainable material.

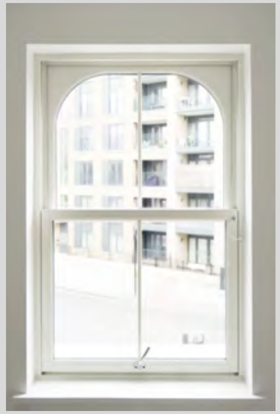


Windows represent a significant opportunity to reduce heat losses (22-31% depending on the flat type)



Windows are also one of the biggest opportunities for improvement (see above comparison of U-value improvements from existing to ideals set out in this study by element).

Windows and doors | Additional information

	Triple glazed casement	Triple glazed mock sash	Advanced secondary glazing	New evacuated glazing	Double glazed sash
					
Advantages	Very high thermal performance. Window is airtight and the frame is robust. The frame can be made relatively narrow.	Very high thermal performance. Window is airtight and the frame is robust.	Original window is preserved. Less disruptive installation process.	High thermal performance. Similar visual appearance to original window.	Average thermal performance. .
Disadvantages	Not applicable to all window upgrade scenarios, such as replacing original sashes on a front elevation.	Fake astragals become apparent when observed close-up.	Repairs are needed to make good the existing, which adds costs.	Frames are not thermally broken. Tend to be relatively expensive. Lead times can be length (limited supply chain).	Fake astragals become apparent when observed close-up.
Watch points	Fatter mid-rail, which will not be conspicuous on larger windows. These do not have a similar visual appearance to the original sliding sashes.	Fatter mid-rail, which will not be conspicuous on larger windows. These are mock sashes that function as inward-opening casements.	Ensure effective cleaning is possible. Ensure it allows adequate ventilation. Check it does not interfere with existing shutter boxes.	The windows open like a conventional sash window. The original astragals are altered to fit in the new glazing.	Fatter mid-rail, which will not be conspicuous on larger windows. Requires a deeper sash box to the original, affecting its relationship to the wall.
Heat loss coefficient U-value, W/m^2.yr *(the lower the better)*	~ 0.8	~ 0.9	~ 1.0	~ 1.1	~ 1.6

Windows and doors | Examples

Secondary glazing in front of historic stained glass

Evacuated glass sash windows within a conservation area

Triple mock sash window (Bere:architects)

Casement advanced secondary system

Double glazed sash window within a conservation area

Triple glazed mock sash windows (PDP architects)

Sliding sash and casement secondary glazing, built into the joinery of the shutter box, within a listed Georgian townhouse.

Triple glazed mock sash window

Triple glazed casement windows

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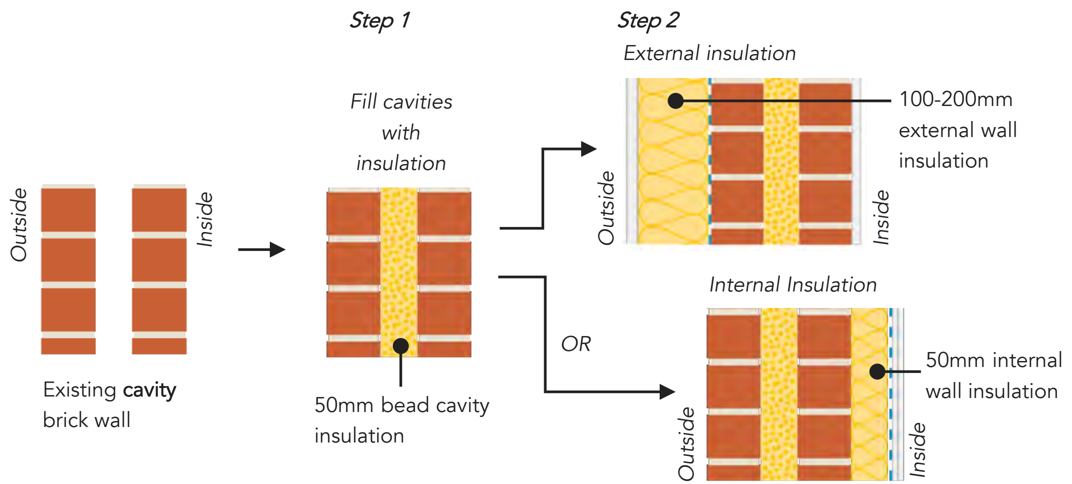
Insulation | Additional information

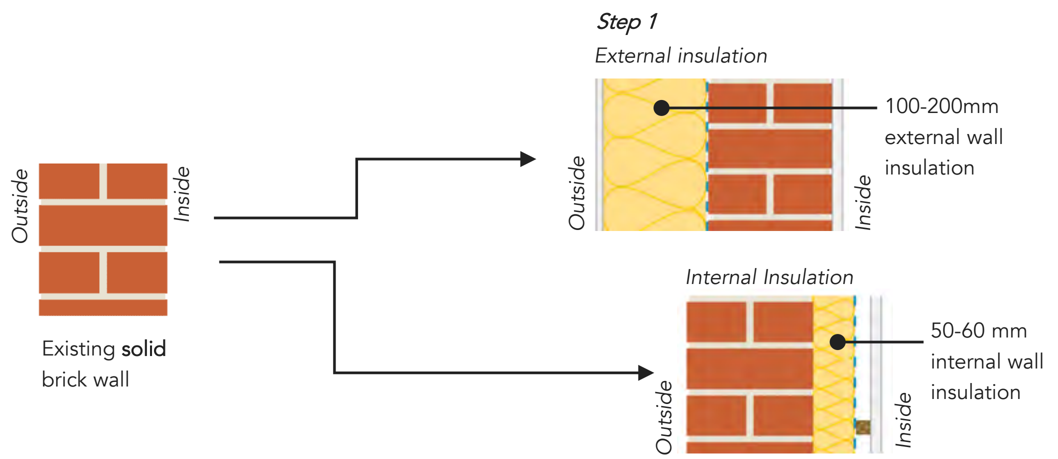
Walls - Insulating externally or internally?

From a heat loss and reduced exposure perspective it is best to externally insulate walls. Allowing the insulation to wrap around the building continuously, keeping it warm and dry, while avoiding the need to address thermal weak points and junctions (e.g. around floor joists) is a significant benefit of external wall insulation. However, the choice will come down to what is practical and visually acceptable.

- **Cavity wall insulation:** can be pumped from holes in the external brick course with little disruption to occupants. There is a moisture ingress risk associated with filling a cavity which is highly exposed, or if the cavity is significantly bridged, for example by a floor structure. This can potentially lead to cold spots in and on the surface of the structure, leading to condensation and moisture problems. One remedy is to externally insulate the structure. Appoint a suitability qualified surveyor and cavity wall specialist to determine the suitability for filling or blocking-up and the likely associated risks.
- **External insulation (EWI):** is applied to the outside of walls. It is effective thermally, does not reduce internal space and creates less disruption to residents during fitting. It should be considered for the rear elevations but would require planning permission. It is very unlikely to be deemed acceptable for the street elevation. Roof eaves and window sills may require extending to cover the insulation and parapets should be wrapped to reduce thermal bridging. Insulation can be finished in lime render, brick slips or pebbledash cladding.
- **Internal insulation (IWI):** breathable materials should be used for internal wall insulation e.g. wood fibre insulation, plastered insulation. Non-breathable materials e.g. rigid foam insulation, can achieve a good thermal performance but they can also trap moisture in the build-up and make detailing around junctions more complicated. Where internal space is limited thin products such as aerogel insulation can be considered. Consider the combustibility of insulation.



Options for insulating cavity walls. *For step 1 ensure measures have been taken to prevent moisture entering or build-up in the cavity.*



Options for insulating solid walls

Insulation | Additional information

Roof / Loft insulation

Pitched roofs: For unheated attic spaces the simplest approach is to insulate the ceiling joists in the loft.

Where external wall insulation meets the roof consider extending eaves to cover the additional wall thickness. Also be sure to maintain or add ventilation at the eaves.

Consider fabric improvements in conjunction with any loft extension works. The loft space could become a 'warm space'/room, by insulating the roof at rafter level and applying a sheathing board over the rafters. Unless a reliable breather membrane is already in place, the roof tiles will require removal and refit to install a new breather membrane. This membrane is critical for partial protection against leaks and to prevent the insulation becoming moist, should condensation form on the underside of the tiles. Once the tiles have been removed, before refit, there is an opportunity to install insulation above the sheathing board. However, alignment with other building features, such as neighbouring roof lines should be reviewed before a decision is made to raise the roof line.

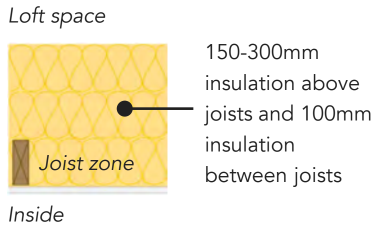
Ideally relocate existing water services and tanks in to the warm roof voids or insulate them.

Flat roofs: Where the home has a flat roof, insulation should be added on top of joists as part of re-roofing/waterproofing or maintenance cycles. Insulating between or below roof joists brings the greatest condensation and moisture risks to the roof structure, and should be avoided where possible. Ensure an adequate vapour control layer (VCL) is added to prevent interstitial condensation. Alignment with other building features, such as parapets, should be reviewed when raising the roof line.

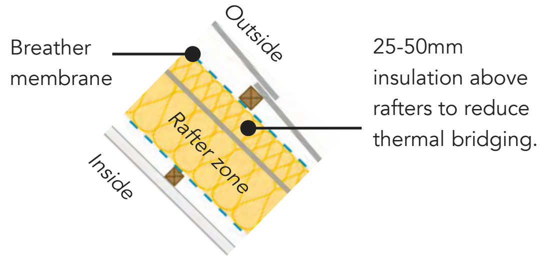
Ground floor insulation

Insulating concrete floors may require raising the floor-level, therefore special consideration should be given on the impact on steps at the entrance, door heights and consistent staircases levels. In the case of raised timber floors, insulation can be hung or sprayed between and below joists, providing airflow if maintained to ventilate the floor void.

Unheated attic spaces *– insulate between and above ceiling joists*

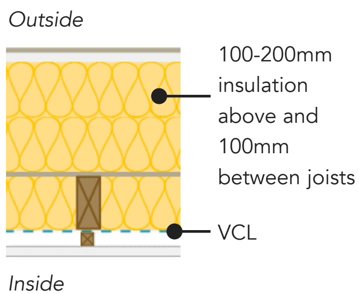


Heated attic spaces *– insulate above and between roof rafters*



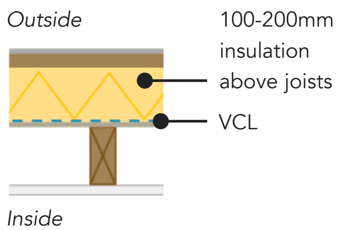
Options for insulating pitched roofs

Warm roof *– insulate above and between and roof joists*



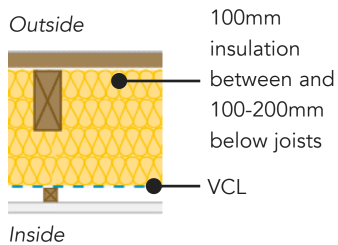
Access is required from above and below roof.

Warm roof *– insulate above roof joists*



Access is required from above roof.

Cold roof *– insulate between and below roof joists – avoid this method where possible*



Access is required from below roof.

This may be the only solution available for specific areas such as an inset balcony above a heated room.

Options for insulating flat roofs

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Insulation | Additional information

There are many types of insulation products. The following considerations should be made when selecting Insulation:

Area for use - Where the insulation be used (e.g. external wall, roof, floor).

Thermal conductivity - How much heat the material conducts. The lower the conductivity, the better performing the product.

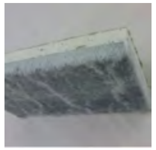
Moisture and air permeability - Some insulation products allow water vapor and/or air to pass through them, and some don't. It is important to understand their hygroscopic properties, particularly when retrofitting older homes to prevent moisture damage to existing structure.

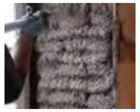
Thickness - The thickness should be considered to ensure it keeps the home warm. For external walls, it is important to ensure that the products used to support insulation are available in the thickness required.

Physical properties - Insulation can be rigid or not, and there are advantages to both.

Fire rating - The building regulations associated with fire rating and insulation should be consulted to ensure safe and compliant products are used in the correct areas.

Compressive strength - Some insulation may require a degree of compressive strength, and this should be considered (usually floors or flat roofs).










Insulation type	Aerogel	Wood fibre board	Insulated lime plaster	Cork	Sheep's wool	Hempcrete	Mineral wool	Glass wool	EPS	PIR
Application *EWI = External Wall Insulation IWI = Internal Wall Insulation.*	IWI, roof and ground floor insulation	EWI, IWI	EWI, IWI	EWI, IWI, roof and ground floor insulation	IWI, roof insulation	EWI, IWI, roof and ground floor insulation	EWI, IWI, roof insulation	EWI, IWI, roof insulation	EWI, roof and ground floor insulation	Roof
Key component	Silica	Wood fibres	Lime, cork and clay plaster	Bark of the cork oak tree	Sheep's wool	Hemp mixed with lime-based binder	Mineral fibres	Recycled glass	Rigid plastic foam board Extruded polystyrene	Rigid plastic foam board Polyisocyan urate
Thermal conductivity	0.018-0.015 W/m.K	0.04-0.05 W/m.K	0.045 W/m.K	0.035-0.043 W/m.K	0.034-0.042 W/m.K	0.06-0.07 W/m.K	0.034-0.035 W/m.K	0.032-0.037 W/m.K	0.024-0.026 W/m.K	0.021-0.26 W/m.K
Vapour resistance/ breathability	Vapour open and breathable	Vapour open and breathable	Vapour open and breathable	Vapour open and breathable	Vapour open and breathable	Vapour open and breathable	Vapour open and non-breathable	Vapour open and non-breathable	Vapour closed and non-breathable	Vapour closed and non-breathable

Check with a professional and the manufacturer to determine which type of insulation best suits the application.

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Insulation | Junctions and thermal bridges

Thermal bridges

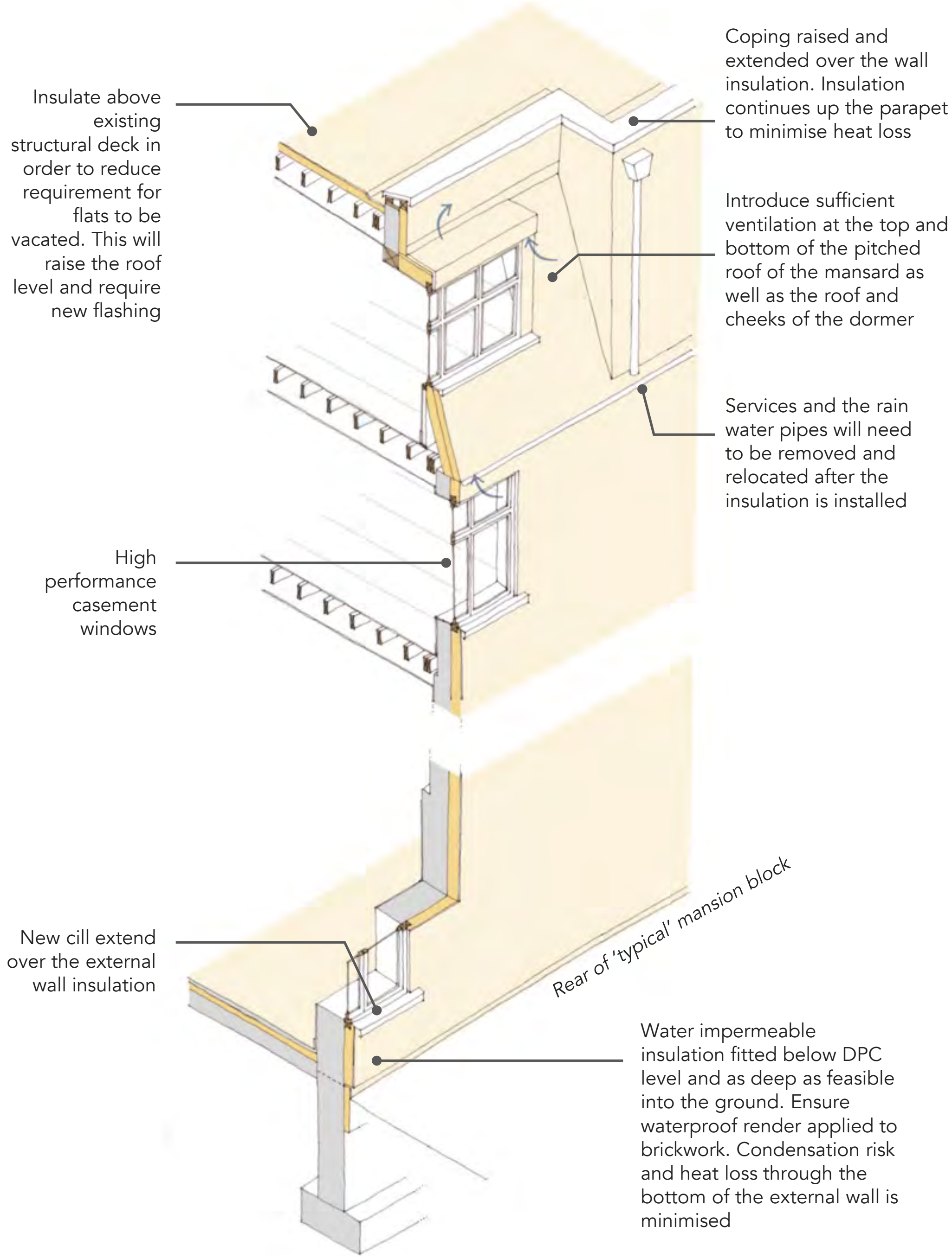
A thermal bridge, or cold bridge, is a location in the thermal envelope of a building through which heat flows easily. For example, a concrete lintel that interrupts the wall insulation layer would be considered a thermal bridge. Thermal bridges should be avoided as they increase heat loss, and can cause cold spots that lead to condensation.

Identifying thermal bridges

A good approach to retrofit is to sketch out a cross section drawing of the building to identify materials interrupting it or areas where something needs to be done to ensure continuity of insulation (e.g. wall to roof insulation). Different materials should be butt jointed, or overlap, ideally for a distance equivalent to the thickness of the insulating element. We strongly recommend engaging an architect or consultant who is able to produce a risk assessment and help design out condensation risk.

Roof and window to wall junction considerations

- Check the existing condition of the roof's structure (battens and rafters) and replace if rotten and damp.
- Check roof covering condition and replace and replicate tiles if are damaged and not weathered proof.
- Check the condition of the wall (including parapet wall) and re-point/ re-render brickwork if needed.
- Check the condition of the existing coping to ensure they are free from moisture defects and in good condition.
- Dispose any existing old insulation in the loft if not in a good condition (e.g. torn or damp).
- Make sure that roof/loft ventilation is improved and meets building regulations to avoid risk of condensation.



Mansard roof to wall to ground junctions - rear of 'typical' mansion block

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Insulation | Examples

Townhouses within a conservation area in London. Add hoc render has been added to rear facades without disrupting the street scene.

Insulated ventilated timber floor using hydroscopic insulation and breathable membrane – source: Ecological Solutions

Exterior view of evacuated glazed sash windows in combination with internal wall insulation, in a conservation area in RBKC .

Wood fibre insulation panels fixed and taped with airtightness tape before plasterboard and batten lining

Mixture of double and single glazed windows, homes may have been insulated internally.

Cork granules visible in lime/cork plaster internal plaster insulation

Initial coats of lime/cork plaster being sprayed onto a masonry wall

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Airtightness | Additional information

What is airtightness?

Making a home more airtight is about eliminating or reducing the level or air leakage in order to retain heat and avoid letting it escape from the flat through gaps and cracks, holes, splits and tears in the building envelope (i.e. walls, windows, floors and roof). It is important to note that an airtight dwelling it is not hermetically sealed, it just means that unintended air leakage is reduced to a minimum.

Why should airtightness be considered?

- The most important reason is to avoid losing heat, to reduce energy wastage and costs.
- Making a home airtight also means making it draught free: it improves comfort level.
- An airtight home also reduces external pollutants in the house, reducing the risk of allergies and other respiratory problems.
- Along with a suitable ventilation system, an airtight home will also help to protect the building fabric by reducing damp and the risk of condensation and mould.

How can I make my dwelling airtight?

Any retrofit plans of improvement should include an ambition to improve airtightness: a target should be set, specific improvements identified and airtightness should be measured at the end of retrofit.

The associated importance of controlled ventilation

The efforts to make your home more airtight must be combined with the introduction of controlled ventilation (see following page).

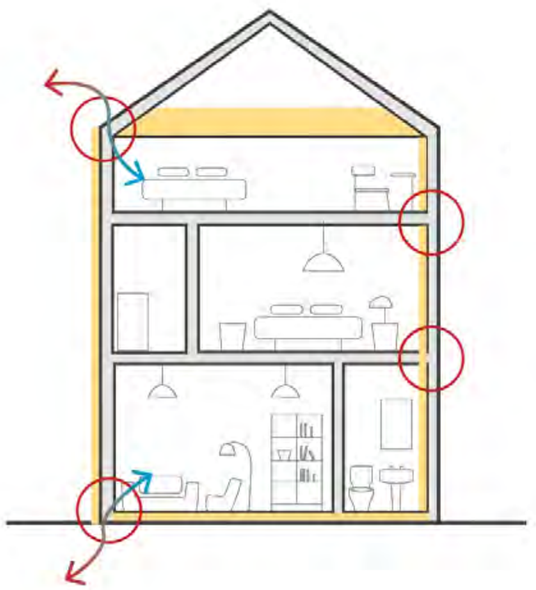

Diagram showing a few examples of potential air leakage points

A range of products are available to improve airtightness: specialist tapes, or specialised grommets that come in a range of sizes.

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Ventilation | Additional information

Why is it important?

Existing homes in the UK are often draughty, which is uncomfortable and increases the amount of heating needed. In most cases, they rely on 'natural ventilation' – opening windows - which is not very effective at making sure all parts of a home have good air movement. This can lead to condensation and then mould forming in some places. Reducing draughts is a very important part of improving energy efficiency, but it generally should not be done without the retrofit of a system to provide more controlled and effective ventilation.

What types of ventilation system could be used?

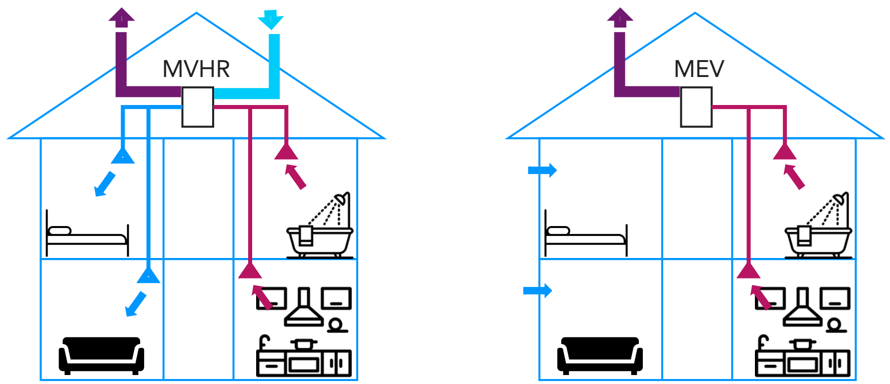
The most energy efficient way to provide controlled ventilation is Mechanical Ventilation with Heat Recovery (MVHR). The equipment circulates air using two small fans, and transfer heat from the air extracted from kitchens and bathrooms into fresh air to be supplied to living rooms and bedrooms.

In retrofit, it is not always possible to find a space for the MVHR unit and/or the associated ductwork to every room. In these cases, a compromise option is to use a system of mechanical extract only with trickle vents in the living and bedrooms to allow fresh air into the rooms. Demand controlled mechanical extract ventilation (dcMEV) is a suitable alternative, although it is less efficient than MVHR, so heating demands will be greater.

Installing and commissioning the system

To ensure the system works as planned, the system must be properly tested to ensure it is balanced, delivers the designed fresh air required and does not generate noise beyond what is expected.

MVHR units can be retrofitted into ceiling voids or wall mounted (© Will South) Ductwork has to be routed to every room. You will need a qualified installer and/or an MVHR manufacturer/supplier to calculate the fresh air required and to design the ventilation system for your home.



MVHR (left) requires more ductwork than dcMEV (right) so can be more challenging to fit into retrofit, but dcMEV is less energy efficient in most homes.

Heating and hot water | Additional information

Heating and hot water systems for blocks of flats

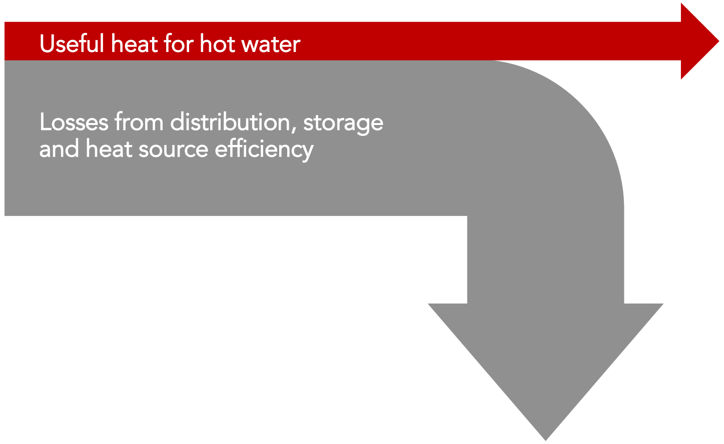
In blocks of flats, heat can be produced in different ways and using different fuels. Individual gas boilers are common in the UK, which burn gas to heat water, which is distributed around the home via pipes to radiators and taps. Some of them have individual electric heating system though, ranging from storage heaters to panel heaters. And blocks of flats sometimes have a communal heating and hot water system, where the heat is generated centrally. Hot water is transported around the building to individual properties, where it is either used directly or where it is transferring its heat to a separate hot water circuit within the flat.

Fuel sources: gas vs electricity

Heat is generally produced by gas or electricity, which have different carbon intensities. For example, burning gas for heating or hot water produces more than 200 grams of CO_2 per unit of energy (gCO_2 /kWh), whereas electricity from the grid produces approximately 150g CO_2/kWh now, a figure projected to reduce to 30g CO_2/kWh by 2050 as more renewable energy is used to generate electricity in the UK.

Distribution losses

Long distribution pipe lengths mean that a large volume of water needs to be kept hot in the system so that it can be used on demand. As this water is at a substantially higher temperature than the surrounding (i.e. 70-80°C), they generally lose a lot of heat, which makes the system very inefficient. In one particular example, **five units of heat energy needed to be produced for 1 unit of useful heat energy for hot water.** For heating and hot water combined, the losses can be less (around 25%), but as a building becomes more efficient and has less heating demand, the proportion of distribution losses will become more significant.



Communal gas boiler and hot water storage generate heat and store it centrally. It is then distributed to each property using an extensive distribution pipework. Even if it is insulated its length leads to a considerable amount of heat being wasted. In an effort to improve energy efficiency, systems with less external distribution should be preferred.

In the example heating system considered, one unit of heat energy for hot water requires five units of heat energy production. This shows that communal heating systems can be very inefficient.

Heating and hot water | Additional information

Types of heating

Electricity is the best energy source for low carbon heating. There are two main types of electric heating:

- **Heat pumps** use electricity to take heat from a source (air, water or the ground), increase its temperature, and then move it to where it is needed. Air source heat pumps are the most common form of heat pump especially in urban settings.
- **Direct electric** heating uses electricity to heat radiators, modern storage heaters with smart controls that can utilise flexible energy tariffs, or infra-red panels.

Hydrogen is sometimes talked about as a replacement for mains gas, but it is very unlikely that this will ever be a cost effective low carbon way to directly heat the majority of UK homes.

Biomass heating is burning wood or other plant material which is not suitable in urban areas because of its impact on local air quality.

Hot water

In some homes, especially smaller one, the energy required for hot water can exceed the amount of energy required for space heating. An energy efficient hot water system is therefore essential to ensure energy use remains low. Well insulated hot water storage is usually the best approach to allow heat pumps to work efficiently, to avoid having very large peaks of electricity demand from the National grid and to allow the storage of energy from PV systems during the day to use later in a cost-effective way.

Making a logical, low carbon choice

If an existing boiler needs to be replaced, heating alternatives which use electricity should be considered (see adjacent diagram). The specific type of heating to be used should be considered in a logical sequence, starting from the ones which are most efficient.

1 What type of heating do you have now?

A. A gas boiler that just serves your home

B. A gas boiler that serves other homes (e.g. all flats in your building)

C. Electric radiators or storage heaters

2 What sort of heating should you replace it with?

A. A heat pump that just serves your home

B. Either a heat pump that serves all the flats in your building or individual heat pumps, one for each flat, or (if not possible), direct electric heating

C. Modern electric radiators or storage heaters which work with smart meters and better controls.

3 For either case A or case B, how much outside space do you have?

I. A private garden or a flat roof with good access

- If you have a garden or a flat roof space that is suitable, use a 'monobloc' air source heat pump.
- If there is room for each flat to have its own heat pump close by, that is the best option. If not, then use one heat pump or group of heat pumps which serve the whole building.

II. None

- Consider a 'compact' heat pump indoor unit with ducts to outside.
- Consider a 'compact' heat pump indoor unit with ducts to outside in each flat

4 For case C

Modern electric heaters are more efficient than the old types, especially storage heaters, so it may be worth replacing your heaters with ones that can be controlled better. It is especially important for you to make improvements to the building fabric of your home, to save money on your bills.

< Return to low carbon heat summary

Heating and hot water | Examples

Compact air source heat pump

Compact air source heat pump

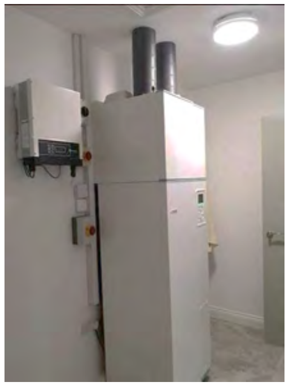
Communal rooftop air source heat pumps

Communal rooftop air source heat pumps

Electric radiator

Hot water cylinder

Ceiling infrared electric panel heater



Compact air source heat pump

Electric radiator

Electric storage heater

Wall infrared electric panel heater

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Solar PVs | Additional information

Why considering solar PVs?

We need to increase solar energy generated in London to reduce carbon emissions and balance energy use. Many homes have a significant roof space and residents can directly benefit from this electricity.

Where to start?

Contacting a local MCS certified solar installer is a great first step to retrofitting a solar Photovoltaic (PV) system. They can assess your property, provide information on solar panels and inverters, and provide a quotation indicating how much energy the system will generate. Quotations typically also include financial analysis such as annual savings and simple payback period. Prices can vary substantially between installers though, so obtain several quotes.

Planning work

Scaffolding will typically need to be erected to install solar panels. Consider whether this could provide opportunities to carry out other retrofit work such as wall insulation, replacing windows, or tackling a thermal bridge between your wall and roof insulation. Standard solar scaffolds may not include working decks on intermediate floors, so if you do plan to do other work discuss it with your installer.

Getting up and running

Once your system is installed, you will need to get registered for the Smart Export Guarantee to receive payments for exported solar energy. Check Solar Energy UK's league table to find an energy supplier offering a competitive rate. Most schemes require an MCS certificate from the solar PV installer and a smart meter or export meter that can record the amount of energy you are supplying to the electricity grid.

Examples of photovoltaic panel precedents, clockwise from top left:

© Historic England, © Deege Solar © RBKC Solar together

Over a million homes in the UK already have solar panels, many of which have been retrofitted. Notify your building's insurance provider if you are having solar panels fitted to ensure they are covered and your policy remains valid. (Source: Alamy Stock Photo)

Solar PVs | Additional information

Note: Solar panels on the front roof slopes of properties should be considered with care to minimise the effect on the character of the conservation area and may require planning permission.
Solar slates may be more acceptable than solar panels in such locations.


PV installation on a roof (block of flats)


PV installation on a roof (block of flats)


PV installation on a roof (block of flats)


PV installation on a roof (house) over the tiles


PV installation on a roof (block of flats)

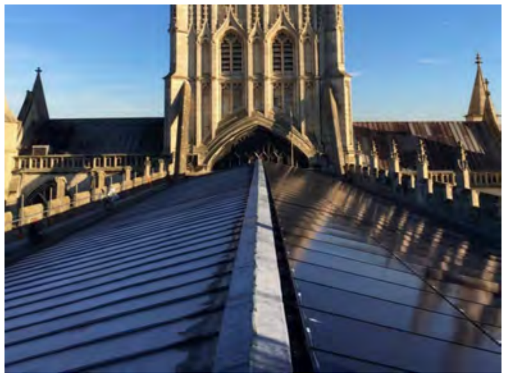

PV installation on a roof (house) – PV slates


PV installation on a roof (block of flats)


PV installation on a roof (house) over the tiles


PV installation on a roof (block of flats)


PV installation on a roof (block of flats)


PV installation at King's College, Cambridge


PV installation (rear elevation) over the tiles

Sources: Solar together, www.greenandheritage.uk, www.home-renewables-scotland.co.uk/

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Appendices

This final section includes:

- A glossary
- A list of guidance documents, reports and resources which can be used to further your understanding of retrofit

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Glossary

Air Source Heat Pumps (ASHP): An electric heating system that extracts ambient heat from external air to efficiently heat a dwelling.

Airtightness or air permeability rate: A measure of how much air naturally leaks out of or into a building, through gaps around doors, windows, cracks, etc. Usually measured in $m^3/m^2/hr$ @ 50Pa.

Building fabric: A term used to describe collectively the walls, roof, floor, windows and doors of a building.

Carbon budgets: A term used to qualify the remaining carbon emissions, or share of carbon emissions, that can be emitted before the amount of cumulative emissions exceeds a climate change target.

Carbon footprint: The amount of carbon emitted by a person or organisation in a given timeframe.

Carbon offsets: A way of balancing emissions in one area by reducing emissions in another or through carbon sequestration.

Climate resilience: Enabling a building, dwelling, geographical area or organisation to adapt to the changing climate.

CO_2: Carbon dioxide, a greenhouse gas.

Coefficient of Performance (CoP): A measure of efficiency usually used for heat pumps. The CoP is the amount of useful energy (heatig or cooling) produced from every unit electricity used, e.g. a heat pump with a CoP of 3 produces 3 kWh of heat for every 1 kWh of electricity it uses.

Communal heating system: A heating system serving several dwellings.

Energy efficiency: The relative amount of energy a building or system uses to achieve a certain aim (e.g. maintain a specific internal temperature).

Building fabric efficiency: A measure of how effective a building's fabric is at retaining heat.

kWh: Kilowatt hour, a measure of the amount of energy used or generated in one hour.

Leaky building: A building with a low level of air-tightness.

Mechanical Ventilation with Heat Recovery (MVHR): A type ventilation system that recovers heat from extracted air before it is vented outside the building and uses it to warm incoming fresh air.

Renewable energy: Energy produced from a renewable source e.g. wind or solar.

Retrofit: The introduction of new materials, products and technologies into an existing building to reduce its energy use and/or increase its renewable energy generation and/or reduce its carbon emissions.

Space heating demand: The amount of heat energy required to heat a space to the required temperature. Space heating demand is a good proxy for the building fabric efficiency and is usually expressed in $kWh/m^2/yr$.

Solar photovoltaic (PV): A form of renewable electricity generation from solar energy well suited to buildings and urban environments.

Thermal bridge: A point, line or area in a building's external envelope which loses more heat than its surroundings, i.e. a weak point from a heat transfer point of view.

Thermal line: The conceptual representation of where the building fabric insulating layer is. It is formed by the insulation in walls, roofs and floors as well as windows, rooflights and doors.

U-value: The metric used to quantify the rate of heat loss for different elements. The higher the U-value, the more heat the element will lose.

Waste Water Heat Recovery (WWHR): A proprietary system which uses heat from waste water and transfers it to the incoming cold water.

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Resources and further reading

Sustainably retrofitting your home: Householders' guide to windows, Royal Borough of Kensington and Chelsea (2024)
https://www.rbkc.gov.uk/planning-and-building-control/planning-policy/sustainably-retrofitting-your-home

Transform your house into a low carbon sustainable home, EcoFurb (2020)
https://www.ecofurb.com

Retrofitting your home, Cambridge City Council (2022)
https://www.cambridge.gov.uk/media/11677/retrofitting-your-home-report-non-accessible-version.pdf

A guide to Retrofitting your home, Trust Mark (2021)
mar0004-retrofit-journey-brochure-a5-20pp-a-spreads.pdf

Individual how-to guides on retrofitting windows and heat pump, Westminster City Council (2022)
https://indd.adobe.com/view/b71d2927-183d-46b4-9f7d-ab4acbd7b052

Home for a Low Carbon Future, People Powered Retrofit (2019)
https://retrofit.coop

Adapting Historic Buildings for Energy and Carbon Efficiency, Historic England (2024)
https://historicengland.org.uk/images-books/publications/adapting-historic-buildings-energy-carbon-efficiency-advice-note-18/

London Energy Transformation Initiative (LETI) Climate Emergency Retrofit Guide, LETI (2021)
https://www.leti.uk/retrofit

Whole House Eco-Retrofit, Centre for Alternative Technology (2023)
https://cat.org.uk/info-resources/free-information-service/eco-renovation/eco-retrofit/

Sustainable Renovation: Improving homes for energy, health and environment, The Pebble Trust (2018)
https://static1.squarespace.com/static/5978a800bf629a80c569eef0/t/5beca5f021c67c2280e66de3/1542235691571/Guide+to+Domestic+Retrofit.pdf

Retrofitting existing homes: Guide for UK homeowners, Urbanist Architecture (2023)
https://urbanistarchitecture.co.uk/retrofitting-uk-houses/

Our guide to retrofitting: how to future proof your older home, The Modern House (2023)
https://www.themodernhouse.com/journal/thoughtful-living-retrofitting/

Retrofit Guide for Homeowners (ventilation), Aereco (2021)
https://www.aereco.co.uk/knowledge-centre/retrofit-guide-for-homeowners/

Retrofit Pattern Book, Greater Manchester Combined Authority, University of Salford and Red
https://retrofit.support

Other trusted sources for good information and advice about retrofit include:

AECB - Association for Environment Conscious Building
STBA - Sustainable Traditional Buildings Alliance
EH - English Heritage
HES - Historic Environment Scotland
The Green Register
The Retrofit Academy
Retrofit.Support website
UKCMB - the UK Centre for Moisture in Buildings